FRANCE

Fourth National Report on Compliance with the Joint Convention Obligations

Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management

Liberté • Égalité • Fraternité
RÉPUBLIQUE FRANÇAISE

September 2011

Table of contents

Table of illustrations

Figures

Tables

Executive Summary

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

Regulatory framework

The regulatory framework in which nuclear facilities are designed, operated and dismantled was revamped notably by the *Act of 13 June 2006 on Transparency and Security on the Nuclear Field* (TSN Act) and its application decrees. The drafting of technical regulations for nuclear facilities in the framework of the broader consultation process of the different stakeholders has progressed well. That work should be completed by 2011 with the publication of an order and by about 15 Resolutions by ASN. The approach also takes into account the European Directive on the safety of nuclear facilities and the work achieved until now by the Western European Nuclear Regulators' Association (WENRA).

Nuclear facilities in France

There are a large number of nuclear facilities in France, including:

- 58 nuclear-power reactors;
- 90 other constituted nuclear facilities
- fuel-cycle facilities;
- research establishments in the field of nuclear-power generation or other disciplines;
- one facility for the management of radioactive waste by incineration or fusion (CENTRACO);
- storage facilities for radioactive waste;
- three permanent surface disposal facilities for radioactive waste: two for low-level and intermediate-level short-lived waste (one in its post-operation monitoring stage and one in service) and one for very-low-level waste;
- facilities undergoing dismantling, and
- one plant producing pharmaceuticals and irradiators.

In addition, several facilities are under construction, including:

- one European Pressurised Reactor (EPR) on the Flamanville Site (Flamanville 3);
- the Jules-Horowitz experimental reactor on the Cadarache Site;
- the Georges-Besse II plant (enrichment);
- the COMURHEX II plant (chemical conversion);
- the Conditioning and Storage Facility for Activated Waste (*Installation de conditionnement et d'entreposage de déchets activés* – ICEDA) storage facility for the intermediate-level long-lived waste of *Électricité de France* (EDF).

Various facility projects are also under study, as follows:

- the ITER Project,
- a deep geological repository for intermediate-level long-lived and high-level waste.
- a subsurface disposal facility for low-level long-lived waste, and
- one EPR reactor on the Penly site (Penly 3).

Lastly, a few facilities contain radioactive waste, notably old uranium mines where mine tailings were disposed of.

Fuel-cycle facilities

Uranium extraction, chemical conversion and enrichment, together with its final processing and recycling after use constitute the fuel cycle. The major plants of that cycle (COMURHEX; Georges-Besse I, operated by EURODIF; Georges-Besse II, under construction, operated by the *Société d'enrichissement du Tricastin* (SET), *Franco-belge de fabrication du combustible* (FBFC), MÉLOX, AREVA NC La Hague) are all part of the AREVA Group.

With regard to uranium-enrichment activities, AREVA decided in 2010 to stop the operation of Georges Besse I Plant by the European Gaseous Diffusion Uranium Enrichment Consortium (EURODIF) at the end of 2012 and to proceed immediately with the preparations for its final shutdown and dismantling. In parallel, the operations for the commissioning of the Georges Besse II Plant in order to replace the former are progressing satisfactorily.

The process for shutting down and dismantling the older facilities of the La Hague Plant was initiated and the corresponding licensing decree was published for the High-activity Oxide Workshop: (HAO), whereas the applications submitted by the operator for the UP 2-400, STE2 and ELAN IIB facilities re under review by the French Nuclear Safety Authority (*Autorité de sûreté nucléaire* – ASN).

In 2010, a new innovating process in cold crucible was commissioned in Workshop B of the R7 Facility in order to vitrify older solution of fission products and more generally to optimise the industrial tool. However, the retrieval and conditioning of historical waste (other than fission products) remains a subject of concern.

The safety reassessment of the UP3 Facility was submitted by the operator and is currently under review by ASN. It involves significant actions with regard to the safety control of the facilities.

Over the last two years, the operators of fuel-cycle facilities have progressed in their integration of experience feedback: overall, they demonstrated more rigour with respect to the declaration criteria and the transmission deadlines of event reports. In another field, the operator of the La Hague Plant also progressed in the implementation of an internal-authorisation system that ASN assessed and approved in its Resolution of 14 December 2010. More generally, ASN launched in September 2010 a management-review process for nuclear safety and radiation protection in the AREVA Group.

Lastly, the overall consistency of the fuel-cycle management in the future is reviewed with extra care in order to take into account the changes induced by the use of new fuel types and by the quantity and the quality of the resulting waste.

Nuclear research establishments and other nuclear facilities

Nuclear research establishments and facilities that are not directly involved in the nuclear-power industry include all basic nuclear facilities (INB) of the civilian part of the French Atomic Energy and Alternative Energies Commission (CEA), the INBs of other research organisations et a few other INBs that are not power reactors and are not part of the nuclear fuel cycle.

A large number of facilities, which are currently operated by the CEA, have been commissioned in the early 1960s. With their older design, the equipment of those facilities is becoming obsolete and has been modified over time, sometimes without an overall reassessment from a safety standpoint. All facilities, whose safety reassessment has not been scheduled so far, must be reassessed by 2017 and every 10 years thereafter.

In 2010, the safety-reassessment case concerning ORPHÉE Facility was reviewed by ASN, which judged it to be satisfactory and did not raise any objection to the continuation of its operation.

ASN also completed the safety reassessment of the OSIRIS facility. In 2010, the CEA submitted its safety reassessment for the ÉOLE and MINERVE Facilities, whose shutdown is scheduled over the next 10 years and will be reviewed in 2011.

Although certain items still require improvement, the CEA has made significant advances since 1999 with regard to the management safety and radiation protection. However, the “broad-commitment” approach must be pursued and strictly applied. In fact, the CEA is now equipped since 2007 with a system capable of handling at the highest level all decisions concerning the refurbishment of older facilities and new projects. Such “broad commitments” are followed up formally every six months by the CEA.

In 2011, ASN will pursue its field control of the CEA’s internal-authorisation system. It will also examine the safety of the Large National Heavy Ion Accelerator (GANIL), concomitantly with the review of the application to modify the decree of that facility in order to implement the new accelerator. In addition, it will complete the review of the safety-reassessment case of CIS bio international’s radiopharmaceutical production plant whether to recognise if it is acceptable to pursue its operation over the medium and long terms.

The licence-application case for the ITER Facility project will be reviewed.

Furthermore, in 2011, through the review of the ASTRID Prototype Project and of the work on Generation-IV reactor system, will also be reviewed the experience feedback from fast-neutron reactors PHÉNIX, SUPERPHÉNIX and RAPSODIE, which are now shut down, along with comparison elements, in terms of safety, for the different potential systems of that generation.

Safe dismantling of nuclear facilities

Dismantling, which is a phase encompassing the overall activities carried out after the shutdown of a nuclear facility until the achievement of the predefined final state, has concerned about 30 nuclear facilities until now, to which must be added 27 ther facilities, which have already been dismantled and decommissioned. That phase involves radiological or conventional risks, some of which are similar to those considered during the operation of a facility, whereas other risks are more specific.

The dismantling doctrine for nuclear facilities was issued in 2010, with a view to:

- facilitating full dismantling to be committed immediately after the shutdown of the facilities;
- making a clear distinction between the operating phase from the dismantling phase, by issuing two different licensing decrees, and
- favouring an overall vision of the dismantling projects (single decree for final shutdown and dismantling of the facility involved) by specifying the broad technical and administrative steps, especially those requiring a licence from ASN).

In 2010, Guide No. 6 concerning the final shutdown, dismantling and decommissioning of INBs was published and the draft for Guide No. 14 on acceptable cleanup methodologies for French INBs, dating from June 2010, is being finalised.

In addition, dismantling operations are covered by public-information actions not only in the framework of the public inquiry that was organised at the time the application was made for final shutdown and dismantling, but also towards Local Information Committees (CLI).

With regard to the financing of dismantling operations and the long-term management of radioactive waste, operators have submitted their second triennial safety reports, as prescribed by the *Planning Act of 28 June 2006 Concerning the Sustainable Management of Radioactive Materials and Waste*, with a view to assessing the long-term charges, the applicable calculation methods for the accruing provisions to those charges and the selected options with regard to the composition and management of the assets allocated to the coverage of those provisions. With due account of the experience feedback from those reports, a guide intended for operators is being drafted in order to specify the application modalities of t he regulatory provisions, notably with regard to the description technical and assessment scenarios for corresponding charges.

The overall dismantling of EDF reactors continued under satisfactory conditions. However, with regard to the Brennilis NPP, the new dismantling licence was submitted to a public inquiry at the end of 2009 and was rejected by the Inquiry Committee, in March 2010, although it felt that EDF may be authorised to conduct some work. With due account of that opinion, a decree for partial dismantling will be proposed to the government un 2001.

With regard to CEA facilities, the overall dismantling operations under way are evolving under satisfactory conditions, although a large number of delays have been recorded or announced on future worksites.

Dismantling preparations for AREVA's older facilities at La Hague are now far advanced, especially with regard to the process aiming at drafting the licensing decrees for the final shutdown and dismantling. Since the removal of historical waste constitutes a significant aspect in the dismantling of those older facilities, it is therefore important that special care be given to that issue (see paragraph below).

Lastly, a note should be made that the dismantling of the Strasbourg University Reactor was completed in 2010 pending its decommissioning, whereas the dismantling and cleanup of the facilities at the CEA's site in Grenoble are still under way.

In the operators' strategies, special attention is given to the availability of appropriate waste-elimination systems, the management of waste streams and capacities, the integration of uncertainties and technical contingencies, organisational structures, etc. Nowadays, although activities regarding the dismantling of nuclear facilities have reached the stage of industrial development, further progress margins ought to be sought.

Radioactive waste and polluted sites

Radioactive-waste management is ruled by the *2006 Planning Act*, which sets a "route card" for the overall management of radioactive waste, notably imposing that a National Management Plan for Radioactive Materials and Waste (PNGMDR) be adopted every three years.

The second edition (2010-12) of the PNGMDR was tabled before Parliament in early 2010 and made public. A decree specifying the prescriptions for the PNGMDR is expected in 2011.

Both disposal facilities for low-level and intermediate-level short-lived waste and for very-low-level waste continue to operate smoothly, as well as the monitoring of the *Centre de la Manche* Disposal Facility.

The project for a deep geological repository for high-level waste close to the Underground Research Laboratory located at Bure, in Eastern France, is consistent with the schedule prescribed by the *2006 Planning Act* and the Decree of 16 April 2008.

Once the government had approved the 30-km^2 interest zone for in-depth reconnaissance for the implementation of the repository, ANDRA launched an in-depth reconnaissance campaign (including 3D seismics) reconnaissance in the interest zone and whose results should be available by 2012. In late 2009, ANDRA submitted a case describing an updated account of the safety and reversibility options for the repository, in response to which ASN issued its position and a certain umber of recommendations in early 2011. ANDRA also drafted a development plan for the project, which presents the research and study strategy between 2007 and 2014 in order to meet the objectives prescribed by the *2006 Planning Act*. In June 2010, ANDRA submitted the updated version of its 2008-14 Scientific Programme, whose conclusions serve as the supportive evidence for the safety demonstration.

The key steps in the development of the project will be addressed over the next few years, especially during the public debate scheduled in 2013 and at the time the creation-licence application will be submitted in 2015. Through the opinion it recently issued on the case submitted by Andra in 2009 concerning safety and reversibility options, ASN has set forth the main work areas that ANDRA will need to improve before submitting its creation-licence application. A significant element in the development of that project is the submission in due time and quality of the creation-licence application case, including the relevant reversibility conditions and the guarantee that they are compatible with the long-term safety of the repository.

The processes, both for siting and for developing disposal concepts for low-level long-lived waste, are still under way. By the end of 2012, ANDRA will submit a report describing a study on management scenarios for those residues and integrating the possibility to manage graphite and radium-bearing waste. The study will be accompanied by safety studies justifying the compatibility of that type of waste with the different disposal solutions. Hence, the key steps in the development of the disposal project should be achieved over the next few years.

The removal and conditioning of historical waste remains a subject of concern, although advances have been observed at various operators.

The assessment of the long-term impact of disposal facilities for mine tailings has improved, notably from a methodological standpoint. The conclusions of available studies show that the covers installed over several disposal sites for mine tailings have improved in quality and appear as an efficient solution to reduce exposures over the long term. That improvement must be reviewed further in order to assess the feasibility and soundness of all disposal sites for mine tailings. Further provisions with a view to improving knowledge about the environmental and health impact of old uranium mines and the management of mine tailings re under way and must be pursued.

In addition, the final report of the Pluralistic Expert Group on Former Limousin Uranium Mining Sites in Central Western France sur (GEP Limousin), containing a few recommendations, was published in 2010.

Lastly, the regulatory framework for managing polluted sites and soils was revamped. A circular, published in 2.008, specifies the roles and responsibilities of the different actors involved in the take-over of the polluted sites and soils involved. It already appears that leaving the contamination on site must not be the reference solution for managing sites contaminated with radioactive materials and that such option may only serve as an interim solution or be restricted to cases where the cleanup option is not possible due to the waste volume to be excavated.

Taking into account the Fukushima accident experience feedback

France considers that it is essential to draw all possible lessons from the accident that occurred at the Fukushima-Daiichi NPP in Japan.

Over the short term, complementary safety assessments (*Evaluations complémentaires de sûreté* - ECS) at French nuclear facilities with regard to similar events évènements to those that happened at Fukushima have been organised. Those ECSs are part of a dual framework consisting in the organisation of stress tests requested by the European Council and the holding of an audit on the safety of French nuclear facilities with regard to the events that occurred Fukushima, which was referred to ASN by the Prime Minister.

ECSs concern almost all INBs. In the case of top-priority facilities (notably all nuclear power reactors in service or under construction), the operators have submitted to ASN on 1 June 2011 a note describing the selected methodology for conducting the assessment transmitted to ASN on 15 September 2011. ASN and the IRSN have until 15 November 2011 to analyse those reports.

In the case of facilities with minor prioritiy levels, operators will have until 15 September 2012 to carry out their ECSs and must submit to ASN his methodological note by 15 January 2012.

Follow-up mission of the Integrated Regulatory Review Service (IRRS)

From 29 March to 3 April 2009 and at ASN's request, the international audit mission for the Integrated Regulatory Process Review Service (IRRS) took place.

That new IRRS mission focused not only on verifying the actions implemented by ASN in response to the recommendations and suggestions formulated during the previous audit mission in November 2006, but also on the existing provisions to control the security of the sources.

The mission report confirms that ASN took effective measures to implement the recommendations and suggestions of the international reference system.

A few improvements areas have also been identified.

A full English version of the mission report may be consulted on ASN's website (www.asn.fr), together with a summary in French.

International activities

Since France owns the second largest nuclear fleet in the world, she is extremely active and committed on the international scene, as reflected in both bilateral and multilateral agreements.

At the Third Review Meeting of the *Joint Convention*, it was decided that topical international meetings would be held, notably for continuity's sake, between plenary meetings of the Contracting Parties. In 2010, France organised the first meeting of national radioactive-waste-management organisations. She also participates in the drafting of the *Joint Convention's Newsletter*.

At the European scale, France has also participated in the European Directive on radioactive waste, which reiterates notably the principle to develop a national management plan for radioactive waste and spent fuel, as designed in France. That directive (Directive 2011/070/Euratom) was adopted on 19 July 2011.

Lastly, France was deeply involved and will enhance its involvement in international activities by maintaining its active participation in working groups, especially within the Waste Safety Standards Committee (WASSC) of the International Atomic Energy Agency (IAEA), which reviews more closely the reference-system projects on radioactive-waste management, the European Nuclear Safety Regulators Group (ENSREG), WENRA, the Nuclear Energy Agency (NEA), and by participating in the reflection efforts pursued by the different international entities on radioactive-waste disposal facilities, and notably reversibility.

Conclusions, challenges and prospects resulting from the third review meeting

During the Third Review Meeting that was held in May 2009, several challenges and measures were addressed in order to improve the safe management of spent fuel and radioactive waste in France. Those topics, which are listed below, were highlighted in this report as a result of the Fourth Review Meeting and are developed in § K.1.1.1 :

- to ensure the safe management of all historical waste;

- to develop management system for low-level long-lived and high-level and intermediate-level long-lived waste:
- to pursue the development of an international approach for specifying safety requirements for deep geological repositories, and
- to maintain efforts with a view to ensuring the safe and sound dismantling of nuclear faculties.

Section A : INTRODUCTION

A.1 GENERAL INTRODUCTION

A.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 fourth 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*.

A.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 referred to as a "basic nuclear facility" (*installation nucléaire de base* – INB) and placed under the control of the French Nuclear Safety Authority (*Autorité de sûreté nucléaire* – ASN). Below that threshold and provided that the facility involved falls under a category of the nomenclature of classified facilities for other purposes than their radioactive materials, any facility may be considered as a "classified facility on environmental-protection grounds" (*installation classée pour la protection de l'environnement* – ICPE) and 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.

A.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), the Nuclear Safety and Radiation Protection Mission of the Ministry of Ecology, Sustainable Development, Transportation and Housing (*Ministère de l'Écologie, du Développement durable, des Transports et du Logement* – MEDDTL) and the Institute for Radiation Protection and Nuclear Safety (*Institut de radioprotection et de sûreté nucléaire* – IRSN), but also from the major operators of nuclear facilities, including *Électricité de France* (EDF), AREVA, and particularly its subsidiary AREVA NC, the French Alternative Energies and Atomic Energy Commission (*Commissariat à l'énergie atomique et aux energies alternatives* – CEA) and the National Radioactive Waste Management Agency (*Agence nationale pour la gestion des déchets radioactifs* – ANDRA). The final draft was completed in September 2011 after consultation with all French parties concerned.

A.1.4 - Structure of the report

For her fourty 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 Planned safety-improvement actions.

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.

A.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

A.2 - MAJOR DEVELOPMENTS SINCE THE LAST FRENCH REPORT

A.2.1 - Evolution of nuclear safety control

A.2.1.1 - European legislative framework

On 25 June 2009, the Council of the European Union adopted Directive 2009/71/EURATOM setting up a community framework for the nuclear safety of nuclear facilities. The Directive constitutes a significant step towards the implementation of a common legal framework in the field of nuclear safety for all Member States. It creates a legally-binding community framework with regard to nuclear safety and prescribes the basic obligations and general principles in that field. It reinforces the role of the national regulatory organisations involved in safety control and guarantees a high level of transparency on issues concerning the safety of the facilities. Hence, it contributes to the harmonisation of safety requirements among all Member States and to the development of a high level of safety in nuclear facilities throughout the European Union. The Directive applies notably to spent-fuel processing and storage facilities and to specific radioactive-waste storage facilities, if they are located on the same site as other nuclear facilities.

In addition, another directive establishing a community framework for the safe and responsible management of spent fuel, and radioactive waste was adopted on 19 July 2011 (Directive 2011/70/Euratom).

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, It must be developed and notified to the European Commission not later than 23 August 2013; besides the objectives being sought, it must describe the technical concepts, plans or solutions, together with the matching schedule, in order to ensure the safe and responsible management of spent fuel and radioactive materials in accordance with the objectives of the Directive.

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 reprocessing).

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 or reprocessing 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;
- 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.

Member States are required to transpose the provisions of the Directive in their national legal system before 23 August 2013. They also have until 23 August 2015 to notify the Commission for the first time about the content of their national programme.

The Directive applies to all management steps for spent fuel and radioactive waste, including production, handling, pre-treatment, processing, conditioning and interim disposal, 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.

A.2.1.2 - Consolidation of general technical regulations

Following the publication of the *Act of 13 June 2006 on Transparency and Security on the Nuclear Field* (hereinafter called the "*TSN Act*") and of its enforcement decrees, ASN intended to proceed with a thorough consolidation of the general technical regulations for INBs. 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 new technical regulatory set will include the following:

- an Order by the Ministers in charge of nuclear safety prescribing the essential requirements applicable to all INBs for the protection of human beings and of the environment against accident risks, chronic pollutions or other nuisances. That Order, also known as the "INB regime", reiterates the currently applicable prescriptions and integrates WENRA's reference levels. After the usual consultations and exchanges, the Order is expected to be adopted in 2013, and
- about 20 ASN Resolutions made pursuant to Article 4 of the TSN Act in order to clarify decrees and orders regarding nuclear safety and radiation protection that are submitted to the government's approval.

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

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

The *Planning Act of 28 June 2006 Concerning the Sustainable Management of Radioactive Materials and Waste* (hereinafter called "the *2006 Planning Act*") entrusts upon the government to develop a National Plan Management for Radioactive Materials and Waste (*Plan national de gestion des matières et des déchets radioactifs* – PNGMDR) and to update it every three years. The Plan is tabled before Parliament, which in turn refers it for review to the Parliamentary Office for Scientific and Technological Choices (*Office parlementaire d'évaluation des choix scientifiques et technologiques – OPECST*) before publication.

The PNGMDR provides an overview of the range of existing means to manage radioactive materials and waste, lists the foreseeable needs for storage or disposal facilities, details the required capacities for such facilities, as well as their storage capacities; and, in the case of radioactive waste for which a final management solution is still pending, sets off the objectives to be met. In accordance with the orientations described in Articles 3 and 4 of the *2006 Planning Act,* the PNGMDR organises the implementation of investigations and studies on the management of radioactive materials and waste, by prescribing deadlines for the implementation of new management modes, the creation of facilities or the modification of existing facilities designed to fulfil the needs and objectives referred to […] above". The Decree of 16 April 2008 was issued in order to clarify the main provision of the 2006 *Planning Act*.

The first PNGMDR was tabled before Parliament and published in 2007. Based on the work of a pluralistic group (co-chaired by the Ministry of Ecology, the Environment, Sustainable Development and the Sea and ASN), the new 2010-12 PNGMDR was drafted and tabled before Parliament in early 2010 and published later in the middle of that year.

The government is now responsible for the implementation of the current PNGMDR (decree in preparation) and is preparing the publication of the next Plan for 2013-15 (scheduled in 2013).

France was the first country to develop a PNGMDR and worked actively at the European scale on the project for a directive requesting the drafting of management plans for radioactive waste in every EU Member State.

A.2.2.2 - Ongoing evolution of management systems

In late 2009, ANDRA submitted to the government several proposals concerning the implementation and design of the repository project for high-level and intermediate-level long-lived (HL/IL-LL) waste. Hence, the project is now preparing to leave its feasibility phase and to enter into its definition phase and, subject to approval, into its execution phase.

In March 2010, the government validated the delineated zone proposed by ANDRA for the implementation of the repository's underground installations, after having received the opinions of ASN and of the National Review Board (*Commission nationale d'évaluation* – CNE) and consulted with local actors. The consultation approach will be pursued when proposing the implementation of surface installations during the public debate scheduled in 2013.

The recommendations formulated by the assessors following the review of the technical options presented in 2009 and the analysis of the investigated optimisation leads constitute input data for the next study phase. Numerous exchanges were organised on reversibility, such as meetings with local actors, a multidisciplinary scientific symposium in June 2009, the international conference organised by the OECD Nuclear Energy Agency (NEA) in December 2010 in the framework of the Reversibility and Retrievability Project, etc. Such exchanges contribute also to the preparation of the public debate and to the drafting of the future act prescribing the reversibility specifications for the repository.

The search for long-term management solutions for low-level long-lived (LL-LL) waste continues. In 2012, ANDRA will submit a report on various management scenarios for radium-bearing and graphite waste.

A.2.3 - Conference on the Creation of National Management Entities for Radioactive Waste

Pursuant to the decision taken at the end of the third meeting concerning the *Joint Convention*, France organised and hosted the first Joint Technical Meeting designed to maintain exchanges in the meantime between two review meetings of the *Joint Convention*. The selected theme for the conference dealt with the creation of national radioactive-waste-management organisations.

The conference was organised jointly by ASN, the DGEC and ANDRA. It took place on 7-9 June 2010 and gathered close to 120 participants from 48 different countries, as well as representatives from the IAEA, the NEA and the EC.

Exchanges proved most productive. The significance of having a radioactive-waste-management agency, independent from the producers, was emphasised. The responsibilities pertaining to such authorities vary from one Contracting Party to the other, but the possibility to rely on a single entity to manage all waste, to exercise a full control and to ensure the consistency of the management methods was also recognised.

A tour of the disposal facilities located in the Aube District in North-eastern France followed at the end of the two-day conference. More than 60 participants attended the visit and appreciated the quality of the installations not only for the disposal of intermediate-level and low-level short-lived (LIL-SL) waste, but also of very-low-level (VLL) waste.

A.2.4 - Follow-up mission on the audit of IAEA Integrated Regulatory Review Service (IRRS)

At ASN's request, the international audit mission for the Integrated Regulatory Process Review Service (IRRS) took place from 29 March to 3 April 2009.

That new IRRS mission focused not only on verifying the actions implemented by ASN in response to the recommendations and suggestions formulated during the previous audit mission in November 2006, but also on the existing provisions to control the security of the sources.

The mission report confirms that ASN took effective measures to implement the recommendations and suggestions of the international reference system. It also confirms ASN's own sound position with regard to best international practices in the fields of nuclear safety and radiation protection. It also underlines ASN's good practices and especially the following:

- its international role in order to improve nuclear safety and radiation protection,
- the national relations it has created in order to ensure an effective control of nuclear safety and radiation protection, and
- the prompt and effective implementation of the prescriptions referred to in the TSN Act.

A few improvements areas have also been identified, such as the management of ASN's human resources, the follow-up of the expert assessments performed by the IRSN on

ASN's behalf and the action plan to be implemented as soon as ASN will be responsible for the security of sources.

A full English version of the mission report may be consulted on ASN's website (www.asn.fr), together with a summary in French.

A.3 - INTEGRATION OF EXPERIENCE FEEDBACK FROM THE FUKUSHIMA ACCIDENT

France considers that it is essential to draw all possible lessons from the accident that occurred at the Fukushima-Daiichi NPP in Japan, in line with what was done for those that happened at Three Mile Island and Chernobyl. As in those previous accidents, the comprehensive experience-feedback exercise from the Fukushima accident will be a long process that will extend over several years.

A.3.1 – Complementary French safety assessments: European and French contexts

Over the short term, ASN has decided to organise complementary safety assessments (*Evaluations complémentaires de sûreté* - ECS) at French nuclear facilities with regard to similar events évènements to those that happened at Fukushima, as a supplement to the safety approach that is applied on a permanent basis.

Those ECSs are part of a dual framework consisting in the organisation of stress tests requested by the European Council and the holding of an audit on the safety of French nuclear facilities with regard to the events that occurred Fukushima, which was referred to ASN by the Prime Minister pursuant to the *TSN Act*.

A.3.2 – Organisation of complementary safety assessments

In accordance with the principle of the operator's accountability, ECSs will require all relevant operators to prepare a consistent report with ASN's specifications within a clearly-defined timeframe. Every report will then be reviewed by ASN, with the support of the IRSN. ASN's conclusions will be made public and may give rise to further prescriptions by ASN, and, if need be, to proposals to the government if the relevant measures involve it.

National and local consultations will be conducted throughout that process. The intervention of experts from various disciplines, whether from France or from abroad, will be sought.

A.3.3 – Specifications

In order to assure maximum consistency between the European and the French approaches, French specifications were developed on the basis of European equivalents for stress tests on power reactors.

Since ASN has decided to conduct ECSs on all nuclear facilities likely to be at risk in case of Fukushima-like events to, and not only on power reactors, it was necessary for the first time to adapt the French specifications to the European document. Other improvements were made during the comprehensive consultation conducted by the High Committee for Transparency and Information on Nuclear Safety (*Haut Comité pour la transparence et l'information sur la sécurité nucléaire* – HCTISN), which notably led to the development of the aspects relating to socio-organisational and human factors.

The ECSs will consist in a targeted reassessment of the safety margins of nuclear facilities in the light of the events that occurred at Fukushima, that is, extreme natural phenomena (earthquake, flood and their combination) that jeopardised the safety functions of the facilities and lead to a severa accident. The assessment will deal first and foremost with the impact of those natural phenomena, before addressing not only the loss of one or several of the safety functions involved at Fukushima (power supply and cooling systems), irrespective of the probability or the cause of such loss of functions, but also the management of severe accidents that may result from such events. Three major aspects will need to be included in the assessment, as follows:

- the measures to be taken into account in the design of the facility, and the consistency of the facility with applicable design requirements;
- the robustness of the facility over and above its specifications; the operator must identify notably the situations that may lead to a sudden alteration in the accidental sequences of (“cliff-edge” effects) and will relevant measures to avoid them, and
- any potential change likely to improve the safety level of the facility.

A.3.4 – Facilities involved and schedule

ECSs concern almost all INBs, which have been divided into three categories according to their vulnerability to the phenomena that caused the Fukushima accident and to the significance of the impact of an accident that would affect them.

In the case of top-priority facilities (notably all nuclear power reactors in service or under construction), the operators have submitted to ASN on 1 June 2011 a note describing the selected methodology for conducting the assessment transmitted to ASN on 15 September 2011. ASN and the IRSN have until 15 November 2011 to analyse those reports.

In the case of facilities with minor prioritiy levels operators will have until 15 September 2012 to carry out their ECSs. Any operator who is only concerned by that second category of facilities, he must submit to ASN his methodological note by 15 January 2012.

Lastly, non-priority facilities will be processed through adapted requests from ASN, notably at the time of their next decennial safety reassessment. The list of nuclear facilities and of their matching priority level is shown in Annex L.4.

Section B : POLICIES AND PRACTICES (Article 32 – § 1)

In accordance with the provisions of Article 30, each Contracting Party shall submit a national report to each review meeting of the Contracting Parties. This report shall address the measures taken to implement each of the obligations of the Convention. For each Contracting Party the report shall also address its:

- *spent fuel management policy;*
- *spent fuel management practices;*
- *radioactive waste management policy;*
- *radioactive waste management practices;*
- *criteria used to define and categorise radioactive waste.*

B.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 Concerning Research Activities on the Management of Radioactive Waste* (*1991 Law*) and the *Planning Act of 28 June 2006 Concerning the Sustainable Management of Radioactive Materials and Waste* (*2006 Planning 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 Recoverable Materials* (*Inventaire national des déchets radioactifs et des matières valorisables*) (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 dismantling activities.

B.1.1 - Planning Act of 28 June 2006 Concerning the Sustainable Management of Radioactive Materials and Waste

The *2006 Planning 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 dismantling 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 *Environmental Code* (Articles L. 542-1 to L. 542-14).

	Subject of decree	Article	Publication date
National Management Policy for Radioactive Materials and Waste	Description of a National Management Plan for Radioactive Materials and Waste	Art. 6	16 April 2008
	Management of foreign waste and processing contracts	Art. 8	3 March 2008
	Appointment of CNE members	Art. 9	5 April 2007
	Nature of information to be transmitted for National inventory and PNGMDR	Art. 22	29 August 2008
Support for research conducted at the Meuse/Haute Marne URL	CLIS	Art. 18	7 May 2007
	GIPs – Generic decree	Art. 13	14 December 2006
	Delineation of the proximity zone–- GIP Meuse and Haute-Marne	Art. 13	5 February 2007

	"Support" tax: fraction paid by GIPs to communes located within the 10-km zone	Art. 21	7 May 2007
	Coefficient of "incentive" and "technological diffusion" taxes	Art. 21	26 December 2007
	Consultation zone for the creation of a repository	Art. 12	To be publ. in 2012
Funding provisions	Coefficient of the additional "research" tax	Art. 21	26 December 2007
	Securisation of long-term nuclear charges	Art. 20	23 February 2007
	Implementation of the CNEF	Art. 20	20 June 2008

Table 1: List of decrees taken pursuant to the 2006 Planning Act *until late 2010*

B.1.2 - An all-encompadding management policy for radioactive substances

B.1.2.1 - Definitions

In accordance with Article 3 of the *2006 Planning Act*, 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.

B.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 reprocessing. They also include thorium.

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

- reprocessed plutonium 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 reprocessed uranium (about one third of the annual production is re-enriched abroad and is used for the fabrication of the fuel types used at the Cruas Nuclear Power Plant (NPP). It should be noted that the future GB II enrichment plant should be able to enrich reprocessed uranium. A more thorough recovery of reprocessed uranium could be envisaged as mentioned in § B.2 and § D.1.2.1.1.

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 in making the Plan consistent with the scope of the National Inventory of Radioactive Waste and Recoverable Materials, as established by ANDRA.

However, certain members of the Working Group feel that those materials ought to be considered as waste. They believe that the presentation of certain materials resulting from the operation of INBS as a recoverable material is likely to orient future choices within the energy policy towards nuclear energy.

The 2010-12 PNGMDR is not taking any stand on the status of recoverable materials, but takes their existence into account and advocates long-term management solutions in cases where they would not be reused. Nevertheless, the Plan mentions a few reservations on the recovery possibilities of certain materials, with due account of the technico-economic aspects of the time, notably with regard to thorium. The future of those materials is reviewed periodically, especially during the update of the PNGMDR.

B.1.2.3 - The National Inventory of Radioactive Waste and Recoverable Materials

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.

The first edition of the National Inventory of Radioactive Waste and Recoverable Materials was published by ANDRA in November 2004. Subsequent editions were issued in January 2006 and June 2009. The actual preparation of the inventory was supervised by a steering committee including representatives from large waste producers, various administrations, ASN and ANDRA. 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.

The 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 inventory may be consulted on ANDRA's website (www.andra.fr).

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

Over and above the principles mentioned above, 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 *2006 Planning 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 validation of the decree stating the requirements for the second Plan is under way.

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.

B.1.3.1 - Legislative framework for the implementation of the PNGMDR

B.1.3.1.1 - Driving principles of the PNGMDR

The driving principles of the PNGMDR are as follows:

- 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.

Other principles are also important with regard to radioactive-waste management, such as:

- compliance with protection principles against ionising radiation (justification, optimisation, limitation) and for environmental monitoring (precaution principle, polluter-pays, etc.);
- information and active involvement of citizens;
- traceability of waste management;
- due account of hazards relating to the transport of radioactive waste within the overall optimisation of management risks;
- 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;
- optimisation (cost/benefit) of all overall systems, and
- quantifiable progress approach relating to methods and techniques.

B.1.3.1.2 - Objectives of the PNGMDR

The PNGMDR objectives are as follows:

- to establish a clear definition of the waste categories to be considered as radioactive, with due account of the existence of naturally-occurring radioactivity with a variable intensity and of certain radioactive materials not intended for reuse;
- to seek long-term management solutions for every category of radioactive waste being produced;
- to analyse the long-term management solutions 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 consistency among practices relating to polluted sites and rehabilitation methods, and
- to take due account of public concerns 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.

B.1.3.2 - Implementation of the 2010 PNGMDR

B.1.3.2.1 - Scope of the PNGMDR

The PNGMDR applies to the following waste categories:

- all "waste resulting from nuclear activities" (regulated activities due to the presence of radioactivity involved) and which may have been contaminated or are likely to be contaminated by radioactivity or activated due to the nuclear activity;
- 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).

B.1.3.2.2 - Conclusions of the PNGMDR 2010

The 2010-12 PNGMDR concludes that close to 90% of the total volume of radioactive waste already have their own long-term management systems, whereas the other waste is stored temporarily pending similar long-term management systems.

It underlines the significant advances achieved since the 2007 Plan.

It specifies the significant work programme being undertaken to further committed improvements and describes new areas for improvement, such as:

- developing projects aiming at implementing a deep reversible repository for HL/IL-LL and IL-LL waste and of shallow facilities for low-level long-lived waste;
- scheduling milestones in order to ensure the conditioning of historical waste;
- conducting work with a view to developing new conditioning processes for certain waste categories;
- reducing the long-term impact of disposal facilities for mine tailings, and
- undertaking work in order to develop new industrial systems for waste categories pending one.

B.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.

Article 8 of the *2006 Planning Act* (as codified in Articles L. 542-2, L. 542-2-1 and L. 542-2-2 of the *Environmental 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 Order of 17 December 2010 includes various adjustment provisions to EU law with regard to waste, and especially through its Article 20 dealing with radioactive waste.

In addition, the *Planning 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 intergovernrnental 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.

B

B.1.5 - Management policy based on research and development

B.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 *2006 Planning Act* as follows:

- partitioning and transmutation of long-lived radioelements: a status report on the various transmutation systems will be prepared in 2012. Depending on the conclusions of that report, facility prototypes may start to be built in 2020 and likely to be commissioned industrially around 2040. Those investigations are conducted in parallel with those on Generation-IV reactor systems with a view to studying the possibility of reducing the toxicity of those residues by separating the most toxic elements and by transforming them into lesser-radioactive or shorter-lived radioelements, since the latter are easier to isolate from human beings and the environment over long timescales. At best, those new measures would only involve residues generated after 2040;
- reversible waste disposal within a deep geological formation: the goal is to conduct studies and investigations for siting and designing a suitable repository in order for the corresponding licence application to be reviewed in 2015 and for the facility to be commissioned by 2025, subject to the favourable outcome of the review. The Act specifies a minimum reversibility period of 100 years. That disposal option is described by the Act as the reference solution for replacing the current storage of ultimate radioactive residues that are unsuitable for disposal in surface or shallow facilities due to safety and radiation-protection concerns. The purpose of ANDRA's investigations is to design such a repository and to rely on the experimental results achieved in the Bure Underground Research Laboratory, which is designed to study the rocks in situ by qualifying their mechanical, chemical, hydrogeological and thermal properties, and
- conditioning and storage processes: new facilities will need to be created or existing facilities will need to be modified no later than 2015 in order to fulfil the needs listed in the PNGMDR.

Contrary to disposal, storage is only a temporary solution, offering a provisional means for securing the waste pending the commissioning of the repository. Beyond the commissioning of the repository, storage also provides an opportunity to organise the operating campaigns of the repository by adding flexibility between the construction of disposal cells, transfers and the emplacement of waste packages. For certain waste categories, a phase of radioactive decay in storage before disposal is technically required. In accordance with the reversibility principle, storage will also allow for managing any package that would need to be removed from the repository. Storage may also constitute an ideal means to observe and monitor packages. Those different complementary aspects between storage and reversible disposal make it possible to consider storage facilities with operating lifetimes ranging from several decades up to about 100 years, a consistent timescale with the top current industrial know-how and a requirement for a safety assessment in order to justify their acceptability.

The reversibility of repositories, as prescribed by the *2006 Planning Act,* is a noteworthy evolution in relation to the *1991 Law*. The *Planning 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 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.

Investigations on deep geological disposal and on storage are conducted by ANDRA and currently financed according to the "polluter-pays" principle by a special tax on INBs producing HL/IL-LL waste. As for research on waste conditioning, investigations are conducted and financed by waste producers. The programme called "Future Investments" (Investissements d'avenir) has provided ANDRA with new financial means in order to contribute to the development of new processing technologies for waste whose properties complicate their conditioning for storage purposes. So far, research on partitioning and transmutation, funded by a CEA subsidy, has induced the following expenses:

Areas	Total expenses from 1992 to 2007 *(in millions of euros)*
Area 1 (partitioning/transmutation)	1,065 (including 89 in 2005; 79 in 2006; 75 in 2007)
Area 2 (deep geological disposal)	1,346 (including 101 in 2005; 81 in 2006; 116 in 2007)
Area 3 (conditioning/storage)	813 (including 55 in 2005; 50 in 2006; 42 in 2007)
Total – Research on HL-IL/LL waste	3,223 (including 245 in 2005; 210 in 2006; 235 in 2007)

Table 2 : Total research expenses for deep geological disposal, storage and partitioning/transmutation with special focus between 2005 and 2007

B.1.5.2 - Low-level long-lived waste

The *2006 Planning Act* provides for the development of disposal solutions for LL/LL waste, and particularly for radium-bearing and graphite waste. In 2012, ANDRA will submit a report on possible management scenarios for LL/LL waste.

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".

B.1.5.3 - Other waste categories covered by research programmes

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 VLL-Waste Disposal Facility and to a lesser extent to the LIL-Waste Disposal Facility (*Centre de stockage pour les déchets de faible et moyenne activité* –CSFMA).

The current inventory of asbestos-bearing waste has already reached several thousands of cubic metres m3 (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.

That work should be completed by the end of 2011.

A second area of work concerns waste categories with no management system so far, or in other words, those residues whose management, processing or conditioning mode is yet to be ascertained.

Part of those residues are generated by small-sscale nuclear activities (polluted soils, laboratories, etc.) and remain under the responsibility of ANDRA whose task is therefore to identify suitable management solutions, notably in the case of residues containing mercury, magnesium, aluminium, organic liquids, etc.

To the farthest extent possible, but with due account of the small volumes involved, ANDRA is thinking of processing those residues via processes that already exist or are under investigation and that would be dedicated to larger waste volumes. The purpose of that approach aims notably at stabilising mercury-bearing waste by flower of sulphur, or magnesium- or aluminium-bearing waste by a dedicated mortar formulation. Actions in that sense are also envisaged in the framework of the Future Investment Programme.

Two types of studies are also the topics of research programmes in the case of waste that is either disposed of or likely to be disposed of at the CSFMA. The first concerns the source term and the organic or inorganic speciation of the carbon-14 contained in ion-exchange resins, which constitutes the major source of carbon-14 at the CSFMA. The second addresses radionuclide transfers in concrete and includes two actions, as follows:

- determining the transfer processes and modalities of tritium in concretes, notably in relation to the intended form: gaseous phase (HT) dissolved state (HTO), and
- improving diffusion tests in concrete in order to assess better the acceptability of waste packages.

B.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 was organised over a four-month period before the adoption of the 2006 Planning Act. Another debate will be organised before the review of the licence application for the creation of a deep geological repository: before the end of 2012, ANDRA will submit to the Ministers in charge of energy, research and the environment the supporting documentation for the organisation of the public debate, and
- in Parliament: in the framework of the licensing of a deep geological repository, the 2006 Planning Act prescribes two parliamentary deadlines, the first in 2015 in order to set forth its reversibility conditions, 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 Article 22 of the Planning Act, 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 Planning Act includes penalties in case of non-compliance on the part of operators.

B.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 INB decommissioning

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

The French funding system for decommissioning INBs and managing the resulting radioactive waste rests on the full financial liability of industrial operators, as follows:

- INB operators must establish conservative estimates of the charges for dismantling 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 an facility either existing or under construction. Even though reprocessing costs are not submitted to the constitution of covering assets, management costs for radioactive waste resulting from that reprocessing 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 2006 Planning 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 musdt 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, and

- the law also provides for a State control supported by regulatory and sanctionary 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 nucleotides de base et de gestion des combustibles usés et des déchets radioactifs*), in order to assess the control conducted by the administrative authority.

B.1.7.2 - Funding research and development on deep geological disposal

Pursuant to the *2006 Planning Act*, a specific fund was created within ANDRA in order to finance investigations and studies on storage and deep geological disposal. The fund shall be supplied by a so-called "additional research tax" to the INB tax. When ANDRA's objectives regarding safety, reversibility and planning were renewed or assigned, it seemed appropriate to secure its financing sources.

The amount of that tax is calculated as the product of a lump imposition by an adjustment factor. Hence, on the basis of current INBs, ANDRA receives more than 100 M€ every year.

B.2 - FRENCH SPENT-FUEL-MANAGEMENT POLICY

B.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 (408 TWh in 2010), 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 *2006 Planning 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 compared to the quantity intended for recycling.

B.2.2 - Justification of the processing/recycling option

The selection of processing/recycling rests primarily on energy and environmental considerations. France believes that such strategy includes a certain number of advantages, as follows:

- 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 may also reduce the consumption of natural uranium by as much as 25% due to an equal share of MOX fuel and to the enrichment of reprocessed uranium. 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 is relevant within the perspective of using nuclear power over the long term, since processed spent fuel provides useful energy materials for the wide use of future Generation-IV 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 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 Generation-IV 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 Generation-IV reactors are involved or not, and
- 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.

B.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 plan (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 reprocessed and re-enriched uranium.

With due account of such a reactor fleet running on MOX fuel and of the share of reprocessed uranium that is re-enriched, 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 reprocessed as prospects develop for the extracted plutonium ("flux-adequacy principle") and causes about 1,050 t of fuel (out of the 1,150 t to be unloaded from French reactors) to be processed every year, while it also ensures the recycling of plutonium as 120 t of MOX fuel.

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.

B.2.4 - Prospects

- 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_2), which is manufactured from reprocessed uranium, the current strategy consists in storing them and processing them at a timely moment with a view to using the resulting plutonium in Generation-IV 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 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 planned for the 2020s), which represent a key technology for the sustainable use of nuclear systems.

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

The *2006 Planning Act* 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 reprocessed 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.1.6.

Pursuant to Article 13 of the 16 April 2008 Decree, 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).

B.3 - SPENT-FUEL MANAGEMENT PRACTICES

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

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

EDF's current strategy is to reprocess 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 (reprocessed re-enriched uranium) after re-enrichment.

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

- the consumption of MOX fuel has increased thanks to its upcoming use in two reactors (licence application under review) in addition to the 22 other reactors already running on it, and
- the number of reactors using fuel containing reprocessed and re-enriched is raised from two to four. Uranium reduces the toxicity of conditioned radionuclides present in the waste by a factor of about 10, given that, quantitatively, plutonium is the most radiotoxic element in the spent fuel.

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 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.

B.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 reprocessing to facilities dealing with the back-end of the fuel cycle.

Most of the CEA's spent fuel is sent for reprocessing to the La Hague Plant (AREVA NC), but fuel types are also intended for deep geological disposal.

Pending their reprocessing at the La Hague Plant or the availability of a deep geological repository, 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).

Interim storage facilities still exist at Saclay and Marcoule: the fuel they contain will be disposed of during the next decade. Those that are still laying in the INB-22 PÉGASE ponds at Cadarache and in the INB-72 will be disposed off by 2013 and 2017, respectively.

All planned technological solutions until now are summarised in Table 2. They include staggered processing at La Hague's Plant or storage in Cadarache's CASCAD or CARES facilities pending the construction of the deep geological repository.

Fuel family	Origin or interim location	Currently implemented or planned solution
Cold PHÉNIX spent fuel	Atelier pilote de Marcoule (APM)	Processing
Hot PHÉNIX spent fuel	Cycles 1 to 4	Processing
	Cycles 5, 6 and last core	Processing
EL4	CASCAD pit	CASCAD $\Rightarrow$ Deep geological repository
OSIRIS oxides	PÉGASE	CARES $\Rightarrow$ Deep geological repository
OSIRIS silicides	PÉGASE	Processing
	OSIRIS	Processing
UAI	*CABRI/SCARABÉE*	Processing
	SILOE, SILOETTE	
	ORPHÉE	
	ORPHÉE	
	ULYSSE	
Gas-cooled reactor – EL	PÉGASE	CASCAD $\Rightarrow$ Deep geological repository
	INB 72 (dykes 106 and 126)	CASCAD $\Rightarrow$ Deep geological repository
Experimental fuels	INB 72, INB 22 – PÉGASE, LAMA, LECI, LECA	CASCAD $\Rightarrow$ Deep geological disposal

Table 3 : Current technological solutions for CEA spent fuel

B.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 *Environmental 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).

B.4 - Applicable criteria for the definition and classification of radioactive waste

B.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 call for comments: the first deals with the time when a substance starts to be considered as radioactive, whereas the second concerns the status of a substance considered as a recoverable substance or a waste.

B.4.1.1 - Radioactive character of substances

In France, there is no single activity or concentration threshold for all radionuclides that would be used to justify whether a radioactivity control is warranted or not. Hence, in order to specify individual thresholds, it is appropriate not only to refer to the notions of exclusion, exemption and clearance, but also to examine the status of the substance at stake (substance or waste).

B.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. Materials are then considered as non-radioactive and managed as such.

B.4.1.1.2 - Exemption

With regard to activities involving radionuclides, radiation-protection controls are not necessary for any material to be used in limited quantities (typically less than 1 t) and whose specific activity in becquerels per gram and the total activity in becquerels are lower than those “exemption thresholds”, as defined in the *Public Health Code*. In addition, there are also accumulation rules and total-activity limits in order to ensure that, in case of significant accumulation of a large number of exempt sources, the activity is subject to licensing from a radiological standpoint. Exemption corresponds to the initial decision not to impose any radiation-protection control, when it is not necessary.

B.4.1.1.3 - Clearance

Another important notion is that of clearance, that is, the waiving of any regulatory form of regulation imposed on any material. There are different approaches to clear a material from any form of regulatory radiological control, according to each individual country. Some countries apply clearance levels expressed in terms of specific activity (becquerels per gram) or universal clearance levels (irrespective of the material involved, its origin or its destination). France has developed a different approach, according to which any material subject to the regulation of radiological uses (that is to say within the framework of a nuclear activity as defined in the regulations) is considered as radioactive from the moment it is likely to have come in contact with radioactive contamination or to have been activated by radiation. Since the French doctrine does not include any unconditional clearance of VLL waste based on universal thresholds, that waste is managed according to a specific treatment or disposal system in dedicated facilities.

The intentional addition of natural or man-made radionuclides in all consumer goods or building materials is prohibited by Article R. 1333-2 of the *Public Health Code*. However, derogations may be granted by the Minister in charge of health, after consultation with the Higher Council for Public Heath (*Haut conseil de santé publiqu*e – HCSP), except for foodstuffs and all materials coming in their contact, such as cosmetics, toys or jewellery. The Interministerial Order of 5 May 2000 specifies the content of the supporting documentation for all derogation applications and for the consumer-information modalities as prescribed by the *Public Health Code*. That prohibition system does not cover naturally-occurring radionuclides contained in the original components or in the additives used in the preparation of foodstuffs (as in the case of potassium 40 in milk) or in the fabrication of the constituting materials of consumer goods or building materials.

Currently speaking, there are no regulations with a view to limiting the natural radioactivity of building materials when it is naturally occurring in the components used for their fabrication.

As a complement, it was also decided to forbid the re-use outside the nuclear sector of all materials or waste generated by a nuclear activity, if they are contaminated or likely to be contaminated by radionuclides due to that activity.

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. That situation is likely to raise a consistency issue, notably in Europe. It is suggested that, instead of harmonising clearance thresholds, European countries harmonise first and foremost the objective to protect the population by reinforcing the clearance conditions for the materials originating from INBs. Certain measures, such as facility zoning (limits of contaminated or activated zones, see above), the availability of suitable disposal faculties for radioactive waste exceeding clearance thresholds, the traceability of operations, as well as the re-use of INB slightly-contaminated materials where radiological controls exist and where harmonisation may be contemplated in the future. Traceability represents a crucial issue, because it concerns not only the origin and characteristics of the materials, but also the final destination of the processed materials and the nature of the controls being conducted.

Any request to recycle VLL materials in the nuclear sector must be subject to a licensing procedure based on relevant documentation prepared by the prospective operator in order to describe his project in detail and showing how the risks are being controlled throughout the recycling chain. Every study must be conducted on a case-by-case basis in relation to several characteristics, such as the status of the operator in charge of recycling operations, process performance and the nature of re-use. Until now, few projects have been launched, but ASN considers that recycling options for materials must be reviewed in order to verify their technico-economic feasibility (see § F.6.3).

B.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 already intended or 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 16 April 2008, all owners of radioactive materials for which recovery processes have never been implemented have submitted to the government in late 2008 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).

B.4.1.2.1 - Spent fuel

Most spent fuel includes recoverable materials. More particularly, in the case of UOX fuel, the recovery of civilian uranium-bearing spent fuel is already widely 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 small quantities of certain types of spent fuel from research reactors, the feasibility of the process at an industrial scale for the fuel being unloaded from research reactors or nuclear-driven ships is confirmed.

B.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 potential future Generation-IV reactors that will provide a chance to draw the full energy potential of uranium by consuming uranium-238, which is currently non-recoverable, since the enrichment of depleted uranium allows only for the recovery of its uranium-235 content, but not of its uranium-238.

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 aleady scheduled or contemplated.

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

In cases where Generation-IV 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 *2006 Planning Act* concerning the programme for the sustainable management of radioactive materials and waste. With regard to plutonium, EDF feels that the overall quantity of mobilisable plutonium in 2040 (including in spent fuel and in the "last cores") should be in the order of 505 to 565 ***t***. 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.

B.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.

B.4.1.2.4 - Thorium

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.

B.4.1.2.5 - ASN's opinion

In the opinion it submitted to the relevant Ministers with regard to those studies (Opinion No. 009-AV-0075 of 25 August 2009), ASN considered that the experience feedback confirmed the recoverable character of the materials generated by the "uranium" system (depleted natural uranium and reprocessed uranium) and of the materials generated by the "plutonium" system under both the current energy conditions and in fast reactors. In addition, ASN feels that the recovery of thorium-bearing materials is still to be confirmed.

However, ASN has recommended that studies be complemented by a further analysis on the future of uranium after a potential second recycling (possibility of new waste recovery or processing). In addition, ASN has recommended that Rhodia, AREVA and the CEA study various management systems for reprocessed uranium (Urt), depleted uranium (Uapp) and thorium, if they ever were requalified as waste and secure appropriate funds for their long-term management.

B.4.1.2.6 - PNGMDR recommendations

In line with ASN's recommendations and reservations regarding recovery prospects, the 2010-12 PNGMDR includes the following recommendations:

- all French owners of recoverable radioactive materials shall, as a protective measure, conduct by the end of 2010 specific studies on potential management systems in case those materials qualified as waste in the future, and
- considering the strong reservations being expressed about the recovery potential of thorium over the short and medium terms, specific reflections should take place over the next few years regarding the timeliness and feasibility of a suitable mechanism to secure sufficient funds for the long-term management of thorium, incase that material ultimately qualified as waste.

B.4.2 - Classification of radioactive waste

B.4.2.1 - Criteria and categories

The various types of radioactive waste are classified according to the half-lives and radioactivity levels of the main radionuclides they contain, to their physical and chemical characteristics, as well as to their origins. With regard to half-lives, they are divided into very-short (less than 100 days), short (between 100 days and 31 years) and long (over 31 years).

In France, there are six major waste categories depending on their radioactive content (activity level and half-life), as follows:

- high-level (HL) waste consists mainly of vitrified-waste packages in the form of stainless-steel containers, which contain the vast majority of radionuclides, whether in the form of fission products or of minor actinides. Radionuclides contained in spent fuel are separated from plutonium and uranium during fuel reprocessing at the La Hague Plant. The activity level of vitrified waste lies in the order of several billions of becquerels per gram;
- intermediate-level long-lived (IL-LL) waste originates mostly from the reprocessing of spent fuel and consists of structural residues from nuclear fuel (i.e., hulls [sheath sections] and end-pieces, which were conditioned initially into cemented waste packages, but are now compacted into stainless-steel containers). It also includes technological waste (e.g., used tools, equipment, etc.) and residues resulting from the processing of effluents, such as bitumised sludges. The activity of those residues ranges between 1 million and

1 billion becquerels per gram. There is either no or negligible heat release;

- low-level long-lived (LL-LL) waste consists mainly of graphite and radium-bearing waste. The activity of graphite waste ranges between 10,000 Bq/g and a few hundreds of thousands of becquerels per gram. Its long-term activity lies essentially with long-lived beta-emitter radionuclides. Radium-bearing waste contains long-lived alpha-emitter radionuclides and their activity lies between a few tens to a few thousands of becquerels per gram;
- low-level and intermediate-level short-lived (LIL-SL) waste results mainly from the operation and dismantling of nuclear power plants, fuel-cycle facilities and research establishments, as well as, for a slight share, from activities relating to biological and academic studies. Most residues in that category were disposed of in a surface facility at the Centre de la Manche Disposal Facility (CSM) up to 1994 and are now disposed at Centre de l'Aube Disposal Facility for LIL Waste (CSFMA) since 1992;
- very-low-level (VLL) waste is mostly due to the operation, maintenance and dismantling of NPPs, fuel-cycle facilities and research establishments. Its activity level is generally lower than 100 Bq/g. All residues of that category are disposed of at the Centre de l'Aube Disposal Facility for VLL Waste (CSTFA), and
- very-short-lived waste includes residues that result notably from medical uses.

For practical purposes, the following acronyms are often used:

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

Note: There is currently no acronym for "very-short-lived waste".

Table 4 : Acronyms used for the different waste categories

Table 4 presents the advances made with regard to long-term management solutions for each waste category. For some categories, the corresponding long-term management solution is still under study: that issue is addressed in the PNGMDR and specific objectives have been prescribed by the *2006 Planning Act*.

<table>
<tr><th>Half-life
Activity</th><th>Very short half-life
(< 100 days)</th><th>Short half-life
(≤31 years)</th><th>Long half-life
(> 31 years)</th></tr>
<tr><td>Very-low level waste (VLL)</td><td rowspan="3">Management by radioactive decay</td><td colspan="2">Surface disposal (CSTFA)
Recycling systems</td></tr>
<tr><td>Low level (LL)</td><td rowspan="2">Surface disposal (CSFMA) except for tritiated waste
and certain sealed sources</td><td>Dedicated shallow disposal facilities under study pursuant to Article 3 of the 2006 Planning Act.</td></tr>
<tr><td>Intermediate level (IL)</td><td>Systems under study pursuant to Article 3 of the 2006 Planning Act.</td></tr>
<tr><td>High level (HL)</td><td>N/A*</td><td colspan="2">Systems under study pursuant to Article 3
of the 2006 Planning Act.</td></tr>
</table>

Table 5 : Status of long-term management solutions for each waste category

B.4.2.2 - Absence of single and simple classification criterion

There is no simple and single criterion to classify radioactive waste. There is no overall activity level, for instance, to determine if a given residue belongs to the LIL-SL waste category. As a matter of fact, it is necessary to examine the radioactivity of the different radionuclides present in the waste in order to rank it according to the classification. More particularly, in order to be considered as LIL-SL waste, the specific activity of each radionuclide in the waste must be lower than the prescribed thresholds in the CSFMA's waste-acceptance specifications. In that category, the activity of long-lived radionuclides is particularly limited.

However, failing the existence of a single criterion, it is possible to indicate a range of specific activities within which each waste category generally belongs.

It may occur that a specific waste pertaining to one of the above-mentioned categories is not acceptable within the corresponding management system due to other chemical, physical, or other characteristics. Such is the case of residues containing significant quantities of tritium (a radionuclide that is difficult to confine) or of sealed sources.

A special case also concerns the waste generated by uranium-enrichment facilities and fabrication plants of nuclear fuel containing uranium oxide. Those residues contain a small quantity of uranium and are compatible with the acceptance criteria of the CSFMA or, if their activity is very low, with those of the CSTFA. In the first case, the waste is disposed of at the CSTFA and, by convention, registered as LIL-SL waste, notably in the National Inventory. In the second case, the waste is disposed of at the CSTFA and included in the VLL waste category.

B.5 - RADIOACTIVE WASTE MANAGEMENT POLICY

B.5.1 - General framework

Radioactive-waste management is part of the general framework set forth in *Law No. 75-633 of 15 July 1975 Concerning Waste Elimination and Material Recovery* (Article L. 541 of the *Environmental 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 legal framework constituted by two acts and their implementation instruments as follows: the *1991 Law* and the *2006 Planning Act* (see § A.2 and B.1).

B.5.2 - Conventional waste, radioactive waste and VLL waste

B.5.2.1 - Conventional and radioactive waste in INBs

INBs generate two types of waste: radioactive and non-radioactive residues. Managing the radioactive waste produced by INBs rests on a strict regulatory framework detailed in the *Order of 31 December 1999 Concerning General Technical Requirements to Prevent and Limit External Nuisances and Risks Arising from the Operation of INBs,* as follows:

- the preparation of waste surveys for each nuclear site according to the approach already being used for some "classified facilities on environmental-protection grounds" (*installation classée pour la protection de l'environnement* – ICPE); the waste survey, which must lead to a status report from it about waste management on a specific site, shall distinguish notably between a clearly-defined and separate "waste zoning[1]" covering the areas of the facility where the waste is likely to have been contaminated with radioactive materials or activated by radiation, and zones in which the waste may not contain any added radioactivity. The survey must be approved by ASN;
- for each type of waste (see definition, § B.4.2), the development of adapted and duly approved long-term management systems based on impact assessments and covered by public information or consultation, and
- the implementation of waste follow-up systems in order to ensure the traceability of the waste.

The purpose of the waste-survey mechanism is to improve the overall waste-management process, especially in terms of transparency, and to develop optimised management systems.

The above-mentioned measures shall be reiterated in the future INB order being prepared.

1. "Waste zoning" divides facilities into zones generating nuclear (or radioactive) waste and zones generating conventional waste. It takes into account the design and the history of the operation and it is confirmed by radiological monitoring.

The traceability system for radioactive and non-radioactive waste is set forth in *Decree No. 2005-635 of 30 May 2005 Concerning the Control of Waste Treatment Circuits.* The *Order of 30 October 2006* taken in application of that decree deals more specifically with the radioactive waste generated by INBs (nuclear processing, storage or other purposes) or other establishments (research, medicine, etc.) and shipped to ICPEs.

B.5.2.2 - Waste with enhanced naturally-occurring radioactivity

B.5.2.2.1 - Nature of waste and current management

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. They come from various origins and constitute significant volumes. They are also long-lived. 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. Since production residues may therefore include natural radioactivity in a concentrated form, the situation may raise some concerns with respect to radiation protection.

In June 2009 ; pursuant to Article 12 of the Decree of 16 April 2008 specifying the prescriptions for the PNGMDR, ASN submitted to the Ministers for Health and the Environment a status report on the management of waste with enhanced naturally-occurring radioactivity. In order to prepare that report, ASN based itself on two studies written by an association.

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

- *VLL-LL waste* constituting large volumes of waste enhanced naturally-occurring radioactivity, such as historical stockpiles of phosphogypsum and coal-ash , 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.

In addition, certain town-planning activities sometimes have required in the past the use of backfill material originating from conventional industries, but having a low radiological activity.

Uncertainties subsist regarding both the volume of generated waste and the radiological activity of certain waste. In fact, the activity sectors involved are much diversified in nature and the number of industrialists is huge. Data are not always available and the quality of collected data varies significantly in quality, thus complicating the preparation of a comprehensive inventory.

Some of the activities that generated waste with enhanced naturally-occurring radioactivity whose specific mass was the highest have already stopped. Only very few companies continue to produce them. Nevertheless, a certain number of processes cause the production of tartar with a potential activity level of several tens of becquerels per gram (Bq/g) as low-level waste.

VLL waste with enhanced naturally-occurring radioactivity is managed in accordance with one of the following methods:

- in disposal facilities for hazardous, non-hazardous or inert waste, or
- in ANDRA's CSTFA facility, or
- in an internal dump.

In the past, ash and phosphogypsum stockpiles were implemented in the case of VLL waste with enhanced naturally-occurring radioactivity. In general, every stockpile represents at least several hundreds of thousands of tonnes. Certain ash stockpiles are being taken over with a view to recovering them in the public-work sector. A few stockpiles have already been rehabilitated or will be. Only a few ash and phosphogypsum stockpiles are monitored. Nevertheless, such monitoring only involves chemical parameters.

In general, *VLL waste with enhanced naturally-occurring radioactivity* is stored on operators' premises, since there is currently no operational elimination system. In the past, a few thousands of tonnes of waste with enhanced naturally-occurring radioactivity were sent to disposal facilities for hazardous and non-hazardous waste (conventional disposal facilities).

Those activities were conducted in order to verify the acceptability of the disposal of waste with enhanced naturally-occurring radioactivity at delivery time in conventional disposable facilities. They led to the preparation of a circular issued by the Ministry of Ecology on 25 July 2006 and of a methodology guide by the IRSN for the acceptance of waste with naturally-occurring radioactivity in conventional disposal facilities.

B.5.2.2.2 - ASN recommendations

In the above-mentioned status report that ASN submitted to the Ministers, it published several recommendations, as follows:

- the inventory of the waste with enhanced naturally-occurring radioactivity should be completed;
- the traceability of the waste with enhanced naturally-occurring radioactivity should be enhanced;
- the absence of environmental impact on historical disposal facilities for waste with enhanced naturally-occurring radioactivity should be verified and appropriate environmental-monitoring programmes should be implemented, if need be, and

- various actions should be conducted in order to consolidate the current elimination systems for waste with enhanced naturally-occurring radioactivity.

In addition, specific measures require to be implemented in order to secure sufficient funds for the management of waste with enhanced naturally-occurring radioactivity, as need be.

Measures have already been taken by the Ministry of Ecology for

- an “environmental zero point” to be instituted around ash and phosphogypsum stockpiles in order to ensure that they do not induce any environmental impact;
- an initial work launched in accordance with the 25 July 2006 Circular concerning the acceptance of waste with enhanced naturally-occurring radioactivity in waste-disposal facilities in order to specify any complementary actions, as need be.

Lastly, it should be noted that ANDRA is studying the possibility to create a storage facility for LL-LL waste by the end of 2012.

B.5.2.3 - Disposal of radioactive waste in conventional disposal facilities

In the past, radioactive waste consisting mostly of sludges, 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 geographical inventory of radioactive waste published by ANDRA includes 11 disposal sites having received radioactive waste 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 Pontailler-sur-Saône and Monteux Dumps that accommodated the waste resulting from the sewage sludges 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 groundwaters, as in the case of the Vif and Monteux Dumps.

B.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, decommissioning / declassification, 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.

B.5.4 - Unsealed sources and radioactive waste from ICPEs

All radioactive waste originating form ICPEs or regulated facilities by the *Public Health Code* will also be eliminated in dedicated facilities .

All 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. From now on, those facilities are classified according to the nature of the waste they receive and to the hazards and inconvenience they involve, contrary to what used to be formerly the case when it was based on the facility from which originated the waste (Decree No. 2010-369 of 13 April 2010)

In general, the amount of radioactive materials in ICPEs is far lower than in INBs. However, the contamination risk of materials and waste is always present. ICPE waste may only be disposed of in duly licensed facilities, on the basis of an impact assessment taking into account all toxicity factors of the waste being handled. Current regulations prohibit the presence of radioactive waste (except some waste with enhanced natural radioactivity detailed in § B.5.2.3) in conventional industrial storage facilities for hazardous waste, and radioactive waste may only be disposed of in dedicated facilities.

For ICPEs, there are standard general provisions that the departmental authority may modify according to the toxicity of the radionuclides used in the facility.

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.

B.5.5 - Stakeholders's responsibilities

Article L. 542-1 of the *Environmental 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". Hence, the producer of any radioactive waste is responsible for it until its final elimination in a licensed facility for that purpose. 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.

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 INB 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 § H.1.2.3 for LIL-SL waste and in § B.6.1.3.4 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.

B.5.6 - Role of ANDRA

In accordance with Article 14 of the *2006 Planning Act* (as consolidated in Article L. 542-12 of the *Environmental Code*), ANDRA is entrusted with the responsibility to fulfil all operations involved in the long-term management of radioactive waste, and notably:

- to establish, to update every three years and to publish the national inventory and location of all radioactive materials and waste throughout France, together with the waste referred to in Article L. 542-2-1 listed by country; the next inventory will be published in 2012;
- to initiate or to have initiated, in accordance with the national plan referred to in Article L. 542-2-2, investigations and studies on storage and deep geological disposal, as well as to ensure their co-ordination;
- to contribute to the assessment of accruing costs for the implementation of long-term management solutions for high-level and intermediate-level long-lived waste, according to their nature;
- to forecast, with due account of nuclear-safety rules, the disposal specifications for radioactive waste and to provide competent administrative authorities with an opinion on waste-conditioning specifications;
- to design, to implement and to manage radioactive-waste storage or disposal facilities, with due account of the long-term prospects for the production and management of those residues, and to carry out all required studies for those purposes;
- to ensure the collection, transport and take-over of radioactive waste, as well as the rehabilitation of sites contaminated with radioactive waste upon the request and at the cost of the responsible entities for those sites or waste, or upon public request if responsible entities are defaulting;
- to make available to the members of the public relevant information pertaining to radioactive waste management and to participate in the dissemination of the scientific and technological culture in that field, and
- to spread its know-how abroad.

ANDRA is a public industrial and commercial establishment (*établissement public à caractère industriel et commercial* – EPIC) and has the necessary resources for performing the various tasks mentioned above, under the triple supervision of the Ministries for Energy, Research and the Environment.

Through its expertise and skills, ANDRA supports the governmental policy. In that role, it drafts proposals for all issues concerning long-term radioactive-waste management and credible management solutions for each radioactive-waste category.

By conducting investigations in accordance with the 2006 *Planning Act* and the PNGMDR, ANDRA runs the R&D Programme for the construction of a deep geological waste repository to be commissioned in 2025. That programme relies on the work achieved at the underground research laboratory straddling the Meuse and Haute-Marne Districts.

Moreover, in accordance with one of the PNGMDR recommendations, ANDRA is conducting several studies on different management options for graphite and radium-bearing waste by studying notably various possibilities to handle them separately and by pursuing discussions with the authorities of the relevant territories where some communes had submitted their applications to host such a facility.

Those different projects require the reinforcement of partnerships with the other actors in the fields of research and technology, and notably the enforcement of a scientific-exchange policy. ANDRA shall be responsible for the integration of that knowledge in its own projects in accordance with the terms of the contracts it has signed with its scientific and technical partners.

B.5.7 - ASN policy

On behalf of the State, ASN is responsible for controlling the safety of INBs and the radiation protection of all nuclear facilities and activities in order to protect workers, patients, the public and the environment against all hazards associated with nuclear activities.

ASN prepares drafts of regulatory decrees and of ministerial orders for the government and clarifies regulations through various technical Resolutions. It delivers some individual licences and proposes others to the government. It controls compliance with general rules, specific nuclear-safety requirements for INBs and radiation-protection requirements for all nuclear facilities and activities. It also participates in public information programmes and is involved in the management of radiological emergency situations.

In the field of radioactive waste, ASN's policy is to ensure the existence of safe management systems for every category of radioactive materials and waste (which implies identifying the foreseeable requirements of storage or disposal facilities) and determining the actions to be implemented in order for the management of radioactive materials and waste to improve in a consistent and structured fashion.

ASN controls directly ANDRA's overall organisation for the design and operation of disposal facilities, and of the acceptance criteria for the waste sent by producers to those facilities. It also provides an opinion on the waste-management policy and practices being enforced within the overall nuclear activities.

ASN is concerned with three main issues, as follows:

- the safety of each radioactive-waste management step (waste production, treatment, conditioning, storage, transport and elimination);
- the safety of the overall radioactive-waste management strategy, by ensuring its overall consistency, and
- the development of suitable management systems for each waste category, with due account that any delay in the search for waste-elimination solutions multiply the volume and size of on-site storage.

The ASN policy also aims at ensuring that all INB operators and waste producers assume their respective responsibilities with regard to radioactive-waste management.

B.6 - RADIOACTIVE-WASTE MANAGEMENT PRACTICES

B.6.1 - Radioactive waste originating from INBs

B.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, liquid sludges, pre-filters, absolute filters and iodine traps, and
- technological waste arising from maintenance activities. It may be solid (rags, paper, cardboard, vinyl sheets or bags, wood or metal pieces, rubble, gloves, protective clothing, etc.) or liquid (oils, solvents, decontamination effluents, including chemical cleaning solutions).

Tables 6 and 7 show the annual distribution of waste arising from the operation of EDF nuclear reactors in 2010. Data are expressed in the volume of conditioned packages that are intended for disposal at the CSTFA (1) or CSFMA facility, directly or after processing at the CTO (2). Those masses or volumes of packages represent the output in 2010; most packages had been shipped, but some of them were still on the sites at the end of the year.

VLL waste disposed of at the CSTFA

2010 results (58 PWRs)	Disposal facility	Mass of disposed waste (t)	Activity (TBq)
Process waste Technological waste	CSTFA CSTFA	480 1,020	0.001 0.003
Total		1,500	0.004

Table 6 : Volume and activity of nuclear operational waste produced by EDF in 2010 and disposed of at the CSTFA

Note: Values given in § B.6.4 represent the quantities that have actually been shipped to the disposal facility in 2010. More particularly, over 200 t of VLL sludges originated from the 1999 storm on he Blayais NPP site and were removed in 2010.

Disposal of LIL waste at the CSFMA

2010 results *(58 PWRs)*	Routes	Gross volume before conditioning *(m³)*	Volume of disposed packages at CSFMA *(m³)*	Activity *(TBq)*
Process waste Technological waste	CSFMA/ CENTRACO CSFMA/CENTRACO	1,165 8,540	2,790 2,280	117 5
	Total	9,705	5 ,070	122

(*) CTO (Centraco): Processing and Conditioning Plant (Centre de traitement et de conditionnement) *operated by SOCODEI (EDF subsidiary).*

Table 7 : Volume and activity of nuclear operational waste produced by EDF in 2010 and disposed of at the CSFMA

Note: Table 7 does not include the chemical-cleaning effluents from the steam generators that are also incinerated at the CENTRACO Plant. Close to 2,000 t of effluents were produced in 2010.

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 CSFMA press for further compaction and final disposal after concrete encapsulation in 450-L metal drums. Certain non-compactable technological waste is conditioned in 5-m3 metal boxes. Lastly, the most radioactive technological waste is conditioned on site in concrete containers and disposed of directly in the same disposal facility, or
- if combustible LL waste is involved, shipped in metal or plastic drums plastique to the CENTRACO Incineration Unit, whereas LL-contaminated scrap is sent to the melting unit of the same plant in 2-, 4- and 8-m3 metal drums or 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 CSFMA, and
  - 200-L ingots (melting residues), which are disposed of at the CSFMA, or at the CSTFA, if their activity level warrants it. Similarly, ventilation filters for the treatment of gases and smoke, stags and refractories, which are renewed periodically, are disposed of the CSFMA or at the CSTFA.

CENTRACO's low-level-waste processing and conditioning plant, located in Codolet, near the Marcoule Site in the Gard département, and operated by SOCODEI, 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.

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

For the final 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 CSFMA. A concrete container reinforced with a leak-tight steel liner ensures the biological protection of the packages. 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 CSFMA.

Over the last 25 years, significant advances have been made by nuclear reactors that produce mostly LIL-SL waste (it should be noted that spent fuel is not waste). 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 m³/TWh(e) in 1985 to slightly more than 10 m³/TWh(e) today. That latter value (2010) corresponds to an average production of about 87 m³ of packages intended for the CSFMA per PWR unit for a net energy output pf 408 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, and the current individual contributions of both sources are almost identical.

It is important to stress that the reduction in 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 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 performance of each EDF site in service.

B.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;
- conditioning directly disposal packages and primary packages of VL/LL and IL-LL waste, an
- implementing those actions under the best possible nuclear-safety, radiation-protection and technico-economic conditions.

B.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, to condition residual effluents and to control discharges into the environment pursuant to the discharge licence of each site.

At Cadarache, beta/gamma-emitting effluents are treated by evaporation. Concentrates are embedded in a cement matrix for storage at CSFMA until the end of 2011, after which they will be taken over by the new AGATE (INB-171) facility for evaporation purposes and elimination of the concentrated effluents at the Effluent Treatment Station (*Station de traitement des effluents* – STE) in Marcoule.

At Marcoule, alpha and beta/gamma-emitting effluents are treated by evaporation and/or precipitation-filtering; resulting sludges are embedded in bitumen matrices to form packages intended either for disposal at the CSFMA or for storage pending final disposal. Bitumisation will be replaced by cementation in 2015.

In Saclay, starting in 2011, a new facility called STELLA, will replace the former facility and be used to treat beta-gamma effluents by evaporation, whereas concentrates will be embedded in a cement matrix for disposal purposes at the CSFMA.

B.6.1.2.2 - Solid radioactive waste

Since the end of 2003, all VLL waste produced by the CEA has been sent to ANDRA's CSTFA. Since that date, the CEA has been evacuating between 10,000 and 15,000 t of VLL waste every year.

Solid LIL-SL waste is either:

- incinerated at the CENTRACO facility, or
- compacted at Cadarache, Saclay and Marcoule facilities, or
- transferred untreated to the CSFMA for 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 CSFMA or stored at Cadarache, pending a final solution.

The CEA has more than 20 waste-acceptance certificates for those waste packages at CSFMA, thus allowing it to dispose currently of about 4,300 m³ /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 will be taken over as soon as ANDRA commissions the new facility for:

- 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 temporarily stored at Saclay and Cadarache, mainly on behalf of ANDRA and Rodhia–Rare Earths.

For IL-LL waste, the CEA already planned in 1994 to replace the older design of the existing dedicated storage facility in Cadarache (INB 56), which is close to saturation, by the CEDRA Project for the conditioning and storage of radioactive waste (*Projet de conditionnement et d'entreposage de déchets radioactifs*) pending the commissioning of the geological repository (*Centre industriel de stockage géologique* – CIGEO). The CEDRA facility (INB 164) was commissioned in April 2006. In addition, a storage facility for highly-radiating waste will be constructed on the Marcoule Site by 2016.

Since 2005, the CEA has taken over the management of storage facilities on the Marcoule Site that used to be managed by AREVA and, more particularly, the Multi-purpose Temporary Storage Facility (*Entreposage intermédiaire polyvalent* – EIP) where LL-LL and IL-LL bitumised packages resulting from the operation of the UP1 Plant are stored.

The other waste categories produced by the CEA (specific waste) are also addressed in studies or measures with a view to eliminating them, and include the following:

- tritiated waste (see § B 1.4.3. and H.2.3.5);
- 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 2013, 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 CSFMA or CSTFA, and
- contaminated metal waste, such as lead and mercury, for which decontamination processes are available and have been used at Saclay and Marcoule (lead fusion and mercury distillation). Possible options include lead recycling in the nuclear sector and final disposal by ANDRA (after physical and chemical stabilisation in the case of mercury).

Achieving the optimal technical and economic performance in waste management implies:

- a network of service facilities and a packaging fleet, and
- a full range of waste packages consistent with CEA specifications for waste characteristics and ANDRA waste-acceptance criteria in its facilities for final disposal.

In that context, the CEA's policy consists in selecting suitable conditioning processes that ensure the safe storage of packages on its own sites and that are readily acceptable by ANDRA. It is with that goal in mind that the CEA plays an active role in discussions relating to ANDRA's various projects.

B.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 limitating notably the quantity of stored waste. In 2010, 83% of AREVA's operating waste were handled (disposal or recovery).

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 is about 5% of the national inventory, representing a total of approximately 85,000 m^3.

Those residues consist mainly of historical waste from the previous generation of treatment plants that were in operation from the 1960s to the 1980s. The waste 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 vitrifies* – CSD-V) (except for 250 m^3 of UMo solutions (uranium-molybdenum), which will be treated in a cold crucible within the next few years). However, most old IL waste still needs to be recovered and/or packaged. Large-scale programmes are under way to achieve that goal. HL-LL dismantling waste must also be considered, since it will represent a few thousands of cubic metres after packaging.

All waste resulting from the treatment of the fuel owned by foreign customers shall be returned to them as soon as technical conditions allow it in accordance with the *2006 Planning Act*. 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. Today, 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.

B.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.

B.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) 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.

B.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 sludges 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-reprocessing workshops, whereas concentrates are vitrified.

Retrieval and packaging operations regarding "historical" sludges, especially those from the seven STE2 silos now require to be launched. Conditioning modalities are currently under study. Discussions about waste shipments to foreign AREVA customers are under way between those customers and relevant authorities with a view to using bitumen drums or other packagings yet to be designed.

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 CSFMA.

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) has replaced the former facility and was commissioned in 2008.

SOMANU and AREVA NC at 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.

B.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. Once confirmation is given that they meet ANDRA's technical specifications for surface disposal, packages are sent to the CSFMA; otherwise, they 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. Most of the waste includes VLL residues (80%), whereas the rest consists of low-level residues.

COMURHEX Malvési

Compactable waste is shipped to Pierrelatte and managed the same way as those resulting from the Pierrelatte platform. Packaging waste (drums) and packagings 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 group's facilities are subject to an assessment of its radiological activity during management.

B.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^3/t of fuel processed, to less than 0.5 m^3 at present.

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

Industrial, research and medical activities involve a very large number of sites.

B.6.2.1 - Applicable provisions

The general provisions for managing contaminated waste and effluents with regard to the nuclear activities referred to in Article R. 1333-12 of the *Public Health Code*[2] are based on the Order of 23 July 2008 validating ASN's Resolution No. 2008-DC-0095. That Resolution is accompanied by a explanatory guide describing sound practices for managing effluents and waste. The guide may be downloaded from ASN's website: www.asn.fr

That regulatory text provides all technical rules to fulfil when eliminating contaminated effluents and waste. Those provisions now have a statutory status and have therefore become opposable.

In practice, a distinction must be made between the following cases:

- all waste containing radionuclides with a shorter half-life than 100 days, otherwise known as "very-short-lived waste", that are managed on site through radioactive decay, before being eliminated in conventional waste systems ;
- all waste containing radionuclides with a longer half-life than 100 days, otherwise known as "short-lived waste", that shall be eliminated in accordance with management systems for radioactive waste. That waste is then taken over by ANDRA under its public-service mission. Management systems include notably incineration at CENTRACO (incinerable solid or liquid waste, metal waste with low activity levels). Certain solid waste may be disposed of at the CSTFA, with due account of their characteristics;
- all liquid effluents containing radionuclides with a shorter half-life than 100 days, otherwise know as "very-short-lived waste", that are managed through radioactive decay, may be released in the environment under identical conditions to non-radioactive effluents after decay ;
- all liquid effluents containing radionuclides with a longer half-life than 100 days, otherwise known as "short-lived waste", whose release shall be licensed by ASN on the basis of an environmental impact statement and with ASN providing for the conditions of such releases.

The overall modalities for managing the contaminated waste and effluents of any facility must be described in a management plan for contaminated waste and effluents detailing the sorting, conditioning, storage, control and elimination modalities for such waste and effluents produced by the relevant facility (see § B.6.2.4.3).

---

[2] *All authorised and declared nuclear activities are concerned, except for those that are performed in the following facilities:*

- *INBs;*
- *defence-related activities and facilities, and*
- *facilities that are submitted to licensing in accordance with Article 83 of the* Mining Code.

B

B.6.2.2 - Industrial activities outside the nuclear sector

The waste originating from industrial activities outside the nuclear sector originates from the following:

- the fabrication of sealed and unsealed radioactive sources, together with their past or current uses. There are no more sealed-source manufacturers in France, but the number of users is very large in nuclear and non-nuclear industries (measurements, controls, molecule detection, industrial irradiation). The management of sealed sources is addressed in Section J, and
- non-nuclear industries relating to the chemistry, metallurgy or energy-generation sectors in which mineral raw materials, involving naturally-occurring radioactivity, are handled, even though their purpose is not to use that radioactivity.

B.6.2.3 - Research activities, except for CEA centres

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

- establishments for biological research;
- physics laboratories, and
- academic research establishments.

The production of radioactive waste is small in comparison to the nuclear 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).

Those research activities call upon sealed and unsealed radioactive sources. The management of disused sources is addressed in Section J.

In the field of biological research, the most frequently used radionuclides are VSL, SL (tritium) or long-lived (carbon-14). They often appear in the form of unsealed sources.

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.

Organic waste with activities too high to be incinerated at CENTRACO is currently under investigation in order to be accommodated in disposal facilities that are already in operation or under study.

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 the responsibility of the relevant laboratories. Most of the generated waste consists of LIL-SL and VLL residues, which are disposed of in the matching disposal facilities.

With regard to 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, low reactivity, etc.). The residues generated by universities are quite similar to those produced by biological, medical and biomedical research. They may involve biological or chemical hazards.

B.6.2.4 - Management and elimination of radioactive effluents resulting from activities in biomedical research and nuclear medicine

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

All solid contaminated waste is sorted 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

In medical-biology laboratories (diagnosis or *in-vitro* research), whether integrated or not in nuclear-medicine services, the half-life of most radionuclides in use, such as cobalt-57, tritium and carbon-14, exceeds 100 days.

Waste is collected and managed by ANDRA.

B.6.2.4.1 - Management of contaminated liquid effluents3

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

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.

[3] Gaseous effluents are not commented in this article.

B.6.2.4.2 - Management plan for contaminated waste and effluents

The overall modalities for managing contaminated waste and effluents originating from a nuclear-medicine service, and more generally from an establishment, are described in the "Management Plan for Contaminated Waste and Effluents".

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.

That Resolution must be accompanied by an explanatory guide describing relevant practices for the sound management of effluents and waste. That guide is available on ASN's website: www.asn.fr

B.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. In order to pursue with even more determination the action of the operators responsible for managing those sites and of public authorities, the Minister of Ecology and Sustainable Development, 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).

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), led by the IRSN in connection with the General Directorate for Risk Control (*Direction générale de la prevention des risques* – DGPR) and ASN, was launched in 2003 in order to collect historical data on all uranium-mining sites in France (from simple research sites to operational mining sites) 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. Since the end of 2008, the database is also accessible on line on the following website: http://mimausa.irsn.fr

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. Most of the GEP's recommendations require to be integrated as attention and vigilance criteria and as progress and improvement areas to be taken into account by all actors and in line with committed actions in that regard.

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 2008 in that framework constitute notably a significant improvement for the guaranteed safety of those disposal facilities. In August 2009, ASN issued an opinion on those studies. While considering that the status report prepared by AREVA on disposal facilities for mine tailings on nine of the 17 existing sites represent a key milestone in the safety-verification approach of those disposal facilities, ASN also formulated recommendations in several fields (long-term evolution and modelling of the physico-chemical characteristics of tailings resulting from ore processing, dyke behaviour, cover reinforcement of tailing-disposal facilities, impact assessment of mine dumps). The actions to be performed were largely repeated in the 2010-12 PNGMDR.

B.6.4 - Waste management by ANDRA

ANDRA operates three disposal facilities, two of which for LIL-SL waste: the CSM, which is currently into its post-closure monitoring phase (see § D.3.3.1), and the CSFMA, which is still in operation. The CSTFA is the third facility; it is located in Morvilliers and deals with VLL waste. The basic principle of those facilities 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. In those facilities, ANDRA also proceeds with additional conditioning operations for part of the delivered waste, notably through compacting before emplacing permanently the waste packages into disposal structures.

B

	Deliveries to CSFMA (m³)	Deliveries to CSTFA (m³)
EDF	6,900	4,900
AREVA NC	1,500	10,800
CEA	4,500	16,500
Miscellaneous	100	1,100

Table 8 : Waste deliveries at the CSFMA and CSTFA in 2010 (including decommissioning waste)

ANDRA is also involved in the collection of the waste generated outside the nuclear-power sector, such as small and medium-size industries, research laboratories, universities, hospitals, etc. For those "small producers", a removal guide was prepared to describe the take-over protocol of the residues for which ANDRA has various elimination or disposal systems at the CSFMA. Residues are first collected, and then grouped at the SOCATRI INB, as ANDRA's subcontractor, for sorting them and reconditioning them, after which they are processed either through incineration at the CENTRACO Plant at Codolet, or through compacting or injection in boxes at the CSFMA. Collecting those residues represent 3,000 to 4,000 packages every year from about 300 producers disseminated throughout France. The total number of producers in ANDRA's customer base amounts to about 700.

For small producers' waste categories pending an operational disposal solution, ANDRA is investigating various storage systems. It calls upon CEA facilities for orphan sealed sources and radium-bearing lightning conductors. ANDRA also uses some SOCATRI storage areas to store americium-bearing lightning conductors and the radium-bearing waste generated by small producers or resulting from the cleanup of polluted sites.

In order to improve its autonomy in relation to its needs, ANDRA has decided to equip itself with its own storage capacities. It has undertaken to implement a facility capable of accommodating not only LL-LL waste (mostly radium-bearing waste) resulting from its collection or site-cleanup activities, but also sealed sources and lightning conductors toward the end of 2012. That facility will be located within the CSTFA perimeter.

Section C : SCOPE (Article 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 reprocessing facilities as part of a reprocessing activity is not covered in the scope of this Convention unless the Contracting Party declares reprocessing 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.*

C.1 - Status of spent-fuel reprocessing 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 reprocessing in the scope of the Convention.*
>
> *They declare that they shall report, within the context of the Convention, on reprocessing as part of spent fuel management.*
>
> *The United Kingdom, Japan and France invite all other countries that undertake reprocessing 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 reprocessing 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*.

C.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.

C.3 - OTHER SPENT FUEL AND RADIOACTIVE WASTE TREATED WITHIN CIVILIAN PROGRAMMES

All 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 secret facilities. ASN also double-checks their quality after ANDRA in order to verify notably that the implemented procedures at waste producers's 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 Delegate for the Nuclear Safety of National Defence Activities and Facilities – (*Délégué à la sûreté nucléaire et à la radioprotection pour les activités et installations intéressant la défense* – DSND).

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.

C.4 - EFFLUENT DISCHARGES

Effluent discharges are addressed in § F.4.

Section D : INVENTORIES AND LISTS (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).

D.1 - SPENT-FUEL MANAGEMENT FACILITIES

D.1.1 - Spent-fuel generating facilities

In France, most spent fuel is produced by 58 PWRs ranging from 900 to 1,450 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 reprocessing (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.

D.1.2 - Spent-fuel storage or reprocessing facilities

Some INBs 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.

D.1.2.1 - AREVA facilities

D.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 INBs* 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. Capacity may also be expressed technically in terms of terawatthour output of the treated fuel, with due account of technical limitations depending on burnup. In that case, capacity lies between 400 and 450 TWh/a.

Historically speaking, AREVA's Belgian, Dutch and French (EDF) customers have practiced uranium recycling, which accounts for about a third of EDF streams and for all Belgian and Dutch streams. With the recent steep increase in the price of uranium, energy considerations are now notably coupled with those of economy, so much so that all AREVA customers have expressed the desire to recycle the uranium streams derived from spent fuel (EDF, for the remaining two-thirds, Japanese electric utilities, etc.).

Consequently, AREVA introduced a new project on reprocessed uranium (*uranium issu du retraitement* – URT) involving fuel conversion, enrichment and fabrication. By the end of 2010, the accumulated quantity of URT recycled or shipped back by AREVA to its customers amounted to 9,900 t compared to 31,406 separated tonnes. Trends show that such figure is bound to increase.

D.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.

Decree *No. 2003-31* prescribes the following storage capacities for the La Hague installations:

- Pool C: 4,800 t:; Pool D: 4,600 t; Pool E: 6,200 t,and NPH pool: 2,000 t, for a total of 17,600 t.
- CSD-V on 31 December 2010: the total storage capacity CSD-V packages amounted to 12 420 packages, but the EV/SE building extension planned for 2012 will provide an additional capacity for 4,212 packages.

D.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 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 (INBS) and is continuing. Spent fuel from the CEA is also stored at Saclay's INB-72 pending disposal.

D.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	9,539
EDF NPP sites	4,183
CEA centres	120

Table 9 : Mass of French spent fuel stored in France at the end of 2010

Origin	Australia	Belgium
Mass	131 kg	170 kg

France	Italy	Switzerland
9,538 t	0,1 t	0,1 t

Table 10 : Origin of the spent fuel stored on the La Hague Site and corresponding quantities at the end of 2010

D.3 - RADIOACTIVE-WASTE MANAGEMENT FACILITIES

Most of the spent-fuel management facilities listed in § L.1 also generate radioactive waste. That is particularly the case of spent-fuel treatment plants. The inventory of other waste-management facilities is listed in § L.2.

D.3.1 - Facilities generating radioactive waste

D.3.1.1 - INBs in service

Radioactive waste is generated in all operating INBs, with spent-fuel management facilities being listed in § L.1 and other waste-generating INBs (shut-down reactors, laboratories, plants and storage buildings) being listed in § L.2.1.

D.3.1.2 - INBs undergoing dismantling

Radioactive waste is also produced in INBs being dismantled (shut-down reactors, laboratories and plants), the list of which appears in § L.3.

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

As mentioned earlier, France has licensed about 800 ICPEs due to the radioactive substances they hold and use. 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) or health establishments (hospitals, clinics, etc.).

D.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 ICPEs nearing shutdown, Article L512-17 of the *Environmental Code* requires that the site be rehabilitated.

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 June 2009 (available on ANDRA's website: *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*) 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

If the responsible party is defaulting, the cleanup of polluted sites must be ensured under ANDRA's public-interest mission as described in the *2006 Planning Act* and consolidated in Article L. 542-12 of the *Environmental Code.*

In any case, the cleanup objectives must be validated by ASN and the fulfilment of the site-cleanup objectives must be assessed after decontamination.

D.3.2 - Radioactive-waste treatment facilities

Radioactive-waste reprocessing facilities are divided into two categories: treatment facilities and storage facilities.

All treatment facilities operated by the CEA, AREVA, EDF or SOCODEI are listed in § L.2.2.

All storage and disposal facilities operated by ANDRA, the CEA, AREVA, EDF or SOCODEI are also listed in § L.2.2.

D.3.3 - Waste storage facilities

D.3.3.1 - *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, where plans call for an extension in 2012.

	Current capacities		
Total capacities *(number of CSD-Vs)*	 +	8,100 4,320	R7/T7 E-EV-SE
Total	=	12,420	
Available spaces *(9047 stored CSD-Vs at the end of 2007)*	 -	12,420 9,047	
Total	=	3,373	

Table 12 : Storage capacities for HL waste on the La Hague Site as 31 December 2007 (number of places)

Hence, about 3,000 spaces are currently free. A total of 4,164 CSD-V packages have been returned to foreign customers, thus representing a return rate exceeding 75 %.

D.3.3.2 - 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, similar to that of Marcoule, 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 creatipn 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 20 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 will be 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 CSFMA.

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.

D.3.3.3 - 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.

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 INB-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 INB-72, INB-73 and INB-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

The Bollène platform, managed by SOCATRI, performs waste-sorting and storage operations for small producers.

The Northern Collection Centre (*Centre de regroupement Nord*), located on the CEA site at Saclay, centralises residues originating from the medical, research and industrial sectors.

If the storage-facility project that ANDRA is currently examining is commissioned, it should be able to accommodate that waste.

D.3.4 - Waste-disposal facilities

D.3.4.1 - 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 Reprocessing Plant and accommodated approximately 527,000 m^3 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 burying them in a concrete box depended on the radiological activity of the packages and/or the perennity 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.

The documentation designed to maintain the memory of the disposal facility was assembled and a copy was deposited in the French National Archives.

In January 2003, the CSM entered officially into its post-closure monitoring phase for a maximum period of 300 years, 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).

Decree No. 2003-30 of 10 January 2003 authorising the transition of the CSM into its monitoring phase required ANDRA to submit no later than January 2009 a memorandum on the interest of installing a new cover to ensure the passive safety of the disposal facility over the long term, together with an update of the safety report and of the CSM's safety reference system (monitoring plan, on-site emergency plan and general monitoring rules).

ASN has informed ANDRA about its conclusions on those issues in a letter sent on 15 February 2010.

With regard to the safety of the disposal facility, ASN has noted that the facility was behaving according to the expected evolutions, but that its complex behaviour required continuous maintenance efforts and comprehensive modelling. Concerning the installation of a more perennial cover over the facility, ASN considered as satisfactory ANDRA's proposal to reinforce slopes, to soften the grade progressively and to improve the impermeability of the cover. ANDRA, however, has been requested to provide complements within a delay of five years.

In addition, ASN has prescribed that the relevant documentation to maintain the memory of the CSM be submitted to an operation test.

The safety report must also be updated every 10 years.

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.

It should also be noted that, in 2009, investigations were conducted in a settlement zone of the cover in order to ensure the soundness of the bitumen membrane protecting the disposal structures against rainwater seepages. Verifications were made to check whether the bitumen membrane had absorbed ground deformations while maintaining its integrity.

Slopes were also reinforced locally in 2010.

D.3.4.2 - LIL Waste Disposal Facility (CSFMA)

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

Its design relies mostly on the experience feedback from the CSM it superseded. The major lessons learnt include the following:

- the waste-package concept as a component of the multi-barrier system as derived from the CSM, with the other barriers consisting of the structures and the geological formation. The waste is conditioned in the form of packages consistent with specific characteristics. An acceptance procedure is required in order to verify that the characteristics of all packages are consistent with specifications;
- an effluent-management system was implemented in order to separate waters that are likely to come into contact with waste. A specific system was created in order to collect all waters from the structures;
- tritiated waste must be managed with caution (small quantities, very low degassing, etc.), since tritium has been detected in the water table of the CSM where such waste had been disposed of, and
- some radium-bearing waste was disposed of the CSM, but radon discharges impose constraints (drift ventilation in the presence of human beings). Consequently, only limited quantities of such waste are allowed at the CSFMA.

More lessons will be drawn later from the experience feedback concerning the CSM cover and should prove useful for the CSFMA.

The disposal capacity of the CSFMA is set at 1 million cubic metres of waste packages.

Besides disposal operations, the facility is also involved in waste-conditioning activities, consisting either in injecting cement mortar in 5- or 10-m^3 metal boxes or in compacting 200-L drums and immobilising them with mortar into 400-L drums. The site covers a total area of 95 Ha, 30 of which are restricted for disposal.

Disposal structures consist of cells measuring 25 m square by 8 m in height, 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 2010:

- the total volume of disposed waste amounted to approximately to 243,000 m3, and
- 106 structures had been closed down on a planned total of approximately 400.

Given an annual delivery of 10,000 to 15,000 m^3 and the fact that the disposal facility was designed originally for an annual input of 30,000 m^3, the facility will probably remain in operation for several decades.

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.

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

Maximum radiological capacities have been set for a certain number of radionuclides in the CSFMA's creation-licence *Decree of 4 September 1989,* as shown in Table 12.

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

Table 13 : Maximum radiological capacities specified for a certain number of radionuclides in tonnes t.
(Creation-licence 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 89%, compared to 24% 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).

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 licensing Decree for the creation of the CSFMA was modified on 10 August 2006 in order to include en 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 CSFMA'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, 39 PWR covers have already been disposed of, including seven in 2010, and that disposal operation was reviewed and licensed by ASN. In that regard, ANDRA is leading a NEA working group whose purpose is to develop a technical note to assess the relevancy of disposal as is for large components compared to a disposal option consisting of standard packages after shearing.

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.

D.3.4.3 - VLL Waste Disposal Facility (CSTFA)

ANDRA's disposal facility for VLL waste (CSTFA) has a capacity of 650,000 m^3 and is located in Morvilliers, Aube *département*, a few kilometres away from the CSFMA. It covers an area of 45 ha and was opened in August 2003. At the end of 2010, slightly more than 174,500 m^3 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 INB regulations, but to ICPE regulations.

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

With due account of the activity level of the waste involved, the purpose of conditioning is to prevent any dispersal of radioactive materials during transport and disposal operations. However, those criteria apply only to solid and inert waste. 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 the volume of any free water into the cell.

As in the case of the CSFMA, ANDRA allows a maximum impact value of 0.25 mSv/a for the facility under normal conditions, either during operation or after shutdown. For instance, the impact of the facility 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 CSFMA, all risks associated with toxic chemicals have been taken into account.

After two years of operation, ANDRA requested the Prefect of the Aube *département* to increase the annual volume of the facility from 24,000 to 37,000 m^3 and to modify some operating conditions (cover slope, leachate-pumping rule). The request was granted by the *Prefectoral Order of 21 July 2006* and allows ANDRA to face adequately the rise in VLL-waste stream, with due account of current dismantling operations.

The CSTFA was designed before any experience feedback was available on the enforcement of the French regulations regarding waste management in INBs (no clearance threshold, implementation of waste zoning). 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 disposal capacity and jumped from 24,000 to 37,000 m^3 of waste per year.

However, the waste stream may generate an earlier saturation than expected of the CSTFA's 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.

D.3.5 - 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 1,000 m of drifts have already been opened and are available to pursue the experimental and demonstration programme. Close to 4000 sensors have been installed in the URL and already transmit data on the behaviour of the rock and of completed structures.

A special note should be made about the following R&D orientation priorities between 2007 and 2010:

- investigations must involve the hydromechanical and chemical effects in the rock and the evolution of the properties of the excavation damage zone (EDZ) :
  - thermal effects (thermo-hydro-mechanical properties, superimposition of thermal charges);
  - ventilation effects (desaturation/resaturation);
  - non disturbed rock gas flow, assessment of resaturation times of clay sealing structures;
  - impact of oxidising disturbance and of bacteriological contamination, and
  - reactions to interfaces with spare materials to build the repository (steel, glass, concrete), and
- preparations for the initiation of demonstration experiments by testing and fine-tuning the excavation method for the HL-waste disposal.

The overall work conducted in the URL will generate various scientific and technical elements in support of the application to be submitted for the licence to create a deep geological waste repository.

D.3.6 - Mine-tailing disposal facilities

All mine tailings generated by the uranium-mining industry, which is no longer active in France, are currently disposed of in 17 facilities located on actual old mine works (see Table 10 in § D.4.2).

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, whole 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 only facilities set in place by mine operators were designed to treat any overflowing water from the hydraulic basins created by the mine works and drifts.

Once sites are rehabilitated, it is necessary to maintain, at least on some of them, treatment installations for mine waters and/or residue-washing water in order to reduce the uranium and radium concentrations of the waters before discharge.

D

D.4 - Radioactive Waste Inventory

D.4.1 - Annual production of radioactive waste

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

Type of waste	Volume *(m³)*	Fuel cycle and electricity production *(%)*	Nuclear research (%)	Miscellaneous (%)
LIL-SL waste	12,000	75	23	2
IL-LL waste	930	80	20	0
HL waste	155	~100	low	0

Table 14 : Annual production of radioactive waste

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

Percentages were calculated on the basis of the waste conditioned into packages. Figures are approximate and deal with past production rather than that of a given year. Percentages are calculated, except for VLL and LL-LL (the production of LL-LL being low), and exclude disused sealed sources. Spent fuel held in storage facilities is also ignored when calculating percentages. The "Miscellaneous" category comprises only medical waste and residues resulting from research activities in the non-nuclear sector.

D.4.2 - Existing waste in storage facilities

Note: Some data mentioned in this section are taken from the 2009 National Inventory and date back to the end of 2007. Some updated data at the end of 2010 which will appear in ANDRA 2012 National Inventory (to be published in the middle of 2012) are nevertheless integrated in this report.

D.4.2.1 - Waste volume resulting from spent-fuel reprocessing (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 2010, 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 2010 was higher than for vitrified packages, since the priority was given by AREVA to activity over mass.

	Total number of stored packages on 31 December 2010	Estimated share of processed spent fuel belonging to French owners before 31 December 2010 *(%)*
CSD-V	10,828	94,1
CSD-C	10,270	52;1

Table 15 : Quantities of currently-stored on 31 December 2010

D.4.2.2 - Waste volume resulting from spent-fuel reprocessing (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 2010 (%)							
	Australia	Belgium	Germany	Italy	Japan	Netherlands	Spain	Switzerland
CSD-V	< 0.1	0.0	2.7	0.6	0	0.1	0.6	2.0
CSD-V	0.0	2.6	27.8	1.5	12.5	0.8	0	2.7

Table 16 : 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 2010

D.4.2.3 - Other stored waste (end of 2007)

- 15,489 m³ of radium-bearing waste;
- 72,178 m³ of graphite waste containing radioactivity, 60,930 of which are still in the cores of GGRs and, as such, are not currently considered as waste;
- 2,368 m³ of tritiated waste:
- 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;
- 1,700,000 disused radioactive sources, and
- 50 million t. of mine tailings, constituting a specific VLL-waste category, which is managed separately.

Region	Site	%	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
	Lavaugrasse	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 17 : Inventory of uranium mine works and of mine tailings (in millions of tonnes)

D

D.4.3 - Waste intended for final disposal

At the end of 2010, the total volume of disposed VLL, LL and IL-SL waste amounted to about 954,000 m3, as broken down in Table 17.

	Volume (m^3)
Immersion of 14,300 t (1967 and 1969)	9,900
Centre de la Manche	527,000
CSFMA	243,000
CSTFA	174,000

Table 18 : Stored volumes of TFA, FA, MA SL waste at the end of 2010

At the end of 2010, no IL-LL or HL waste had ever been disposed of permanently in France.

D.5 - DISMANTLED NUCLEAR FACILITIES

At the end of 2010 more than 40 facilities were being dismantled or had already been dismantled, as follows:

- nine former nuclear-power reactors;
- 15 non-nuclear power reactors;
- three accelerators;
- 18 former laboratories or plants;
- three former nuclear-power reactors (national-defence programmes) being dismantled at Marcoule and their dismantling waste are being transferred to the civilian programme, and
- the UP1 spent-fuel treatment plant (national-defence programme) being dismantled at Marcoule.

The list of nuclear facilities being dismantled or already dismantled is shown in § L.3.

Section E : LEGISLATIVE AND REGULATORY SYSTEM (Articles 18 to 20)

E.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.

E.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 materials 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 INB Nomenclature,* all nuclear facilities are called INBs and are placed under ASN's control. To that category belong especially all facilities accommodating spent fuel from reactors, reprocessing 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 CSTFA, which constitutes an ICPE) and a large number of facilities containing radioactive waste, although waste management is not their primary purpose: all in all, INBs amount to a total of 126.

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 700 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 (INB operators, such as the CEA, AREVA and EDF; radioactive-material conveyors, radioactive-source users, etc.) and not with public authorities or other parties. In that respect, INB regulations rely mainly on the *TSN Act* and *Decree No. 2007-1557,* taken pursuant to Article 36 of the Act.

The general technical regulations applicable to INBs are currently being consolidated (see § A).

The *EURATOM Treaty* is one of the treaties of the European Union (EU). EU directives must be transposed in every national legislation within a given deadline. Once integrated into the national legislation, the law binds the country for the enforcement of the regulations involved, in accordance with the subsidiarity principle. National laws may be more rigorous than European directives, but never less.

Two European directives on nuclear safety and on the safe and responsible management of spent fuel and radioactive waste were adopted (see § A.).

E.1.1.1 - TSN Act

The legislative basis supporting the safety of INBs in France is the *TSN Act*, which revamped in depth the legal framework applicable to nuclear activities and their control. The Act, that created ASN as an independent administrative authority includes several improvements regarding transparency, among which the integration of the lessons learnt from the review of foreign legislations.

Basic principles

The Act confirms that the following four basic principles relating to environmental protection apply to nuclear activities: prevention, precaution, polluter-pays and public participation. In that respect, it lists the content of the *Environmental Charter,* which has now become an integral part of the *Constitution*. It reaffirms also the major radiation-protection principles: justification, optimisation and limitation. It states the fundamental principle involving the primary responsibility of operators with regard to the daily safety of their facilities, as recognised in international law, and essential in order for operators and the regulatory authority to have a clear understanding of their respective responsibilities.

Creation of ASN

The *TSN Act* granted ASN the status of an independent administrative authority and entrusted upon it to control nuclear safety and radiation protection on behalf of the State.

The government shall maintain its own power to set forth by decree or order any general regulations applicable to nuclear activities. It also takes a limited number of major individual decisions concerning nuclear facilities, notably for licensing their creation and dismantling. The government must also be in charge of emergency preparedness (see § E.3).

Transparency regarding nuclear safety and radiation protection

The right of access of any individual to any information concerning nuclear safety and radiation protection held by public authorities is already guaranteed by the *Environmental Code*. The *TSN Act* extends the scope of that right by granting the public a right of access to any information held by INB operators, transport companies and holders of radioactive substances. That major innovation distinguishes between nuclear activities and other industrial activities, which are not subject to that transparency requirement.

Moreover, the *TSN Act* prescribed that INB operators prepare an annual report describing the following items:

- 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, the 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 commissions locales d'information*).

The Act institutes the High Committee for Transparency and Information on Nuclear Safety (*Haut Comité pour la transparence et l'information sur la sécurité nucléaire* – HCTISN) (see § E.3.3.2.3) with a view to replacing the Senior Council for Nuclear Safety and Information (*Conseil supérieur de la sûreté et de l'information nucléaires*). The High Committee constitutes a forum and participates in public information at the national level. Its membership is open and includes notably parliamentarians and representatives from CLIs, associations and labour unions, as well as qualified personalities.

E.1.1.2 - Decree No. 2007-1557 of 2 November 2007 (INB Procedures)

Decree No. 2007-1557 sets forth the new framework in which INB procedures will apply and encompasses the full INB lifetime cycle from the creation and commissioning licences up to final shutdown and dismantling (or, in the case of a disposal facility, up to the post-closure monitoring phase). Lastly, it clarifies the relationship between the Ministers in charge of nuclear safety (the Ministers for the Environment and Industry) and ASN with regard to the safety of INBs.

The "INB-Procedure" Decree instituted a new consultation authority, the Advisory Committee on Basic Nuclear Facilities (*Commission consultative des installations nucléaires de base* – CCINB). The Decree describes in detail the applicable procedures for adopting general regulations and making individual decisions relating to INBs; it describes the implementation modalities of the law with respect to inspections and administrative or criminal penalties. Lastly, it sets forth the specific implementation conditions for certain regulatory systems within the perimeter of INBs.

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.

E.1.2 - Legal frameworks for ICPEs and mines

ICPE Regulations are taken pursuant to the *Environmental Code*, notably Book V.

They are implemented by the relevant prefect under the authority of the DGPR (formerly the DPPR). For each heading of the ICPE nomenclature, standard technical specifications are established at the national scale. Those specifications form the general framework used by ICPE inspectors to develop formal requirements in the form of prefectoral orders with which operators must comply, while taking into account the specificities of the facilities and their environment.

The DGPR at the Ministry for the Environment contributes to the preparation of those specifications and to the national harmonisation of the actions taken by ICPE inspectors.

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.

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. The ICPE legislation, codified in Title I of Book V of the *Environmental Code,* is the legal basis for the French industrial environment policy. It superseded a 1917 law, which had already replaced a decree dating from 1810.

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.

ICPE regulations concern activities as diverse as animal breeding, large oil industries, quarries extracting materials or the implementation of radioelements.

The ICPE legislation implements a simple system, listing all relevant industrial activities within a nomenclature that assigns them to a licensing or declaration system, depending on the relevant operation or the quantity of hazardous products involved, that is subject to licensing or declaration regarding activities and the quantities of dangerous products involved.

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.

Facilities with a low environmental impact are subject to a simple declaration procedure. Below the declaration threshold, the facility operator has no administrative procedure to initiate in order to prevent nuisances and risks. Between the declaration and approved thresholds, the operator must file a declaration with the relevant prefect and comply with general prescriptions; the facility may be inspected. Beyond the approved threshold, the prior approval of the prefect is necessary and may only be issued after a public and administrative inquiry has been held on the basis of the report of the ICPE Inspectorate and upon the advice of the Departmental Council on the Environment and Health and Technological Risks (*Conseil départemental de l'environnement et des risques sanitaires et technologiques* – CODERST).

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 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.

The ICPE Inspectorate verifies compliance with the technical requirements imposed on operators. It also intervenes in case of complaint, accident or incident. If it finds that requirements are not appropriate, it may recommend to the prefect to impose further requirements by an order. Any operator failing to comply with requirements faces administrative and criminal sanctions (formal notice, fund deposit with a public accountant, compulsory execution of the work at the operator's expense, licence suspension, closure). The law prescribes significant penalties in case os violation.

The rights of third parties are always valid even if the industry complies with regulations.

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.

Depending on the substance involved, mineral-bearing facilities are considered as mines or quarries. Mines include deposits of metal substances, particularly uranium and its compounds. They must be licensed by the State for the relevant substances involved, either by a mining claim or an operating licence for minor deposits. In addition, before starting the operation of any facility, a commissioning licence must also be obtained, particularly with a view to studying its impact.

In the quarry category, substances are left available to the owner of the land. Open pits are nevertheless part of ICPEs and their operators must have met the relevant requirements of the licensing or declaration procedure.

Mining Regulations are distinct from ICPE Regulations, mainly for historical reasons and also because mining, in addition to its strategic nature, raises specific technical problems. The prefect, as the local government representative, represents the controlling authority. However, mining titles (mining claims or operating licences) and subsequent commissioning licences are issued at the national level after consultation with the General Council of Mines (*Conseil general des mines* – CGM).

Mining Regulations covers mining activities themselves and legal outbuildings. Most ore-treatment facilities and mine-tailing disposal facilities are currently classified as ICPEs.

E.1.3 - 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 *Code* 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 *Code* 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.

E.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: INBs; ICPEs and the special case of mines and sealed sources.

E.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.

E.2.2 - Legal framework for INB safety

Besides general regulations, such as those relating to labour law and the protection of nature, INBs 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.

E.2.2.1 - Framework of INB licensing procedures

The French legislation and regulations prohibit the operation of a nuclear facility without the relevant licence. In that framework, INBs are regulated under Title IV of the *TSN Act* and by *Decree No. 2007-1582,* 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 dismantling (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 *TSN Act*. The enforcement of the different licensing procedures runs from the siting and design phases to the final dismantling phase.

E.2.2.2 - INB siting procedures

Well before applying for a licence to create any INB, 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 *sqq.* of the *Environmental Code,* the creation of any INB is subject to a public-debate procedure, as follows:

- 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

Lastly, the French government has to inform all neighbouring countries in accordance with treaties in force, especially the *EURATOM Treaty*.

E.2.2.3 - INB design, construction and safety assessment procedures

E.2.2.3.1 - Safety assessment

Safety options

Any person who intends to run an INB 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.

Safety options must then be presented in the licence application through the preliminary safety report.

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.

The purpose of the preliminary procedure is not to replace any subsequent regulatory reviews, but rather to facilitate them.

Safety review and assessment of INB creation-licence applications

All documents to be submitted in any application to create an INB are listed in the 2 November 2007 Decree. The applicant must provide, for instance, an environmental impact study, as defined in the *Environmental 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 INB commissioning

In any licence application to commission an INB, 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 III of Article 29 of the *TSN Act,* 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 Ministers 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 Ministers 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.

E.2.2.3.2 - Creation licences

Submission of creation-licence applications

All licence applications to create an INB must contain a preliminary safety report and be addressed to the Ministers in charge of nuclear safety (Ministers for the Environment and Industry).

The review of the licence application includes a consultation of the public at large and of local authorities, as well as a technical review.

Consultation of local public and authorities

The Prefect of the *département* in which the facility is to be located must launch a public inquiry. Among other items, the case submitted to the inquiry must specify the name of the applicant, the purpose of the inquiry, as well as the nature and basic characteristics of the facility. It must also include a plan of the facility, a map of the region, a risk study, together with an environmental impact statement.

The purpose of the inquiry is to inform the public and to collect its views, suggestions and counter-proposals in order to provide the competent authority with all required elements for its own information. In addition, any interested party, irrespective of its residence or nationality, is free to formulate views.

An inquiry commissioner (or an inquiry commission, depending on the nature or scale of the operations at stake) must be designated by the President of the competent Administrative Tribunal (*Tribunal administratif*) with the power to receive documents, to visit premises, to hear any party, to organise public meetings and to request an extension of the inquiry.

At the end of the inquiry, the Inquiry Commissioner must examine the comments made by the public as recorded in the inquiry proceedings or sent directly to him. He must also forward his report and opinion to the Prefect within a month after the inquiry.

The Prefect must also consult the departmental or regional administrative services of the ministries involved in the project within the framework of an administrative conference.

At the end of the process, the Prefect must forward his opinion, together with the report and conclusions of the Inquiry Commissioner, as well as the results of the administrative conference, to the Ministers in charge of nuclear safety.

The public inquiry organised in preparation for a potential public-interest statement may also replace the required public inquiry prior to a creation-licence application.

Consultation of technical organisations

The preliminary safety report supporting the creation-licence application must be transmitted to ASN for review by one of its GPEs on the basis of a report prepared by the IRSN.

Once the GPE has reviewed the case and the conclusions of the consultation are known, ASN must submit to the Ministers 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 Ministers in charge of nuclear safety must then address to the applicant the draft decree licensing or rejecting the creation of the facility. Any applicant wishing to submit comments has two months to do so.

Afterwards, the Ministers in charge of nuclear safety must seek ASN's opinion concerning the draft decree licensing or rejecting the creation of the facility. ASN issues its opinion after having heard the applicant and the relevant CLI about the draft decree (see § E.3.4.2.1).

ASN's opinion is deemed favourable, if not provided within two months after receiving the request.

Creation-licence decree

Any INB-creation licence must be issued through a decree signed by the Prime Minister and countersigned by the Ministers in charge of nuclear safety.

The decree sets forth the perimeter and characteristics of the facility, as well as any particular rules with which the operator must comply.

It must also specify the commissioning delay of the facility and may set the term of the licence. 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.

Those requirements may involve notably the quality of the design, construction and operation of the facility, its protective and security systems, contingency solutions, ventilation and discharge networks, anti-seismic protection, radiological protection of the environment and workers, transport of radioactive materials, changes to the facility, final shutdown and dismantling.

ASN must also specify, if need be, any requirement relating to activities involving water intakes by INBs and radioactive substances resulting from INBs. Specific requirements prescribing INB discharge limits must be validated by the Ministers in charge of nuclear safety.

From now on, the licensing decree will include any required approval for the discharge of liquid and gaseous effluent and for water intakes, with ASN limiting its role to specifying the relevant requirements in the licence.

E.2.2.4 - INB operating procedures

E.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 dismantling plan, if need be.

Once the application has been reviewed and compliance has been checked with the objectives and rules of the *TSN Act* and its accruing instruments have been checked, 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 Ministers in charge of nuclear safety and the Prefect concerned. It may also inform 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*.

E.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.

E.2.2.4.3 - Modifications involving INB 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:

- 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 to in I of Article 28 of the *TSN Act*, as mentioned in the licensing decree, or
- it adds up, within the facility site, a new INB referred to in III of Article 28 of the *TSN Act*, the operation of which is associated with the concerned facility.

E.2.2.4.4 - Incident follow-up

According to the *TSN Act,* 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 INB 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.

E.2.2.4.5 - Final shutdown and decommissioning licences

Legislative and regulatory framework for final shutdown and dismantling

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, dismantling 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 dismantling 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 *TSN Act,* the final shutdown and dismantling of any INB 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 dismantling would be required to replace the creation-licence decree of the relevant INB.

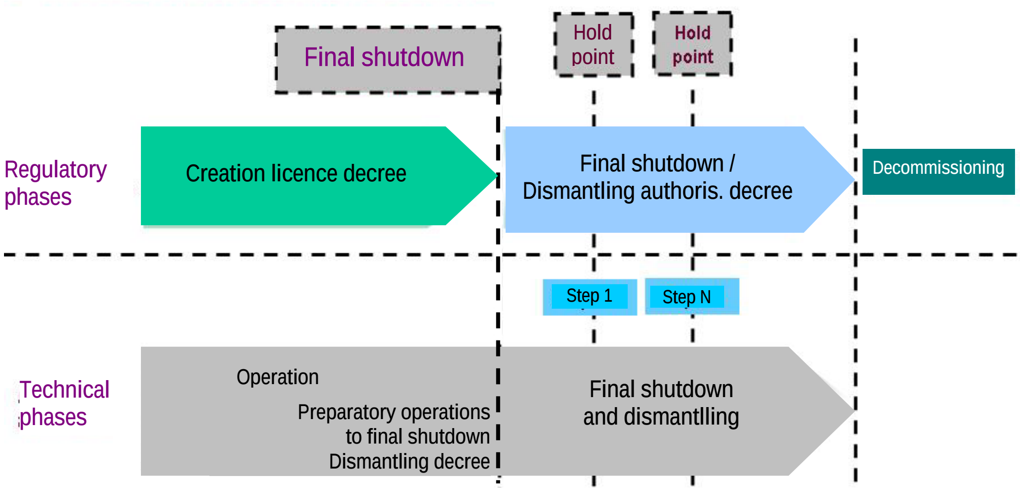

Figure 1 : INB life phases

The *2 November 2007 Decree,* taken in accordance with the *TSN Act,* prescribes the content of the documents to be filed by the operator in support of his application for the final shutdown and dismantling 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 dismantling

Any application to obtain a final-shutdown and dismantling licence must be submitted to the Ministers 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 dismantling is subject to the same consultation and inquiry modalities as for licence applications for the creation of INBs.

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, dismantling 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 dismantling characteristics, the actual dismantling deadline and the types of operations for which the operator remains responsible after dismantling.

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 2006 Planning Act, including the fact that the shutdown of that repository may only be licensed through an act.

Implementation of final shutdown and dismantling operations

For other facilities than radioactive-waste disposal facilities, final-shutdown and dismantling 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
- dismantling operations involving the actual nuclear section itself may be undertaken once final shutdown

operations are completed or postponed (with the understanding that ASN advocates the immediate-dismantling option, see § F.6.1).

In certain cases, such operations as the unloading and evacuation of nuclear fuel, the elimination of fluids or any decontamination and cleanup 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 dismantling.

Decommissioning of facilities and implementation of public easements

Any decommissioning application must include especially a description of the state of the site after dismantling, 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 dismantling operations reach the final expected state as approved by ASN, the facility may be decommissioned and removed from the list of INBs in accordance with the procedure referred to in the licensing decree for the final shutdown and dismantling of the facility.

The decommissioning application must contain especially a statement on the expected state of the site after dismantling, 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 an INB 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 Article 31 of the *TSN Act,* 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 Article 31 of the *TSN Act*.

E.2.2.5 - INB technical rules

Technical rules and practices relating to nuclear safety are set in a multi-tier series of texts, as summarised in § L.4.1 and L.4.2, 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 § A.2.1.2, a comprehensive revamping of the general technical regulations applicable to INBs is under way.

E.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 INB operation (see § E.2.2.6.2).

In accordance with Article 4 of the *TSN Act*, 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 Ministers 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).

E.2.2.5.2 - Basic Safety Rules

On various technical subjects concerning both power reactors and other INBs, 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 redrafted in the form of guides.

All RFSes and guides referring more particularly to facilities within the scope of the *Joint Convention* are listed in § L.4.

E.2.2.6 - Scope of INB 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.

E.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 dismantling. 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.

In the case of INBs, ASN's supervision also includes 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.

E.2.2.6.2 - Environmental protection

The control and limitation of nuisances and risks associated with the operation of INBs are regulated by the *TSN Act* and its implementing decrees, together with the above-mentioned Order of 31 December 1999:

- *Decree No. 63-1228,* further detailed by the *Order of 31 December 1999* setting forth general provisions for the control of environmental risks (especially accidental contamination) and of noise pollution, as well as for waste management in INBs;
- the legislation for relevant ICPEs located within the perimeter of INBs, and
- *Decree No. 95-540,* further detailed by the implementation *Order of 26 November 1999 Concerning the General Technical Requirements for Limits and Procedures of Authorised Intakes and Discharges by INBs* and the *Circular of 20 January 2002.*

Today, the control and limitation of nuisances and risks induced by the operation of INBs are regulated by the *TSN Act* and its implementation decrees, together with the *Order of 31 December 1999.*

In general, ASN's policy regarding environmental protection compares with the policy applied to conventional industrial activities. For instance, the *Order of 26 November 1999* laying down the general technical provisions concerning limits and procedures for authorised intakes and discharges by INBs, requires that discharge limits be set for each INB, on the basis of the use of the best available technologies at an economically acceptable cost, with due account of the specific characteristics of the site environment. That approach leads to a better understanding of the limits for chemical discharges and to a reduction of authorised limits for radioactive and chemical discharges. The former regulatory system provided for discharge licences with limited timeframes. As those licences expire, they are renewed in accordance with the above-mentioned provisions. Hence, the renewal process offers an opportunity to examine the possibility to reduce discharges from the facility and to improve monitoring conditions.

E.2.2.6.3 - Working conditions in INBs

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, advise 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 INBs 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.

E.2.2.7 - Control modalities for INBs

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 INB operators or the manufacturers of equipment used in facilities, and
- the review of applications and supporting documents submitted by operators.

E.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 (previously known as "INB 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 INBs and on shipments of radioactive substances.

In 2010, ASN conducted 737 inspections in INBs, 181 of which were unannounced (25%) and 92 dealt with the transport of radioactive materials. The distribution of those inspections per INB category is shown in Figures 2 and 3. In 2010, for instance, 19 inspections were carried out at operators managing radioactive waste (see Figure 2) and

77 inspections dealt with effluents and environmental monitoring (see Figure 3).

.

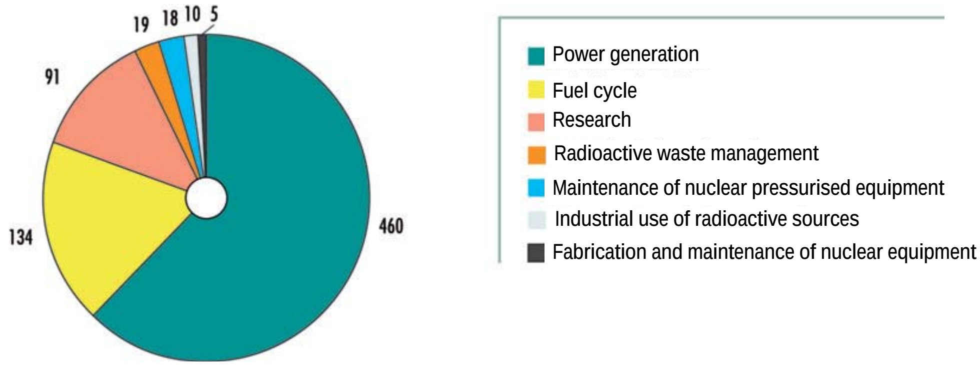

Figure 2 : Distribution of inspections per type of activity in 2010

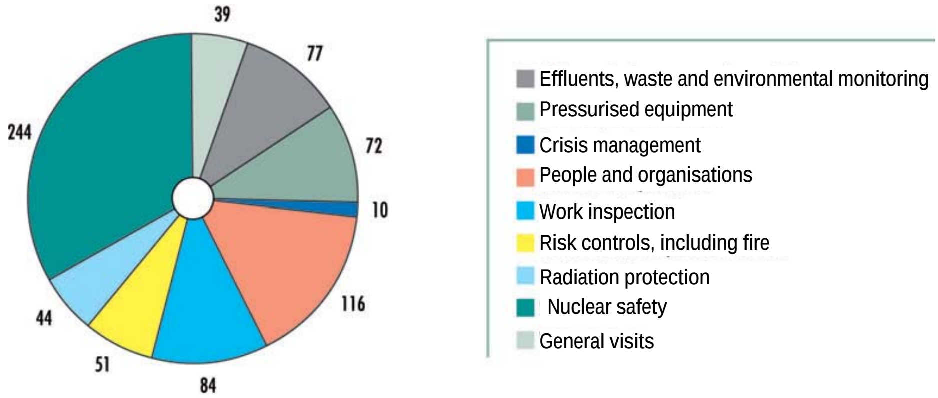

Figure 3 : Distribution inspections per priority topic in 2010

E.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 an INB, 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.

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 INB 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.

E.2.3 - Regulatory frameworks for ICPEs and mines

E.2.3.1 - ICPEs

The ICPE regulatory framework is detailed in § E.1.2.

E.2.3.2 - Mines

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 (formerly Article 77) 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 *Environmental Code*.

At the end of all or part of mining operations, the operator must declare his cessation of activity and indicate which steps he intends in order to take to protect the interests referred to in Article 161-1 (formerly Article 79) of the *Mining Code*. The Prefect either acknowledges the declaration or specifies additional measures.

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* (formerly Articles 94 and 95) of the *Mining Code.*

E.2.3.3 - Scope of ICPE and mine control

E.2.3.3.1 - Security control

As part of its monitoring duties, the ICPE Inspectorate deals with all elements contributing to the safety of facilities and their impact on the environment. Its supervision thus concerns both the actual equipment constituting the facilities and the workers responsible for their operation, together with the related working methods and organisational arrangements.

When the inspections carried out by the ICPE Inspectorate reveal any failure to comply with the requirements of the facility's licensing conditions, penalties may be imposed on the operators. The first penalty consists in a formal notice. If the formal notice is ignored, the Prefect may resort to other administrative penalties, such as fund deposit with a public accountant, compulsory execution of the work at the operator's expense or even a suspension of the licence. A programme of inspections is set every year. The inspection frequency depends on the hazard potential of the facility concerned.

Mines are also inspected by DREAL agents who cover the safety of mining operations, mine workers' health and safety, as well as potential environmental hazards arising from the mine works.

E.2.3.3.2 - Radiation protection control of non-INBs

Article 4 of *TSN Act* states that ASN must ensure compliance with and specific radiation-protection requirements to which are subject the activities and persons referred to in Article L. 333-1 L1333-10, respectively, of the *Public Health Code*. It lays down a permanent radiation-protection watch throughout the country. It designates its agents among its radiation-protection inspectors. It issues required approvals to organisations participating in controls and in the radiation-protection watch.

ASN's action includes reviewing licence applications, pre-commissioning visits, joint inspections and actions with professional organisations (unions, orders, learned societies, etc.). It concerns directly either ionising-radiation users or certified bodies to carry out technical inspections of those users.

ASN has structured its control efforts in order for them to be commensurate with the radiological challenges represented by the use of ionising radiation and consistent with the action of other inspection services.

E.3 - REGULATORY BODIES (ARTICLE 20)

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 or radioactive waste*

E.3.1 - Nuclear Safety Authority (ASN)

ASN is responsible for controlling all nuclear activities in INB, small-scale industrial facilities, research laboratories and medical establishments using ionising radiation and involving the transport of radioactive substances.

ASN must be consulted on all draft decrees and orders with a regulatory character from the government and may refine those texts by technical resolutions. It takes individual resolutions concerning nuclear activities (for instance, the commissioning licence of an INB, the use of transport packagings for radioactive substances or the use of radioactive sources). It also imposes individual prescriptions. It ensures the conduct of inspections and may issue sanctions, such as suspending the operation of a facility in case of emergency. It also organises the permanent watch with regard to radiation protection (e.g., environmental monitoring and occupational exposures). Furthermore, it assists the government in case of emergency.

Lastly, ASN contributes to public information about nuclear safety and radiation protection.

E.3.1.1 - 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.

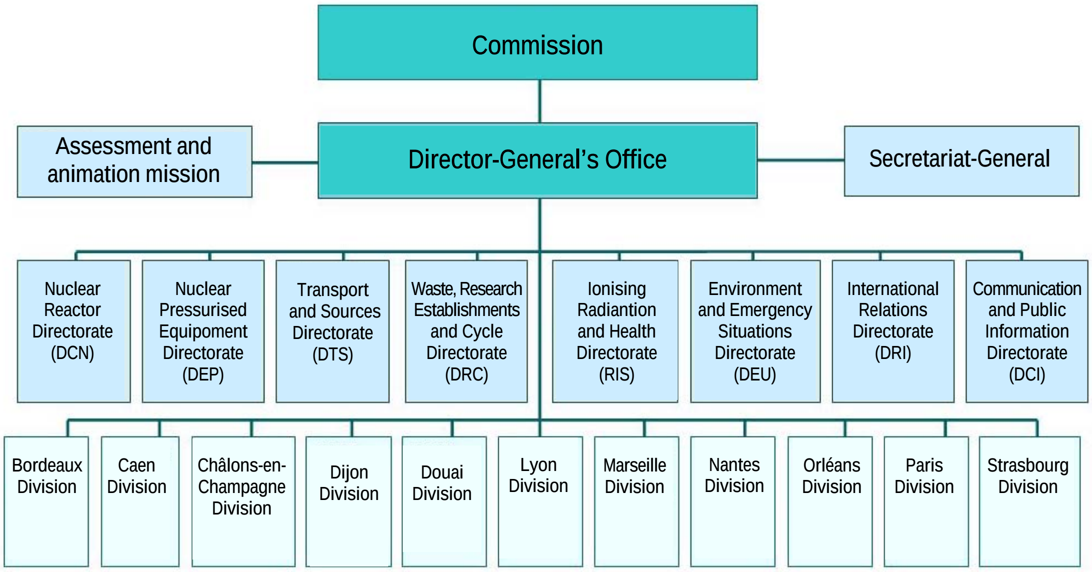

Figure 4 : ASN's organisational chart

E.3.1.1.1 - ASN Commission

Five full-time and irremovable commissioners are appointed for a non-renewable six-year term.

The Commission establishes ASN's strategy and is more particularly involved in the specification of control policies and external relations at both the national and international scales. With that purpose in mind, it adopted the *National 2011-12 Multi-annual Plan* as well as a few general policy memoranda.

In accordance with the *TSN Act*, the Commission submits ASN's opinions to the government and takes ASN's main resolutions. All opinions and resolutions are published on ASN's website (www.asn.fr).

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 INBs, 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 Ministers in charge of nuclear safety or radiation protection.

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.

In 2010, the ASN Commission met 59 times, issued 24 opinions and took 33 resolutions.

E.3.1.1.2 - 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.

E.3.1.1.3 - 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 INBs, 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.

E.3.1.2 - Human resources and their management at ASN

E.3.1.2.1 - Resources

Human resources

On 31 December 2010, ASN's effective amounted to 451 employees, divided as follows:

- 366 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 Table 18.

Central services	Territorial divisions	Total
239	212	451

Table 19 : Distribution of ASN staff on 31 December 2010

Among ASN's staff, 75% are managers and 21% of those managers are women. Most managers originate from State technical institutions and often benefit from their previous experience with control activities. Some managers with experience in nuclear or radiological activities have also been seconded by the CEA or the IRSN, while some radiation-protection engineers have been hired on contract.

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 2010, the State budget dedicated to the control of nuclear safety and of radiation protection in France stood at 145.9 M€ and was distributed as follows:

- 52.2 M€ for payroll credits;
- 15.6 M€ of the working credit financing ASN's central services and 11 divisions, and
- 78.1 M€ of credits dedicated to IRSN's technical assessments on ASN's behalf.

INB 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 INB 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 *2006 Planning Act* also instituted three additional INB 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 2010, those taxes generated 183.2 million euros.

	Amount in 2010 (in millions of euros)	
Operators	INB Tax	Additional taxes
EDF	547.3	138.8
AREVA	15.1	8.9
CEA	6.9	31.2
ANDRA	6.5	–
Miscellaneous	8.8	4.6
TOTAL	584.6	183.5

Table 20 : Distribution of contributions from operators

E.3.1.2.2 - 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 2010, ASN agents spent 4,100 days in technical training spread over 230 sessions within 133 different courses. The financial cost of those training sessions provided the other organisations than ASN amounted to 470,000 € in 2010

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 2010 and proposed to certify 12 INB inspectors. On 31 December 2010, 56 ASN nuclear-safety inspectors are certified inspectors and represent approximately 18% 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 extrnal 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.

E.3.1.3 - 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.

E.3.1.3.1 - 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 research and assessment in the fields of nuclear safety and radiation protection.

INBs 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, ASN relies on the opinion of a relevant GPE on the basis of operator data and of their critical analysis by the IRSN. For other projects (minor modifications to installations, steps taken after minor incidents), 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 2010, with regard to "civilian" INBs, other than nuclear reactors in service, the IRSN provided ASN with approximately:

- 155 opinions concerning minor modifications to facilities or incidents, and
- five opinions for the GPE on major changes or new facilities,

The IRSN also provided ASN with 90 opinions concerning the safe transport of radioactive materials.

About 200 experts and specialists were involved in the preparation of those opinions.

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 involves more and more co-operation with French and international bodies.

E.3.1.3.2 - 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).

ASN is pursuing its co-operative efforts with:

- the Study Centre for Protection Assessment in the Nuclear Field (*Centre d'étude sur l'évaluation de la protection dans le domaine nucléaire* – CEPN), in the framework dans le cadre of CODIRPA's work with a view to establishing a status report on the training programmes for the radiological protection of patients;
- the *Bureau Veritas* Company for consultancy services in the framework of a certification approach by ASN/DEP in accordance with Standard ISO-17 020, concerning the review of a document issued by the

French Association on In-service Design, Construction and Monitoring Rules for the Equipment of Nuclear Power Boilers (*Association française pour les règles de conception, de construction et de surveillance en exploitation des matériels des chaudières électronucléaires* – AFCEN) justifying the capability of *Design and Construction Rules of Mechanical Equipment from PWR Nuclear Islands* (*Règles de conception et de construction des matériels mécaniques des îlots nucléaires REP*) to meet certain basic security requirements;

- the APAVE Group to carry ou radon measurements in homes;
- the pluralistic Expert Group of the Limousin mines (Limousin GPE), which provides support to public authorities on issues dealing with the rehabilitation of uranium-mining sites, and
- the *Radio-écologie Nord-Contentin* group, which provides support to public authorities on the environmental and health consequences on INBs in service on the peninsula.

E.3.1.4 - 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 (GPRAD), reactors (GPR), as well as transport, laboratories and plants (GPU).

More particularly, they review the preliminary, temporary and final safety reports of every INB. 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.

E.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, the Minister of Industry and the Minister of Health, 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. Hence, the MSNR:

- drafts general regulations, in connection with ASN;
- leads individual administrative procedures pertaining to the ministers' jurisdiction;
- co-ordinates all DREAL activities regarding uranium mines and ICPE where radioactive substances are involved, and
- 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.3.4.3.3).

E.3.3 - ICPE Inspectorate and Mine Inspectorate

ICPEs and mines are inspected by the staff from delegated services, such as the DREAL, veterinary services and the Interdepartmental Technical ICPE Inspection Service (*Service technique d'inspection des installations classées* – STIIC). In each region, the DREAL Director is responsible for organising inspections under the responsibility of the relevant prefects.

The ICPE Inspectorate is responsible for ensuring that operators comply with applicable regulations and fully assume their responsibilities. Inspectors review licence applications, conduct inspection visits and perform various checks at ICPEs. In case of violation, the Inspectorate files administrative sanctions to the Prefect and criminal charges to the Public Prosecutor's Office.

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.

E.3.4 - Other actors involved in safety and radiation-protection control

E.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.

In March 2011, the Bureau of the National Assembly and of the Senate Commission on Economy, Sustainable Development and Land Planning both referred to the OPECST a study on "nuclear safety, the place of the nuclear system and its future". The OPECST also issues an opinion on the PNGMDR.

E.3.4.2 - 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 *2006 Planning Act* 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 has been modified and clarified the non-renewable mandate, (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 also 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.

E.3.4.3 - Advisory bodies

E.3.4.3.1 - Higher Council for the Control of Technological Risks (CSPRT)

The INB Advisory Committee (*Commission consultative des INB* – CCINB), created by the *2 November 2007* Decree concerning INBs and the control of the transport of radioactive substances with regard to nuclear safety, had to be consulted by the Ministers in charge of nuclear safety not only concerning licence applications to create, to modify or to shut down definitely INBs, but also the general regulations applicable to each of those facilities.

The *2 November 2007 Decree* was modified by Decree No. 2010-882 of 27 July 2010 in order to cancel the CCINB. From now on, the general regulatory texts concerning INBs 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 INBs and ICPEs. As regard texts involving individual measures for such or such INB (licensing decree for creation or final shutdown dismantling, 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.

E.3.4.3.2 - 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.

E.3.4.3.3 - 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 Ministers 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 INB 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, associations, managers of nuclear activities, labour unions, ASN and the government. 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.

E.3.4.3.4 - Laboratory Accreditation Commission

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 and management of which are set by ASN and the IRSN, respectively. The network collates the various statutory environmental analysis results, particularly 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.

An ASN resolution concerning the appointment of commissioners will be required as soon as the resolution relating to the laboratory-accreditation modalities for measuring environmental radioactivity is approved. The validation of ASN's *Resolution No. 2008-DC-0099 of 29 April 2008 Concerning the National Measurement Network of Environmental Radioactivity* and prescribing laboratory-accreditation modalities is under way.

E.3.4.4 - Health and safety agencies

E.3.4.4.1 - 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.

E.3.4.4.2 - French Health and Safety Agency for Health Products (AFSSAPS)

The French Health and Safety Agency for Health Products (*Agence française de sécurité sanitaire des produits de santé* – AFSSAPS) is a State corporation placed under the supervision of the Minister for Health. It participates in the enforcement of laws and regulations on all activities relating to the assessment, testing, fabrication, preparation, import, export, wholesale distribution, conditioning, conservation, operation, marketing, advertising, launching or use of health products intended for human use and cosmetic products, notably drugs, biomaterials and medical devices, medical *in-vitro* diagnosis devices, including those involving ionising radiation.

With regard to radiogenic health products, the AFSSAPS issues radiation-protection licences for the distribution of radiopharmaceuticals and medical devices emitting ionising radiation, such as radioactive sources, electrical X-ray generators, etc. It is also in charge of organising the control of medical devices and, in particular, it certifies control organisations and sets the corresponding reference systems per category of equipment.

E.3.4.4.3 - 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 wealth 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 (Articles 21 to 26)

F.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 licence 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.*

F.1.1 - Spent-fuel management

Spent fuel is produced and stored in INBs. The fundamental principle of the overall specific organisation and regulatory system for 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 *TSN Act* and, in the case of waste producers, in the *2006 Planning Act*.

In addition, Article 1 of the *Order of 10 August 1984 Concerning the Design, Construction and Operation Quality of Basic Nuclear Facilities,* hereinafter referred to as the *"1984 Quality Order",* states that any INB operator shall ensure that a quality level commensurate with the safety significance of the function of the various facility components and of its operating conditions is set, achieved and maintained.

The system set in place by the operator must demonstrate that the quality of the components is achieved and maintained as early as the design phase and throughout all subsequent lifetime phases of the INB.

On behalf of the State, ASN ensures that such responsibility is assumed fully in accordance with regulatory provisions. 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 procedures 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.

F.1.2 - Radioactive-waste management

The respective responsibilities of the different parties involved in radioactive-waste management are described in § B.5.5 and summarised below.

F.1.2.1 - ASN and INB operator with regard to radioactive-waste management

The respective roles and responsibilities of ASN and of the operator of any INB are similar to those described in § F.1.1 with regard to the spent-fuel management.

F.1.2.2 - Operator producing radioactive waste and operator of radioactive-waste-management facilities (waste-treatment company, storage keeper, ANDRA)

As in the case of any other type of waste, the producer of radioactive waste must remain responsible for that waste until their final elimination in duly licensed facilities for that purpose. Even if any waste is sent to be processed or stored in a different facility operated by a different company, the producer remains responsible for his waste.

However, the operator of the facility in which the waste is stored and/or processed si responsible for the safety and radiation protection of his facility. He is also responsible for all dismantling operations at his facility. Similarly, ANDRA is responsible for the safety and radiation protection of its disposal facilities.

With regard to the respective responsibilities of the waste producer and ANDRA when the radioactive waste is taken over by ANDRA, it is clear that the waste producer remains responsible for his/her waste, even after storage or disposal by ANDRA. The ownership of the waste is not transferred to ANDRA. However, as mentioned above, that principle does not exclude ANDRA's responsibility as an INB 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 cleanup 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 20th century. In accordance with Article 14 of the *2006 Planning Act*, 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 last paragraph of Article 15 of the *2006 Planning Act* 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.

F.2 - Human and financial resources (Article 22)

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.

F.2.1 - ASN requirements concerning INBs

Article 29 of the *TSN Act* provides that “the creation licence of any INB 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 dismantling 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”.

Article 7 of the *1984 Quality Order* specifies that “all human and technical resources and the organisation implemented for the performance of a quality-related activity must be commensurate with that activity and allow for relevant requirements to be met. In particular, only persons with required skills may be assigned to a quality-dependent activity, the assessment of such skills being especially based on their training and experience.”

With regard to the provisions for charges relating to dismantling and the management of radioactive waste and of spent fuel, Article 20 of the 2006 Planning Act specifies the associated obligations imposed upon INB operators and describes the methodology to be used in order to enforce those obligations (see § B.1.6.1 and § F.2.3.2).

F.2.2 - Presentation of safety-allocated resources by INB operators

F.2.2.1 - ANDRA’s human and financial resources

F.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*. That status ensures the independence of the Agency in relation to any waste producers and institutions responsible for research in waste management.

ANDRA's structure was clarified in Decree No. 92-1391 of 30 December 1992 and consolidated in Articles R. 542-1 *sqq.* of the *Environmental Code*, and modified zgain 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.5.1.

Since 1 January 2007, ANDRA is financed by the following sources:

- a specific tax – In accordance with Article L. 542-12-1 of the *Environmental Code,* ANDRA manages an internal research fund designed to finance studies and investigations on storage and on the deep geological disposal facilities of HL-IL/LL waste. The fund is supplied by an additional "research tax" to the existing INB tax. The additional tax supersedes the commercial contract between ANDRA and large waste producers in order "to ensure the funding of research activities and the long-term management of radioactive waste". ANDRA collects the tax from waste producers in accordance with the "polluter-pays" principle and on the basis of the lump sums prescribed by the *2006 Planning Act* and of the multipliers set by *Decree No. 2007-1870 of 26 December 2007 Setting the Coefficients of the Additional Taxes to the INB Tax.* Lump sums may vary depending on the facilities involved (nuclear-power reactor, spent-fuel processing plant, etc.);
- commercial contracts for ANDRA's industrial activities[4] (operation and monitoring of radioactive-waste disposal facilities, specific studies, take-over of nuclear diffuse 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 take-over of some "small-scale" radioactive waste or the rehabilitation of sites contaminated with radioactive substances in cases of default of the liable entity. Indeed, in accordance with Article L. 542-12-1 of the *Environmental 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".

Lastly, Article 16 of the *2006 Planning Act* (Article L. 542-12-2 of the *Environmental Code*) provides for a new financial measure for the future (2015) 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 INB operators, as designated by agreements.

As mentioned in § B.1.6, INB operators must set aside sufficient funds corresponding to the management charges for their waste and spent fuel (and to dismantling 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).

F.2.2.1.2 - ANDRA's human resources

At the beginning of 2011, ANDRA's staff amounted to approximately 500 agents, 65% of which were engineers and managers. Some 75 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 100 employees participate directly in the Agency's industrial activities, particularly in the operation and monitoring of surface disposal facilities. They include agents in charge of checking that delivered packages comply with the facility's safety rules. In that regard, the Agency intends to maintain and to develop 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, consisting of 50 agents whose duties involve also quality and environmental-management activities.

With a staff of about 50 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, it participates in safety studies for both operational and planned disposal facilities.

3. *Due to their nature, commercial contracts are subject to conventional commercial risks and may therefore generate benefits or involve intrinsic risk.*

With an effective of about 60 employees, the Programme, Engineering and CIGEO 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.

F.2.2.2 - CEA and ILL human and financial resources

F.2.2.2.1 - Financial 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 § L.5.2. In 2009, the CEA's resources for civilian nuclear programmes amounted to 2,383 million euros, 45 % of which were funded through public resources (a subsidy of 1,083 million euros), with the remaining 55 % funded via equity capital (including 821 million euros of third-party receipts).

Since 2002, cleanup and dismantling operations in the CEA's civilian sites, as well as the long-term management of radioactive waste, have been financed by a specific fund set up in 2001 and supplied by the income of *CEA Industrie* and by the contributions made by industrial operators and CEA partners towards dismantling costs. The fund comes under the CEA's responsibility; its use is controlled by a monitoring committee in order to review annual expenditures and their eligibility for funding, multi-year expenditure plans and the management of financial assets. Annual expenditures in 2009 amounted to approximately 236 million euros.

Similarly, the cleanup and dismantling operations at the UP1 Plant, which were funded by the dedicated National-Defence Fund, amount to approximately 266 million euros.

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 2009, its budget amounted to 82 million euros.

F.2.2.2.2 - Human resources

On 31 December 2009, the CEA had 15,756 permanent employees, including 56.6% managerial staff and 43.4% non-managerial staff. There were 11,274 employees working for civilian programmes and 4,482 for the Military Application Directorate. The female employment rate reached 30.4%. In addition, the CEA welcomed 1,182 doctorands and postdoctorands, 424 apprentices and 1,324 trainees.

The employees working for civilian programmes are distributed over the five following sites: Saclay, Cadarache, Marcoule, Fontenay-aux-Roses and Grenoble.

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.

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.

At the end of 2009, the ILL had 475 employees with 24 different nationalities (36% managerial and 64% non-managerial), 25 of which were assigned to safety. The ILL also relies on the CEA's know-how.

F.2.2.3 - AREVA's human and financial resources

F.2.2.3.1 - Organisation of AREVA

AREVA's major shareholders at the end of 2010 are shown in Table 20.

Line managers within each unit are responsible for assigning fully-qualified staff to the achievement of necessary tasks and for assessing their skills. In order to achieve that goal, managers refer to basic training and to experience; they also identify any need for further training, qualification and certification for specific tasks. They are supported by the Human Resources Division and its functional branches on the various sites, which are responsible for providing training and maintaining training records.

Shareholder	Share in %
CEA	78.96
French State	8.39
Bearers of investment certificates	4.03
Deposit and Consignment Office (*Caisse des dépôts et consignations*)	3.59
EDF	2.42
Total	1.02
Calyon	0.96
Framépargne	0.42

Table 21 : Distribution of AREVA shareholders

In 2009, the turnover of the AREVA' Group amounted to 8,529 million euros and the net income of the Group reached 552 million euros.

At the end of 2009, the Group had a staff of 79,444 employees, 59% 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.

Pursuant to Article 7 of the 1984 *Quality Order,* ASN checks on a regular basis the consistency between human-resource and safety requirements during monitoring visits.

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 dismantling 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 2009 totalled 5,308 million euros at present value and covered the liabilities of the 20 INBs owned by the group and referred to in Article 20 of the *2006 Planning Act*. Provisions concern the following subsidiaries and facilities: AREVA NC at La Hague. Marcoule, Pierrelatte, Cadarache, Obligations/SICN; COMURHEX at Pierrelatte/Malvési; MÉLOX SA at Marcoule; EURODIF and SOCATRI; SOMANU at Maubeuge, and CERCA and FBFC at Romans.

The liabilities concerned include: facility dismantling, waste-recovery and conditioning programmes and existing waste with no management solutions.

On 31 December 2009, the realisable value of that liability coverage was estimated at 5,379 million euros.

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 100% (within the scope defined by law). Moreover, as early as December 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 cleanup and dismantling 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 2009, corresponding provisions totalled 352 million euros at present value.

F.2.2.4 - EDF's human and financial resources

F.2.2.4.1 - Human resources

The staff working at EDF's Nuclear Power Generation Division (*Division de production nucléaire* – DPN), which is in charge of operating nuclear reactors, amounts to approximately 19,200 employees who are distributed among the three poles, as follows: operating staff (about 3%), supervisory staff (about 67%) and managerial staff (about 30%).

In addition to those 19,200 members of staff who are directly involved in the operation of EDF's current fleet of 58 nuclear reactors, EDF also dedicates human resources to the design, new construction; engineering of the reactors in service and supporting functions, as well as the deconstruction of nuclear reactors, as follows:

- about 4,000 engineers and technicians from the Nuclear Engineering Division (*Division ingénierie nucléaire* – DIN), distributed throughout the pole categories as follows: 74% managers and 26% supervisors;
- close to 170 engineers and technicians in the Nuclear Fuel Division (*Division combustible nucléaire* – DCN), and
- more than 600 engineers and technicians in the Research and Development Division (EDF R&D).

Specific human resources are devoted to nuclear safety and radiation protection. EDF has designed its organisation to ensure that a large majority of employees spend a significant proportion of their time and activities on those two issues. EDF's accountability and decentralisation policy and the development of a safety culture within work teams ensure that nuclear safety and radiation protection form an integral part of work involved in the planning, execution, inspection and review of interventions.

If we look at staff members whose mission and activities are conducted exclusively in the field of nuclear safety (safety engineers at NPPs, safety specialists and experts in central services, engineering groups and inspection units), there are more than 300 people to be taken into account.

A similar number of staff deals with safety and radiation protection.

In 2006, EDF implemented an in-depth programme designed to secure skills and career paths for the staff, in order to start preparing for the generational handover. An initiative launched at the end of 2005 on the basis of homogeneous principles for all NPPs, and prepared through successive iterations with a detailed focus on field realities, has secured sufficient development potential to ensure the renewal of skills. Those programmes are specifically monitored, co-ordinated and controlled.

F.2.2.4.2 - EDF's financial resources

In 2009, EDF's net power output in France amounted to 447.7 TWh, including 390 of nuclear origin (87%). In 2010, its nuclear power generation increased by 4.6% and reached 408 TWh.

From the French standpoint, the total output was 518.8 TWh in 2009 and 550.3 TWh in 2010, with the share of nuclear power generation representing 75 and 74% in 2009 and 2010 respectively. The balance between contractual exchanges was 25.7 and 29.5 TWh in 2009 and 2010, respectively.

In 2010, the EDF Group posted consolidated revenues of 65 165 million euros, a net Group share income of 1 020 million euros and a gross operating surplus of 16 623 million euros.

The provisions created by EDF (in present values in accordance with international standards) at the end of 2010 amounted to about 15 360 million euros for the back-end of the nuclear fuel cycle (management of spent fuel and radioactive waste) and to about 13 419 million euros for the deconstruction of NPPs and the last core.

Those provisions were created on the basis of estimated waste-processing and disposal costs, at a gradual rate determined by burnup in the reactor with due account of future expense schedules.

With regard to the dismantling 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 dismantling EDF's 58 power reactors currently in operation, plus the assets for dismantling nine EDF reactors permanently shut down, for which deconstruction 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.

Pursuant to the decision of its Board of Directors in June 1999, EDF has gradually started in financial year 2000 to constitute dedicated assets via annual allocations. On 31 December 2009, they represented a market value of 11.4 billion euros.

In the light of all above-mentioned information, 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.

F.2.3 - State control

F.2.3.1 - ASN analysis in the framework of the licensing system

In 2007, nuclear operators submitted their first triennial report in accordance with the provisions of Article 20 of the *2006 Planning Act*. ASN sent its opinion to the government about the consistency of the proposed strategies fordismantling facilities and managing spent fuel and radioactive waste (20 November 2007 Opinion).

In 2008 and 2009, ASN reviewed the new elements sent by operators in their annual update notes. ASN recognised that notable efforts had been made in order to respond to the questions raised in the above-mentioned opinion, but that further actions were needed.

In 2010, ASN and the DGEC verified upon several occasions with operators the relevant preparation modalities for the triennial status reports and updating notes and reminded them of regulatory requirements, notably with regard to Article 2 of *Decree No. 2007-43 of 23 February 2007* (Paragraph II of that article requites that the operator assess INB-dismantling charges on the basis of an analysis of the different options, which are reasonably foreseeable to conduct the operation after selection). With due account of the experience acquired during the first year, ASN has undertaken to prepare a guide intended for operators in order to clarify the justifications for regulatory requirements, notably with regard to the description of technical and assessment scenarios for the corresponding charges.

In 2010, ASN reviewed the second triennial reports submitted by the operators in accordance with Article 20 of the *2006 Planning Act*. It noted that the objectives of operators with regard to dismantling were consistent with ASN's policy (immediate dismantling, final state). ASN recommended that:

- in the case of advances dismantling projects, operators indicate their method to assess the uncertainties weighing not only on the cost of dismantling and waste-management operations, but also on the contingencies;
- in the case of the facilities to be dismantled over the medium or long term, operators justify their potential gains associated with scale or reproducibility effects to be estimated on the basis of the completed operations and, re-assess, if need be, the dismantling charges involved, and
- databases and the methods used by operators be audited as prescribed by Article 13 of the *23 February 2007 Decree.*

F.2.3.2 - Control of the administrative authority for securing the funding of long-term nuclear charges

As for funding the dismantling and the management of radioactive waste, Article 20 of the 2006 Planning Act describes the control modalities for financial securisation, whereas the obligations to be borne by operators are described in § B.1.6.1.

The administrative authority consists jointly of the Ministers in charge of Economy and Energy. The DGEC assumes that mission by delegation from the relevant Ministers. Pursuant to Article 20 of the *2006 Planning 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 dismantling 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.

The administrative authority disposes of prescriptive and sanctionary 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 impose 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 Article 20 of the *2006 Planning Act* 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 Article 20 of the *2006 Planning Act* has also created a second-level control entity, called the National Assessment Committee for the Financing of the Dismantling 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.

F.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. The dangerousness level of those facilities does not seem to justify any additional provisions. In the event of a defaulting operator, special mechanisms supported by public funds exist for resolving hazardous situations for the public or the environment.

As far as mines are concerned, no new licence may be delivered today prior to the presentation of the work-cessation conditions and a related cost estimate. Since such requirement did not exist in the past, all French uranium mines are not covered by that provision. 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.

F.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.

F.3 - Quality assurance (Article 23)

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.

F.3.1 - ASN requirements concerning INBs

The *1984 Quality Order* provides a general framework for the steps any INB 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 major purpose of the Order is to specify the satisfactory quality level to be sought through specific requirements, to be achieved through appropriate skills and methods, and to be maintained by compliance checks.

The 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 operator:

- "for quality-related activities carried out by suppliers, shall ensure that contracts include the notification to those suppliers of the applicable steps for the enforcement of [the] order;
- shall supervise or have supervised all his suppliers in order to ensure that they comply with the notified steps. More specifically, he shall ensure that any provided goods or services are duly controlled in order to verify compliance upon request, and
- must constitute and update a file summarising the planned steps and means for enforcing [the] Order; more particularly, the operator must use it to describe his supplier-monitoring criteria".

ASN must control that all operators comply with the 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. According to Article 8 of the Order, all INBs must include an internal review team of quality-related tasks that must be independent from the teams who conducted them. The efficiency of internal verifications performed by operators is also assessed by ASN through inspections.

Lastly, experience feedback from incidents and accidents occurring in INBs, the analysis of malfunctions, together with inspection findings, all enable ASN to assess the compliance of every INB operator with the Order.

F.3.2 - Steps taken by INB operators

F.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 *2006 Planning 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.5.6.

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 Quality Order for INBs. It started in 2001 with the certification of its organisation with regard to ISO-9001 and ISO-14001 Standards. It followed in 2010 with the triple certification by the French Standardisation Agency (*Agence française de normalisation* – AFNOR), which covers all ANDRA's activities throughout its sites.

F.3.2.2 - CEA's and ILL's Quality Assurance Policy and Programme

The CEA is strongly committed to a continuous-improvement approach relative to all activities that impact on the Commission's performance, an approach that 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 seen as 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 CEA's key quality actions focus on project management, process identification, interface management, the availability of up-to-date and accessible guides and suitable training. The CEA is generalising the implementation of quality-management systems, and most divisions have launched initiatives with regard to ISO-9001, ISO-14001 and OHSAS-18001 certifications or ISO-17025 laboratory-accreditation (sound laboratory practices).

The Nuclear Energy Division and its three operational subdivisions (Cadarache, Marcoule and Saclay's Nuclear Activities, are mostly in charge of the CEA's fuel and waste processing and storage facilities and have been granted the ISO-9001:2008 certification for all their activities.

Insofar as the environment is concerned, the Saclay, Marcoule and Cadarache Centres all have received the ISO-14001 certification. As for safety, the Cadarache and Marcoule Centres have obtained the OHSAS-18001 certification of the Occupational Health and Safety Assessment Series in 2008.

Eventually, the CEA intends to set up integrated management systems by merging, as a priority, the quality, security, nuclear-safety and environmental systems. With regard to INBs, a first step towards that goal has made it possible to combine the quality requirements of the *1984 Quality Order* with those for the ISO-9001:2008 Standard.

In the area dealing with INB design, building, operation and dismantling for radioactive-waste management purposes, the CEA has a methodological baseline guide on project management with special instructions on "managing facility projects" and "cleanup and dismantling projects", which highlight the major steps in relation to regulatory obligations.

Good practices are identified, enhanced and made available to all units. Comments and non-conformities may be noticed thanks to audits and internal inspections, thus generating corrective and preventive actions.

F.3.2.3 - AREVA's Quality Assurance Policy and Programme

AREVA adopted a charter of values in which the priority is given to a very high safety level to be applied especially in the nuclear field.

AREVA is committed to a sustainable-development approach since 2001. In the framework of that approach, the purpose is described by 10 structuring commitments.

A Nuclear Safety Charter (accessible on AREVA's website: www.areva.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; voluntaristic 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.areva.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) rests on six commitments regarding environmental management.

A self-assessment and sorting system of the AREVA Group's orientations in target maps and progress plans is useful to lead the continuous-improvement efforts up to the establishments.

With regard to quality, AREVA's first quality-assurance manual was published in 1978, two years after the company was created.

Management systems 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 reprocessing-recycling at AREVA NC Sites in La Hague and Pierrelatte, MÉLOX. That certification is subject to periodical re-assessments to be carried out by a third-party organisation.

In addition, environment-analysis, medical and dosimetry laboratories are accredited in their own field by ASN in accordance with the 8 July 2008 Order concerning the validation of ASN's Resolution No. 2008-DC-0099 of 29 April concerning the organisation of the National Network of Radioactivity Measurements in the Environment (*Réseau national de mesures de la radioactivité de l'environnement*) and specifying the laboratory-certification modalities, which include the following:

- the laboratory analyses of radionuclides present in all types of samples in the environment – 135 :radionuclides in the environment, and
- the protection of workers against the hazards du to ionising radiation, and
- radiological measurements.

The *1984 Quality Order* was incorporated into the procedures and appears as such in the *Quality Assurance Manual*. It is a key element in achieving safety objectives.

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 Cleanup 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-cleanup markets (accessible from www.areva.com).

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).* Every indicator, which was developed by a group of experts, is the subject of a fact sheet describing the data to be transmitted and the calculation procedure.

F.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 dismantling 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.

Hence, there are three objectives:

- to consolidate achievements and to improve results in accordance with a continuing-progress dynamics ;
- to ensure the adherence of stakeholders to the quality system, through their commitment in its implementation and improvement, and
- to have a quality system consistent with French regulatory requirements, international quality recommendations and effective practices and methods highlighted through experience feedback.

The quality management policy, which covers primarily safety-related activities, relies on the following objectives:

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.

Acquired experience contributes to the development of the quality system regarding the following items:

- the overall picture of any activity;
- a preliminary reflection at each step of the process;
- the need to tailor quality-system requirements to significant activities for safety, availability, cost-control and human-resource management, and
- the involvement of every stakeholder in the quality-achievement effort: managers, staff, suppliers, etc.

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 INBs, 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.

In addition, an improvement programme has been launched in order to reinforce the quality of the partnership between service providers and deals mainly with the following:

- assistance in the development and renewal of skills with regard to service-provider staff;
- the quality of interventions (classification of companies, redefinition of monitoring, etc.);
- innovating contracts adding extra weight to the "lowest responsible bidder", and
- facilitation of field-intervention conditions.

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 reprocessing 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 nuclear-waste database are taken from EDF's *Quality Manual* in the same way as for safety-related activities.

The spent-fuel computer database is independent from EURATOM's accounting rules for nuclear materials.

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).

F.3.3 - ASN control and its analysis

Inspection reports and experience feedback from incidents occurring in INBs help ASN verify and analyse compliance with the provisions of the*1984 Quality 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, as in the case of the CEA in 2010.

ASN notes that, in general, quality-assurance requirements are fulfilled by the larger nuclear operators.

Operators subcontract the large majority of their INB-maintenance operations to outside companies. While that industrial policy remains the strategic choice of the operators concerned, ASN verifies their compliance with the provisions of the *1984 Quality Order* 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.

Overall, nuclear industry has proven to be a pioneer for quality assurance in France, thanks to the *1984 Quality Order* requiring that relevant steps be taken. Since then, new widespread quality references have been appearing in the industry, notably via the ISO-9000 and ISO-14000

Standards. Nevertheless, the *1984 Quality Order* will be superseded by the future INB Order in order to take into account both the experience acquired over the last decades and WENRA's reference levels.

F.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 at the end of 2009. 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 an 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. 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).

F.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, provide for suitable steps to trace back every movement of those sources.

The monitoring of every movement (acquisition, transfer, import, export) lies with the IRSN, which must promptly 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. With the assistance of the IRSN, 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.

F

F.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.

F.4.1 - General framework of radiation protection

F.4.1.1 - Legislative bases of radiation protection

Radiation-protection regulations have been entirely overhauled over the last five years.

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 undertook 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.

In accordance with the *TSN Act,* it is ASN's responsibility to license the commissioning of any INB 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.

F.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.

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 cm²), respectively. Any dose in excess of those limits is deemed unacceptable and is liable to administrative or criminal penalties.

F.4.1.1.2 - Labour Code

Articles L230-7-1 and 2 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*.

F.4.1.2 - Regulatory aspects concerning human protection against ionising-radiation hazards due to nuclear activities

F.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) have been reduced to 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.

F.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 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 outside INBs.

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). 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*

F

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*)*.

The management of waste and effluents generated by INBs 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. 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 INBs 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).

F.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.* INBs 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).

F.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.

F.4.1.3 - Radiation protection in INBs

"Nuclear activities" include those performed in INBs, 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 *TSN Act* and the *2 November 2007 Decree*, all INB 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 dismantling.

INBs 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 INBs 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.

F.4.1.4 - INB discharge licences

F.4.1.4.1 - INB 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.

In that respect, INBs are subject to the provisions of the *TSN Act* and of the *2 November 2007 Decree* abrogating *Decree of 4 May 1995.*

The *TSN Act* modifies substantially the conditions under which INB discharges are regulated.. The purpose of the change is to integrate better environmental considerations with nuclear-safety and radiation-protection issues through the creation- or dismantling-licence application. Consequently, the operator is now required to submit a single application covering all aspects in the form of a creation- or dismantling-licence application. The content of the application and the matching procedure are detailed in the *2 November 2007 Decree.* If approved, the application is followed by a licensing decree. ASN then sets out the relevant technical considerations relating to discharges (limit values, monitoring, information, etc.) through technical prescriptions. With regard to specific discharge limits, ASN's resolution is subject to the validation of the Ministers 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.

For several years, ASN has undertaken to review discharge limits as close as possible to actual discharges, thus maintaining a strong incentive for operators. ASN is thinking of completing that approach by requiring INB operators to establish a yearly forecast of their planned discharges. That forecast, which will be obviously inferior to the regulatory limit, is designed to encourage operators to manage their discharges according to the finest technical forecasting method possible.

Moreover, in accordance with Article 37 of the *EURATOM Treaty*, France provides the EC with general data on all planned discharges of radioactive effluents.

F.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 INBs, because they stem from the same laws (in particular *Law No. 92-3 of 3 January 1992 Concerning Water*).

Mine discharges are regulated by the second part of Title "Ionising radiation" of the *General Mining Industry Regulations*. The commissioning licences issued by prefectoral 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.

F.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*[5] 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

---

[5] *All authorised or declared nuclear activities are concerned, except for those that are performed in the following facilities:*

- *INBs ;*
- *nuclear activities and facilities associate with National Defence, and,*
- *facilities subject to licensing, pursuant to Article 83 of the* Mining Code*.*

F

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*.

F.4.2 - Radiation-protection steps taken by INB operators

F.4.2.1 - Radiation protection and effluent limitation at ANDRA

Radiation protection and effluent minimisation of are key areas in ANDRA's environmental policy.

F.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.3.3.2 and D.3.3.3, 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 CSFMA, 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.

F.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 CSFMA and by the Prefect for the CSTFA), and
- detecting any anomaly as early as possible.

Radioactivity is measured in air, surface waters (rivers, run-offs), groundwaters, rainwaters, river sediments, flora and the food chain (e.g., milk). Facility personnel are submitted to individual dosimetric monitoring.

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 2010, the maximum recorded doses at the CSFMA and the CSTFA were 1.29 and 0.014 mSv, respectively (active dosimetry).

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.

F.4.2.1.3 - Effluent discharges and releases from ANDRA facilities

In order for the CSM to move unto 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 unto the monitoring phase is conducted in the same way as for the creation of an INB, 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 2010 at less than 10^{-4} µSv for discharges into the sea and at 0.36 µSv for discharges into the closest stream.

With regard to the CSFMA, discharge conditions are regulated by the discharge Order of 21 August 2006 and Decree No. 2006-1006 of 10 August 2006.

Radioelements	Gaseous discharges (GBq/a) (conditioning workshop)	Liquid discharges (GBq/a)
Tritium	50	5
Carbon-14	5	0.12
Iodines	2.10^{-2}	–
Other beta-gamma emitters	2.10^{-4}	0.1
Alpha emitters	2.10^{-5}	4.10^{-4}

Table 22 : Discharge limits prescribed for the CSFMA 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 2010, the discharges at the CSFMA resulted into a low impact, as calculated for a hypothetical reference group in the order of 0.001 µSv/a (0,003 µSv/a according to the hypothesis of using the waters for drinking purposes).

F.4.2.2 - Radiation protection and effluent limitation at the CEA and ILL

F.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 dismantling.

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.

Over the last few years, occupational exposures on all CEA sites have been relatively stable in terms of the collective and individual doses received by internal staff. The average annual dose per exposed CEA employee fell to 0.6 mSv in 2009 (against 0.8 mSv in 2002).

In addition, none was exposed to a higher dose than 10 mSv and the maximum dose received by a CEA employee was 4.33 mSv.

In 2009, 7,142 CEA employees were monitored with dosimeters and 87 % of them did not receive any dose.

The total amount of occupational exposures on all CEA sites show low external exposure levels.

Hence, in 2009, the average dose for CEA employees who were actually exposed is equal to 0.31 mSv (against 0.67 in 2008). That variation in the average dose is due to the 50% increase in the number of employees who were actually exposed, whereas the total dose received by all employees remains relatively constant, the maximum dose received by a CEA employee having been 4.9 mSv.

	ILL	EMBL	Experimentators	Intervening companies	Total
Number of monitored persons	445	34	1666	353	2498
Number of zero doses	329	34	1518	311	2192
Collective dose [man.mSv]	34.84	0.00	23.47	8.91	67.22
Maximum individual dose [mSv]	1.85	0.000	1.05	1.10	1.85
Average individual dose [mSv]	0.078	0.000	0.014	0.025	0.027

Table 23 : Doses received by intervening persons at the ILL in 2009

With regard to the ILL, doses are decreasing compared to 2008; the average individual dose is very low at 0.027 mSv. The maximum individual dose (1.85 mSv) was received by a person involved in mechanical maintenance. Zero doses correspond to doses that were inferior to the recording threshold of dosimeters, (i.e., 0.05 mSv).

With regard to internal exposures, only exposures to tritium exceeded the detection threshold and the collective dose amounted to 0.590 mSv spread among 23 persons of the ILL.

F.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.

F.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 (interministerial 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 2009, the CEA laboratories, certified by the French Accreditation Committee (*Comité français d'accréditation* – COFRAC), analysed 23,000 samples collected in the environment. The results of those measurements are distributed both internally and externally. As a major actor of the National Network of Radioactivity Measurements in the Environment (*Réseau national de mesures de la radioactivité de l'environnement*) since its inception, the CEA forwarded 32,000 results in 2009.

The continuous improvement in the performance of the facilities and processes has been useful for many years to reduce gaseous and liquid discharges in the environment. That regular decrease is being confirmed, and discharges remain very much lower than authorised limits on each site.

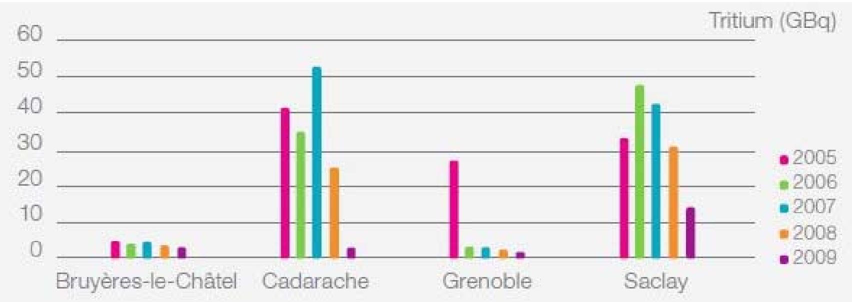

Figure 5 : Report of liquid effluent discharges from major CEA facilities between 2005 and 2009

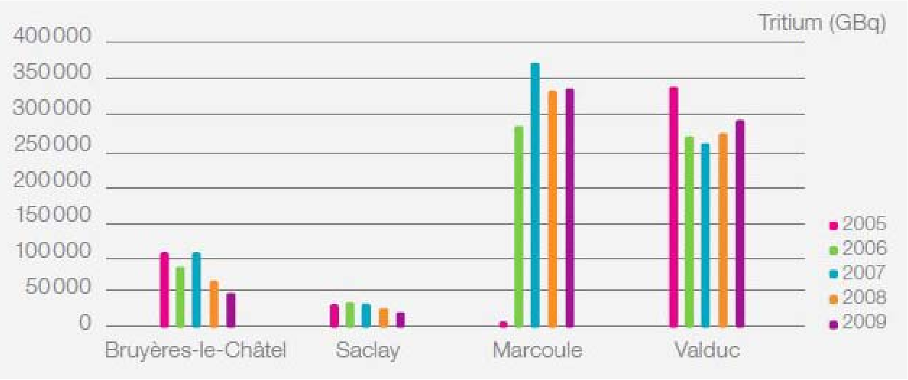

Figure 6 : Report of gaseous effluent discharges from major CEA facilities between 2005 and 2009

The dosimetric impact of discharged radioactive waste remains very low. Under extremely conservative conditions, calculating that impact by factoring in the source term of recent gas and liquid discharges gives annual values that are at the most equal to 5 µSv for the most exposed reference group to gas emissions and liquid discharges at Saclay. For the other CEA sites, the dosimetric impact is lower than 1 µSv, which may be compared with reference values, such as the regulatory limit for the public (1 mSv/a) or the of the average annual dose equivalent received via natural radioactivity (i.e., 2.4 mSv/a in France).

F.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), groundwaters (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 groundwaters 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.

F.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) and CEA website (www.cea.fr). All CEA sites maintain regular contacts with their local authorities and, if it exists, with the relevant CLI.

The accreditation by the 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 implemented by the National Network of Radiological Measurements in the Environment (*Réseau national de mesures de la radioactivité de l'environnement*).

F.4.2.3 - Radiation protection and limitation of effluent discharges at AREVA

F.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.

According to facts, that target was easily reached, since the average occupational individual exposure at La Hague was only 0.098 mSv in 2006 (for both AREVA and subcontractor employees), while the collective dose amounted to 0.505 man.Sv.

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 b, 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 µSv/a in 1985 has stabilised at around 10 µSv/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 efficient 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.

F.4.2.3.2 - 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 of 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, LIL 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 and 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.

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.

F.4.2.3.3 - 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 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 Malvési) were all granted by ASN the relevant certifications for the analyses they performed.

F.4.2.3.4 - Public information

AREVA communicates on a regular basis and in full transparency the results of the measurements made in the environment under the control of ASN, via monthly publications and its website. In France, the CLIs promote direct exchanges with the main local stakeholders; the officers responsible for AREVA establishments inform them notably about the measurements relating to the environment and to safety, and reply to the questions raised by elected officials and associations.

In addition, every INB 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, and
- 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. That report is accessible on line on AREVA's website (www.areva.com)

Both those annual reports, which are intended for public distribution, are addressed not only to ASN, but also to all national and local administrations involved and to the relevant CLI by 30 March or 30 April of the following year, respectively, but also to the HCTISN and the CLI by 30 June.

AREVA also issues a reference document, which is available on its website (www.areva.com).

F.4.2.4 - Radiation protection and effluent limitation at EDF

F.4.2.4.1 - 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, such as the fact that the dose of only three interveners ranged between 16 and 20 mSv in 2010.

Special measures have been taken to limit the highest individual doses. In 2007, no more than 20 workers received a dose varying between 16 and 20 mSv.

In its constant efforts to progress, EDF launched a new ALARA initiative in 2000 as part of a broader development of the optimisation principle as a whole. In that context, the collective dose per reactor decreased further to 0.62 man.sievert in 2010. The initiative is based on three improvement areas, as follows:

- reduced contamination in systems (zinc injection, decontamination work, 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.

The dose-analysis process, which ranges from initial assessment to final optimisation and ends with the integration of experience feedback, is now carried out using a new 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.

In addition, EDF has introduced an initiative with a view to enhancing the safety and security of radiological examinations, in close co-operation with industrial-gammagraphy contractors.

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. 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 one of those values 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 constantly over the past 10 years.

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 packagings

F.4.2.4.2 - Effluent discharges

General regulations regarding the discharges of radioactive effluents provide:

- the relevant procedures for obtaining discharge licences;
- discharge standards and conditions, and
- the role and responsibilities of nuclear-site managers.

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.

Those measures have led to a drastic reduction in liquid effluent discharges, except for tritium and carbon-14, 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 µSv/a) and the exposure limit for the members of the public (1,000 µSv/a).

F.4.2.4.3 - Environmental monitoring

Environmental monitoring encompasses ongoing monitoring of the environment, as well as measurements relating to radioactive and non-radioactive discharges into the environment. Since the environment includes everything outside the radiation-controlled area, site roads and radiological checks upon leaving the site fall within the scope of environmental monitoring.

Since environmental monitoring is a regulated activity, its quality must be monitored and the operator is required to perform the following three technical functions:

- alert;
- control, and
- tracking and analysis.

The alert function is designed to provide prompt notification regarding environmental anomalies. It concerns variations in measurements that may be directly linked to the operation of an NPP.

At EDF, the alert function encompasses monitoring at the point of emission and the continuous recording of the ambient gamma radiation around the NPP, the automatic chemical monitoring of the receiving environment for riverside NPPs, and radiation-monitoring portals when entering or leaving the site.

The control function covers the monitoring activities prescribed by discharge licences and relating to the presence of radioactivity during road transport.

The scientific tracking-and-analysis function includes identifying and forecasting changes: follow-up of integrated parameters, radioecological studies (decennial and annual reviews, specific studies, hydrobiological campaigns).

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.

The analysis of radioecological-monitoring results confirms that atmospheric discharges have no impact on the terrestrial environment. With regard to the water environment, radioelements contained from liquid discharges from NPPs are detected in trace quantities in sediments and water vegetation close downstream from the point of discharge.

F.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.*

F.5.1 - General emergency preparedness in INBs

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 described in the *Interministerial Directive of 7 April 2005.*

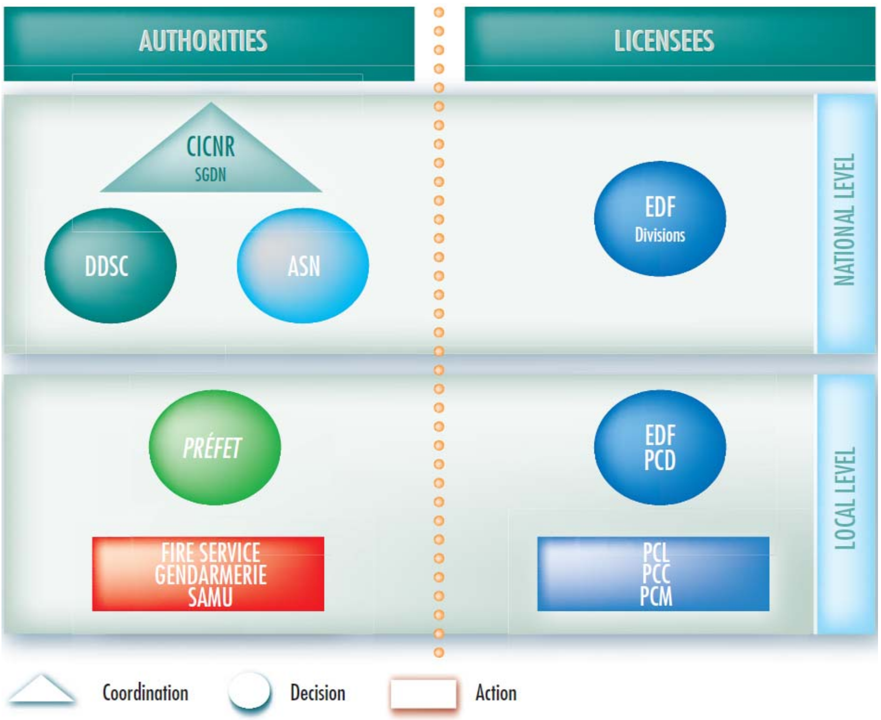

Figure 7 : Typical diagram of crisis organisation for a nuclear reactor operated by EDF

CICNR *: Comité interministériel aux crises nucléaires ou radiologique* – Interministerial Committee for Nuclear or Radiological Emergencies.

SGDN: *Secrétariat général de la défense nationale* – Secretariat-General for National Defence.

DDSC: *Direction de la Défense et de la sécurité civile* – Directorate for Defence and Civil Security.

PCD : *Poste de commandement de direction* – Managemeny Command Post.

PCL: *Poste de commandement local* – Local Command Post.

PCC: *Poste de commandement contrôle* – Supervision Command Post.

PCM: *Poste de commandement moyens* – Resources 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 may be signed with the authorities of bordering countries.

F.5.1.1 - Local organisation

Only two parties are authorised to take operational decisions during an emergency situation:

- the operator of the INB 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.

F.5.1.2 - National organisation

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.

F.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 INBs, 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.

F.5.1.2.2 - Technical bases and countermeasures of emergency plans

The content of emergency response plans must provide suitable responses to INB 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 (especially iodine-131), 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.

F.5.2 - ASN role and organisation

F.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 a four-fold duty:

- to ensure the soundness of the steps taken by the operator;
- to advise the government;
- to take part in the dissemination of information, and
- to act as competent authority in order to comply with international conventions.

F.5.2.2 - Prescribed ASN structure with regard to nuclear safety

In the event of an incident or accident occurring in an INB, ASN is responsible, together with the IRSN's technical support, for setting up a suitable structure at both the national and local levels, as follows:

National level

- a decision-making or main control centre (poste de commandement direction – PCD), designed to adopt positions or take decisions with a view to assisting the Prefect in his capacity of director of emergency operations, but not to conducting a technical analysis of the accident in progress;
- a communication structure, relying on the support of an information cell, located close to ASN's main control centre and led by an ASN representative, and
- an IRSN technical team on duty at IRSN's technical emergency response centre, whose task is to work in close co-operation with the operator's technical teams in order to reach a consensus about the nature and scope of the accident situation and to anticipate how it will develop and what its likely impact might be.

Local level

- a mission designed to assist the Prefect and a mission on the accident site, with a view to help the Prefect in his decisions and communication actions and to ensure the soundness of the decisions made by the operator, and
- an IRSN representative who takes over the cell measures within the central operational station (poste de commandement opérationnel – PCO) in order to co-ordinate field radiological measurements.

F.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.

F.5.2.4 - ASN's role in emergency preparedness

F.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 INB. 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.

F.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.

F.5.2.4.3 - Post-accident Steering Committee

In order to develop a post-accident doctrine, ASN has focused on that aspect throughout national and international drills, such as INEX3, and has initiated an overall reflection by gathering all interested actors within a Post-Accident Steering Committee (*Comité directeur chargé de l'aspect post-accidentel* – CODIR-PA). Led by ASN, the Committee consists of representatives from various Ministry units concerned by the topic, as well as health agencies, associations, CLIs and the IRSN.

F.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.

F.5.3 - Emergency preparedness for accidents in non-INBs

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.

F.6 - Dismantling (Article 26)

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.

F.6.1 - ASN requirements concerning INBs

F.6.1.1 - Definitions

ASN has provided the following definitions:

Cleanup : "Cleanup" corresponds to the operations undertaken in order to reduce or to eliminate any residual radioactivity or any other residual dangerous substance.

Decommissioning : *(from classification)*
"Decommissioning" is an administrative procedure consisting in cancelling the facility from the list of INBs. Hence, the facility is no longer subject to the legal and administrative regime for INBs, thus assuming that all dismantling work has been completed and that the status of the facility has been justified in relation to the objectives set by the decree (verified final status).

Dismantling : "Dismantling" designates the overall technical and administrative activities to carry our in order to achieve a predefined final state of the facility that would allow for its decommissioning to take place. The dismantling phase succeeds the operating phase of the facility and ends at the end of the decommissioning process. The term itself of "dismantling" is close to that of "decommissioning", as defined by the IAEA in its glossary.

Since a large number of INBs 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 dismantling phase. As mentioned in § D.5, more than 40 facilities of all types (nuclear power or research reactors, laboratories, fuel-reprocessing plants, waste-management facilities, etc.) were already shut down or undergoing dismantling in 2010. In that context, the safety and radiation protection of dismantling operations have gradually become major topics for ASN.

F.6.1.2 - Dismantling 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, ASN favours the immediate-dismantling strategy, which prevents especially future generations from carrying the technical and financial burden of dismantling operations. Any other option must be strongly justified by the operator. For the time being, all major French operators have committed themselves to the immediate-dismantling strategy for the current facilities intended for dismantling.

ASN requires that a strict distinction be made between the operating and dismantling phases (see § E.2.2.4.5). In fact, the dismantling 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 dismantling 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.

ASN recommends that the final state be such that all dangerous substances, including non-radioactive ones, have been removed from the facility, as in the case of radioactive or dangerous waste. If a full cleanup is impossible to achieve, the operator must justify that situation in his dismantling plan, although it must remain exceptional.

Consequently, ASN considers that managing waste resulting from dismantling operations constitutes a significant element that conditions the sound occurrence of dismantling programmes under way (availability of systems, management of waste streams). Hence, waste-management procedures are assessed systematically during the review of the overall dismantling strategies of every operator.

The entire set of principles described above constitutes the base of ASN’s policy with regard to the dismantling and decommissioning of INBs in France. The document describing that policy was submitted for public comments in 2008, then tabled before the HCTISN, before it was published in 2010.

In addition, it should be noted that there is no universal clearance threshold for contaminated or likely-contaminated waste. The CSTFA accommodates VLL radioactive waste originating from nuclear-waste zones (in accordance with the facility zoning). However, special care should be given to optimisation in the management of VLL waste in order not to saturate prematurely the CSTFA.

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, AREVA) and whose main objective is to review:

- 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 dismantling and, more particularly, the availability of matching systems;
- the technical feasibility of the scenarios submitted for ongoing or upcoming dismantling worksites, and
- the specific structure set in place to manage those dismantling 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 of to assess the measures proposed by the operator in the supporting case of his creation-licence application, followed by the dismantling-licence application (or during the periodical reviews of the facility involved).

Lastly, ASN feels that the financial aspect of the future dismantling and the constitution of dedicated funds partake in the safety of the future dismantling operations. The obligations of the operators and the control measures are described in the *2006 Planning Act*, whereas the status report on that issue is addressed in § B.1.6, F.2.3.2 and F.6.4.

F.6.1.3 - Regulatory requirements

Specific regulatory requirements for dismantling are mentioned in § E.2.2.4.5. A guide for the enforcement of those requirements (ASN Guide No. 6) completes the regulatory system. ASN has also developed a draft guide concerning full-cleanup methodologies in INBs (draft guide No. 14). Both guides were updated in 2010.

The following paragraphs clarify a few significant issues.

F.6.1.3.1 - Dismantling plan

Regulations require that the operator provide a dismantling plan for every INB as early as he submits his creation-licence application. That plan must be updated on a regular basis and notably when notifying the decision for final shutdown (three years before the actual submission of the application) and when submitting the supporting case of the final-shutdown- and dismantling-licence application.

The plan must describe notably the following:

- the measures taken at the design stage in order to facilitate dismantling, together with the measures to preserve the history of the facility and the accessibility to related data, and to maintain skills and the knowledge of the facility;

- scheduled operations and dismantling steps;
- necessary equipment for dismantling purposes;
- waste-management systems, and
- the final state after dismantling, forecasts for the subsequent use of the site 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.

F.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 *TSN Act*, the shutdown and dismantling of any INB are subject to a prerequisite licence, to be delivered by decree 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 dismantling of his facility must describe the overall work being planned until the final state being sought. It must detail the scheduled work over the short term (approximately five years after the licence has been granted). The other activities to be carried out at a further date may be presented 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 dismantling (with the understanding that it must notably update the report referred to in Article 20 of the *2006 Planning Act* concerning his long-term costs for dismantling and radioactive-waste management), the operator must include an updated overview of his technical and financial capabilities.

The decree must specify which final state is being sought, the timeframe to achieve it and the potential deadlines requiring a pre-agreement for launching the corresponding work.

Technical prescriptions to be issued by ASN may accompany decrees 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.

F.6.1.3.3 - ASN licences and internal authorisations

For every hold point set in the licensing decree for final shutdown and dismantling, the operator must submit a case to ASN for review 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 activities that may have potential consequences on safety and provide the necessary justifying documents and updates. When activities do not threaten significantly the safety of the facility, 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"). That possibility, which is now included in the *2 November 2007 Decree*, ensures that the operator has the necessary industrial flexibility. However, it only applies to minor work with regard to safety. A resolution by ASN, dated 11 July 2008, specifies the requirements as well as the approval and control procedures by ASN. As mentioned above, any work bearing a significant involvement of the safety report of the facility or likely to cause a large increase in the impact on human beings and the environment require that the licensing decree be modified (Article 31 or 32 of the *2 November 2007 Decree*).

F.6.1.3.4 - Periodical safety reviews

For every INB undergoing dismantling, a safety review must be prepared every 10 years (unless otherwise prescribed), as in the case of INBs in service (see § E.2.2.3.1.4).

F.6.1.3.5 - Decommissioning

As dismantling operations progress, nuclear-waste zones are cleaned up and may be entitled for declassification in conventional-waste zones. The operator must declare to ASN any zone he wishes to decommission and must submit in support of his application a justifying case including a status report on the cleanup 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 decommissioned. The legal and regulatory aspects concerning such decommissioning 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 Ministers in charge of nuclear safety.

It appears necessary to preserve the memory of the past existence of INBs after their decommissioning 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 dismantled 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 INB 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.

F.6.1.3.6 - Miscellaneous

Provisions for discharges and more generally for the radiological protection of the staff and members of the public form an integral part of regulatory requirements.

Any update of the PUI when deemed necessary, must be transmitted to ASN before any dismantling operation begins.

All cases containing major decommissioning information must be kept in accordance with the quality-assurance requirements (10 August 1984 Order, which will be superseded by the INB Order in the near future).

F.6.1.4 - Financing of dismantling

In addition, the *2006 Planning Act* requires INB operators to assess the dismantling 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.1.6.1 and § F.2.3.2).

F.6.2 - Steps taken by INB operators

F.6.2.1 - Cleanup and dismantling of CEA facilities

The CEA instituted a proactive strategy consisting in the prompt dismantling of shut-down facilities, as follows:

- the radiological cleanup of the site as soon as the facility is shut down definitively, followed by dismantling up to a level equivalent to the IAEA's Level 3, excluding civil-engineering works;
- the allocation of prime contractorship to specialised companies;
- the completion of the dismantling/cleanup programme in Grenoble facilities by 2015;
- the cleanup and dismantling of the facilities at the Research Centre of Fontenay-aux-Roses, and
- the dismantling of the UP1 Plant as a priority at Marcoule.

Since about 20 facilities are concerned over the next decade (2011-2020), the programme represents a major endeavour in terms of volume and cost.

The total cost of the work is currently estimated by the CEA at about 9.3 billion euros.

With regard to the techniques to be used, the variety of facilities requiring cleanup 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 dismantling technology, monitoring and measurement techniques, 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 dismantling operations (special waste, such as radioactive graphite or asbestos) raises an additional obstacle for certain operations, even though the prospects of certain systems, such as the disposal of LL-LL waste, is now beginning to emerge.

F.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 up and dismantling the equipment and structural elements in the framework of a reference system relating to the final shutdown and dismantling of the facility.

The necessary costs for the performance of dismantling 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 dismantling plan, which will be developed henceforth as early as the preliminary phases of the facility.

The final objective of dismantling and cleanup 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 2010, the French facilities of the group nearing the end of their expected lifetime stood at various levels of advancement with regard to their cleanup and dismantling projects, as follows:

- nearing completion at SICN Annecy (ICPE) and Veurey (INB 65), with only one building to decommission on the Veurey Site;
- for INBs constituting the UP2-400 Plant at La Hague: a decree licensing the final shutdown and dismantling of INB 80 was issued in 2009; for INB-33, INB-38 and INB-47, the regulatory process to obtain identical decrees is under way, since the public inquiry took place in 2010;
- for EURODIF's Georges-Besse 1 Plant, which is still in service, but whose shutdown is scheduled by the end

of 2012, pre-dismantling operations of EURODIF's Intensive Rinsing and Venting Project (Projet de rinçage intensif suivi de la mise à l'air EURODIF – PRISME) and the subsequent dismantling scenarios are under study, and

- for INB-105 at COMURHEX Pierrelatte, the preparation of the supporting case for the licence application to shut down the facility and dismantling it is under way.

Thanks to the specific structure set in place by AREVA with the creation of the Business Unit (BU) for the Recovery of Nuclear Sites, it is possible to deal consistently with the above-mentioned activities by developing new safety and security reference systems relating to dismantling operations.

The structure includes various operating staves of the facilities at stake with a view to benefiting from their knowledge and the background of the facility. That initiative is in phase with AREVA's decision to favour immediate dismantling for its facilities.

Dismantling and cleanup operations are recorded and archived at least until the waste has nee, eliminated and the facility has been decommissioned.

F.6.2.3 - Steps taken by EDF

The objective of the EDF's current deconstruction programme is to complete the dismantling of the following 10 INBs:

- 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 (*2006 Planning Act*).

Type of facility	Unit	Power (MWe)	Commissioning year	Shutdown year	INB No.
6 GGR units	Chinon A1	70	1963	1973	133
	Chinon A2	200	1965	1985	153
	Chinon A3	480	1966	1990	161
	Saint-Laurent A1	480	1969	1990	46
	Saint-Laurent A2	515	1971	1992	
	Bugey 1	540	1972	1994	45
1 HWR	Brennilis	70	1967	1985	162
1 PWR	Chooz A	300	1967	1991	163
1 FNR (*Superphénix*)	Creys-Malville	1,200	1986	1997	91
2 silos at Saint-Laurent	Silos	–	–	–	74
1 conditioning and storage facility (ICEDA) under construction	ICEDA				To be built

Table 24 : EDF facilities involved in the dismantling 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 dismantling 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 dismantling licensing decree (DAD[6])	Beginning of public inquiry	CIINB[7]	Publication of dismantling licensing decree
Creys Malville	06/05/03	01/04/04	11/05/05	21/03/06
Brennilis	22/07/03	N/A	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

[6] *Dismantling licensing decree (*Décret d'autorisation de démantèlement – *DAD).*

[7] *CIINB:* Commission interministérielle d'information relative aux INB *(Interministerial Information Commission on INBs). It was cancelled in 2010 (see § E.3.4.3.1).*

Facility	Submission of case for dismantling licensing decree (DAD[6])	Beginning of public inquiry	CIINB[7]	Publication of dismantling licensing decree
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 25 : Administrative deadlines for a full-dismantling decree

The timescale of the programme as undertaken in 2002 is in the order of 25 years, which is equal to the timeframe required by ANDRA for making available the disposal facility for LL-LL waste prescribed by the *2006 Planning Act,* in order to store the graphite waste resulting from the deconstruction of GGRs.

In order to fulfil the programme, six projects are being created within the Deconstruction Engineering Unit (*Unité d'ingénierie dédiée à la deconstruction*), the Centre for Nuclear Deconstruction and the Environment (*Centre d'ingénierie de la déconstruction et de l'environnement nucléaire* – CIDEN) of the DIN, as follows: Chooz A, Creys-Malville, Brennilis, Bugey 1, Saint-Laurent-des-Eaux A (grouping A1 and A2 units and the graphite-sleeve interim-storage facilities) and Chinon A grouping the three A1, A2 and A3 reactors, to which is added the scheduled ICEDA storage facility for Type-B IL-LL waste, which is now under way.

The corresponding human and financial resources were mentioned in § F.2.2.4.

Those provisions guarantee that resources are adequate, that the documentation is tracked and kept and that those operations may be carried out under sound conditions.

F.6.3 - ASN analysis

ASN feels that current regulations allow dismantling programmes for nuclear facilities to be undertaken under good conditions. The regulations include basic requirements to ensure the safety of the relevant operations and the soundness of the final state of the facilities after dismantling. Similarly, it provides the necessary flexibility to proceed with such operations (with one single licensing decree per given INB, but with potential deadlines and the possibility to rely on an internal authorisation mechanism for minor operations).

It will be further completed by a future order concerning notably the control of risks and nuisances in INBs, from design to dismantling, after which ASN will publish the above-mentioned Guide No.14 (full-cleanup methodologies in INBs). Lastly, ASN will issue a cleanup guide for the polluted soil of dismantling sites.

F.6.3.1 - Operators' policy and strategy

ASN considers that the strategy of the major operators (EDF, CEA, AREVA NC) is consistent with the objectives described in its policy.

In fact, as mentioned above, all those operators have committed themselves to a dismantling policy and strategy for immediate dismantling. In general, the final state being sought refers to the total evacuation of radioactive substances. Radioactive-waste management is analysed and taken into account. The recovery and conditioning of historical waste may prove to be a hindering prerequisite with regard to the dismantling of a facility, such as the STE-2 facility at La Hague, whose dismantling requires that a conditioning solution be developed for the waste it contains or the boxes from GGRs, whose management system involving stacks of graphite waste remains to be determined.

However, ASN has noted delays in dismantling 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.). It is therefore essential to review periodically the overall strategy of every operator, as specified in § F 6.1. In practice, such review occurs about every five years.

In 2009, EDF submitted an updated version of its dismantling strategy. The document takes stock of the advances of the programme, points out significant milestones for the future and presents the state of the reflections on the dismantling strategy of the current PWR fleet. ASN and its technical support organisation are examining it and ASN will issue its conclusions in 2011.

In early 2011, ASN published an updated version of its dismantling strategy. The case is under review.

As mentioned in § F.6.2.2, AREVA-NC has submitted three licence applications for the final shutdown and dismantling of the UP2 -400, STE 2 and ELAN IIB, all of which are currently under review.

F.6.3.2 - Recovery of VLL materials

After noting that the CSTFA was currently receiving waste streams that slightly exceeded the forecasts made during the commissioning of that facility and adopting a resource-conservation policy, the 2010-12 PNGMDR, recommends that recovery leads be furthered for certain types of that waste in the nuclear system.

Until now, rare initiatives have been taken and implemented with a view to re-using metals, such as lead and steel originating from dismantling or maintenance operations.

That is the reason why, consistently with ANDRA, the PNGMDR requires waste producers to conduct studies in the nuclear sector concerning the recovery of metals and concretes originating from the dismantling of nuclear installations.

By the end of 2011, those producers will have to prepare a status report of the committed or expected actions aiming at recovering metal materials and assessing the feasibility and the timeliness of an industrial recovery schedule for their recycling in nuclear facilities, and especially in storage facilities.

Similarly, ANDRA must issue by the end of 2011 a report on the benefits and feasibility of recycling VLL concretes by crushing them notably as a substitute for sand, to fill voids between packages at the CSTFA.

ASN feels that such actions are necessary to determine which leads are likely to reduce the volumes of stored waste and to save space at the CSTFA. ASN will review later the reports involved.

F.6.3.3 - Internal authorisations

In October 2009, EDF submitted a comprehensive case presenting the update of its internal-authorisation system. After reviewing the case, ASN will prepare its resolution whether to approve the proposed system or not, as it did before in the case of the CEA.

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. Each time, an annex prepared by ASN and pertaining to the implementation of the relevant system was attached to the resolution.

ASN's review of the internal-authorisation system proposed by ANDRA is under way.

That possibility was applied first by the CEA. EDF followed suit with its facilities intended for dismantling (ASN's approval issued in February 2004). It has now been integrated the *Decree No. 2007-1557*.

ASN controls the operator's mechanism for internal authorisations with the understanding that it may, at any time, suspend or terminate that possibility.

ASN, for instance, feels that the operation of EDF's internal-authorisation system is generally satisfactory. A few improvements have been pointed out on the interaction between central services and sites in that field.

F.6.3.4 - Site activities

F.6.3.4.1 - EDF / Brennilis NPP

Following the cancellation of the licensing decree for the dismantling of the Brennilis NPP, a new case was prepared in July 2008 and submitted to a public inquiry. The Inquiry Commission received a negative response, estimating that the dismantling of the reactor block was premature due to the fact that the ICEDA facility was not operational yet. However, it felt that EDF could be licensed to conduct some other types of activities. In the opinion it submitted to the government, ASN recommended not only that EDF be licensed to carry out the operations referred to in the opinion of the Inquiry Commission, but also launch a new procedure for full dismantling. Pursuant to Article 37 of the *EURATOM Treaty*, the EC was also consulted concerning the submitted licence and issued a favourable opinion in May 2010. The draft projects concerning the regulations on partial dismantling and on water intakes and discharges, respectively, are under way.

F.6.3.4.2 - EDF / Gas-graphite reactor (GGR)

The licensing decree for the final shutdown and dismantling of the Bugey-1 reactor was issued on 18 November 2008), while those for the Chinon A3 and Saint Laurent-des-Eaux A1 and A2 reactors were both issued on 18 May 2010. Demolition work on reactor vessels will first start at Bugey-1. Expert analyses on the state of the Bugey-1 vessel were conducted in the lower part in order to have a better approach to the initial state of the facility. The experience feedback from those analyses will be used at Saint-Laurent A and at Chinon A3. In addition, it is necessary to clarify the radiological inventory of graphite piles. Cores were collected at Chinon A1. It should be noted that vessel dismantling is associated with the evacuation system for graphite piles (disposal or storage pending disposal, and conditioning solutions).

F.6.3.4.3 - EDF / Chooz A reactor (PWR-type reactor)

The licensing decree for the dismantling of the Chooz-A reactor was issued in September 2007. The dismantling 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. 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.

F.6.3.4.4 - EDF / *Superphénix* reactor (fast-neutron reactor)

The dismantling decree for the *Superphénix* reactor was published in March 2006. it requires that the commissioning of the sodium-treatment facility (TNa) and of all necessary circuits for its operation be submitted to ASN's approval. ASN has licensed EDF to commission the TNa facility and the storage facility for the future large sodium blocks.

F.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, there is a strong presumption of radioactive contamination under Building No. 18 and it is expected that it will probably cause delays in clean-up operations. Before approving the decommissioning of INBs of the Fontenay Site, ASN will issue its conclusions on the radiological state of the site for which the operator has initiated a significant identification task for the marked radioactive zones during past experiments and soil-rehabilitation operations.

At *Grenoble*, there used to be six nuclear facilities, as follows:

- the SILOETTE reactor (INB-21) was decommissioned in 2007;
- the MÉLUSINE (INB-19) reactor is already cleaned up and has moved to the decommissioning procedure;
- the Mathematical Laboratory (*Laboratoire de mathématiques* – LAMA) is nearing the end of its cleanup, and ASN will perform an inspection in 2011 in preparation for its decommissioning;
- the decrees for the final shutdown and dismantling for the Effluent and Waste Treatment Station (*Station de traitement des effluents et des déchets* – STED) and the Treatment Station for Active Effluents and Solid Waste (*Station de traitement des effluents actifs et des déchets solides* – STEDS) have been issued, and
- the decree for the final shutdown and dismantling of the SILOE reactor was published. Due to the activation of the pool block that proved more significant than expected, a decree was published in February 2010 with a view to deferring to February 2011 at the latest the deadline for the completion of dismantling operations.

During its inspections, ASN noted that the CEA's Grenoble Site was calling more and more upon external companies and has required the operator to maintain the relevant means to ensure the best control possible of its facilities in spite of the steady reduction in risks.

F.6.3.4.6 - CEA / Cadarache Facility

On the Cadarache Site, the overall dismantling of the relevant facilities is progressing under satisfactory conditions, as follows:

- the HARMONIE reactor is fully dismantled and its official decommissioning was declared in 2009;
- in 2008, the CEA submitted its case for the final shutdown and dismantling of the RAPSODIE reactor and the Fuel Assembly Shearing Laboratory (*Laboratoire de découpage d'assemblages combustibles* – LDAC). ASN informed the CEA that its case needed further developments. A revision of the dismantling strategy is under way before the CEA submits a new case;
- the decree for the final shutdown and dismantling of the Enriched Uranium Workshop (*Atelier d'uranium enrichi* – ATUE) was published in February 2006. However, technical and economic problems occurred during the operations, thus leading the operator to request a five-year delay and, hence, a modification to the decree, which is currently under review by ASN and the MSNR The operator has also developed a soil-characterisation programme outside the ATUE Workshop in order to detect potential traces of pollution and to specify, if need be, the relevant cleanup methods, and
- the decree for the final shutdown and dismantling 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, ASN gradually licensed the CEA to resume certain operations on the basis of the safety cases reviewed by ASN and its technical support organisation. ASN decided to submit the dismantling operations to several prescriptions (two resolutions in October 2010) and will remain vigilant with regard to safety-criticality aspects.

F.6.3.4.7 - CEA / Saclay Site

Dismantling operations are under way at two facilities on the Saclay Site: the High Activity Laboratory (*Laboratoire de haute activité* – LHA) and the CÉLIMÈNE cell of the Testing Laboratory for Irradiated Fuel (*Laboratoire d'essai des combustibles irradiés* – LECI) for which experimental methods (such as the ASPILASER technique) have been used. As for the third facility, the ULYSSE reactor, the application to approve its final shutdown and dismantling was submitted by the CEA and is now under review by ASN.

F.6.3.4.8 - AREVA NC

The first application case for final shutdown and dismantling concerns INB-80, the High-activity Oxide Workshop (*Atelier, Haute activité oxydes* – HAO). The decree was published in 2009.

As mentioned above, the cases concerning the UP 2-400, STE2 and ELAN IIB facilities, have already been submitted to a public inquiry and are now under review by ASN.

In the case of the AT1 Workshop, ASN has acknowledged the completion of the cleanup operations, except for civil engineering, and of monitoring procedures. In practice, the facility is not decommissioned, and its full dismantling is part of the dismantling application for the UP 2-400 facility.

F.6.3.4.9 - Nuclear Fuel Fabrication Plant at Veurey-Voroize

Decrees licensing dismantling operations for the two INB-65 and INB-90 facilities on the site of the Nuclear Fuel Fabrication Plant (*Usine de fabrication de combustibles nucléaires* – SICN) at Veurey-Voroize were published in February 2006. In 2010, a large number of premises were decommissioned with regard to waste zoning. ASN feels that operations are progressing satisfactorily and should allow for the decommissioning of the "waste zones" in the last buildings. However, following inspections conducted in 2010, ASN has emphasised the need for more rigour in the work follow-up. Lastly, since soils are polluted due to historical activities, public-utility easements will need to be set in place.

F.6.3.4.10 - Reactor at Strasbourg University

Dismantling operations were completed at the reactor of Strasbourg University. Pursuant to the *2006 TSN Act*, ASN launched a consultation with State services, the 21 communes located within 5 km of the facility and the CLI created in July 2010 by the General Council of the Bas-Rhin *département*. ASN feels that dismantling operations took place under satisfactory conditions.

F.6.4 - State control for securing dismantling funds for INBs

State-control procedures for securing INB-dismantling 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, Article 20 of the *2006 Planning Act* provides for a financial-securisation mechanism covering the management of radioactive waste and spent fuel, as well as the dismantling charges for INBs.

F.6.5 - ICPEs and mines

F.6.5.1 - ICPEs

Site-cleanup conditions after the final shutdown of ICPEs may be included in the licensing decree, In the case of facilities subject to a declaration, site-cleanup 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-cleanup steps been taken or planned.

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 groundwaters;
- 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 cleanup 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.

F.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.

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 (Articles 4 to 10)

G.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 us 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.

G.1.1 - ASN requirements for INBs

In France, any spent-fuel management facility constitutes an INB or part of an INB. In that respect, the various fuel-management facilities are subject to general safety provisions, as described in § E.2.2. *Decree No. 2007-1557* states that the operator must submit a safety report containing "the inventory of all hazards, irrespective of their origin, pertaining to the proposed facility, an analysis of the steps taken to prevent those hazards and a description of the relevant steps to limit the probability and effects of accidents" (Article 10). Those analyses cover especially criticality, the removal of residual heat, the protection of individuals, chemical and biological hazards and minimisation in waste production.

The implementation of any new management procedure for fuel assemblies loaded into reactors requires an ASN licence.

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, reprocessing (if applicable), effluent discharges and waste management.

ASN checks that any changes in fuel management are consistent with the texts applicable to fuel-cycle facilities and the transport of radioactive and fissile materials, such as licensing decrees for the creation of new facilities, orders licensing liquid and gaseous-effluent discharges and water intakes, the relevant ASN resolutions, as well as technical prescriptions and transport regulations for radioactive materials.

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.

ASN's role is to assess the safety studies of the facilities at the various stages of their operation by reviewing submitted documents and conducting inspections.

Furthermore, with regard to the consistency control of the fuel cycle, EDF, in its capacity as overall prime producer, presented, at ASN's request a document on the French fuel cycle (*Cycle du combustible français*), which in turn was referred to ASN's GPEs in 2002. ASN's referrals dealt with all responsible operators, in connection with EDF. The case was updated in 2007 and reviewed by the GPEs in 2010 (see § G.1.3).

G.1.2 - Safety policies of INB operators

G.1.2.1 - CEA's and ILL's safety policy

The CEA's safety policy is to prevent the 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 in both the decisions and the subsequent actions. That approach constitutes the basis of "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.

The CEA has developed an internal-authorisation system based on the submission of an 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.

In 2009, the CEA prepared a detailed report on the management of safety and radiation protection at the CEA. Once the IRSN had examined it, it was referred to and reviewed by the GPEs at the end of 2010.

The opinion of the GPEs, which was issued on 3 December 2010 emphasised especially the measures implemented by the CEA with regard to the clarification of the line of action, the support function and the control function. It highlights the higher significance that was given to human and organisational factors in terms of safety and radiation protection with the implementation of a skill network in that field. It also stresses the importance of recovery in terms of sorting by project, the professional behaviour of the actors associated with safety, the animation of experience feedback and the development of tools and indicators to be monitored on a regular basis in the field of safety and radiation protection.

In the conclusion of their opinion, the GPEs noted that the review revealed a situation that was generally satisfactory with regard to the organisation and the managerial provisions involving safety and radiation protection, and showed a significant improvement since 1999, when such review was performed at the CEA for the last time.

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 the CEA's 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 provided that their residual power allows it. Seismic reinforcement works have been carried out since 2002 and ensure that the channel of the storage system and both the second and third containment barriers within the reactor building are able to withstand an earthquake.

G.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* 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 *TSN Act*, 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, present it 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.

G.1.2.3 - EDF's safety policy

The responsibility of nuclear operator within the EDF Group is divided into four main levels, as follows:

- 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 an INB 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
- an operational safety management system and a quality management system consistent with the *1984 Quality Order.*

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, which are partly defined at the national level, and applicable to all sites;

- 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.

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. In that perspective, the main objectives focus on operation and the production tool.

G.1.3 - ASN analysis

ASN supervises the overall consistency of all industrial choices regarding fuel management from the safety and regulatory standpoints.

In order to conduct a prospective assessment, EDF and industrial contractors involved in the nuclear fuel cycle have been required to provide data concerning the compatibility between changes in fuel characteristics or in the management of irradiated fuel and changes in fuel facilities.

Hence, at the end of 2008, EDF submitted its report to ASN on the impact of the fuel cycle in 2007 with a view to ensuring the overall consistency of the management 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 on the basis of an IRSN report. Following the review, ASN intends to strengthen the monitoring of the cycle and of its evolutions through updated notices every two years and has requested EDF to submit an update “cycle” by 2016.

G.2 - EXISTING FACILITIES (ARTICLE 5)

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 ca facility.

G.2.1 - ASN requirements for INBs

In order to take into account the effect of time on facilities 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 the safety aspects of his INBs 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 seismic behaviour 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). Lastly, if economic and industrial constraints often generate changes in the facilities, they may also induce significant changes that may require new facilities.

G.2.2 - Safety review of facilities by INB operators

G.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

During reassessment, the CEA must specify its strategy for each of its facilities with regard to the nature and perennity of the future operating functions and missions of the facility.

The CEA must also 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 equipments 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 cleanup activities, as well as the revision of operating documents.

G.2.2.2 - AREVA's safety review

On the date that the *Joint Convention* came into force, all existing facilities used by AREVA for spent-fuel management purposes were divided into three categories, as follows:

- industrial operations (UP2-800, UP3, FBFC, MÉLOX);
- in preparation for final shutdown (UP2-400), and
- undergoing dismantling (HAO, ATPu).

AREVA has undertaken the periodical reassessment of the safety level of its facilities, notably in the framework of the regulatory procedures for which they are responsible, such as the overall number of INBs in France. Safety analyses are reconsidered and operating documents are updated, with due account of:

- anomalies or incidents that occurred in the facility since the previous safety reassessment, knowing that such events may have caused some changes to the facility or to operating modes prior to that periodic safety reassessment process;
- the experience feedback resulting from the analysis of events that may have occurred in similar facilities;
- the overall improvement of knowledge, whether it originates from independent studies or from direct research activities by AREVA, and
- potential ageing phenomena of the different constituting safety-related elements of the facility.

That periodic safety-reassessment process is used to identify improvements areas for facilities or their operation, after analysing the potential inconveniences that their implementation may have for the facility involved. It may therefore lead to various intervention programmes and work in the facilities in order to maintain in a safety level that is compatible with the evolutions of international and best available practices or technologies.

G.2.2.3 - EDF's safety review

G.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 reference 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. If their benefits appear high enough and clearly outweigh their drawbacks, changes are made to the safety reference system. 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.

G.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.

Following that review, EDF concluded that the overall criticality risk was well under control during the spent-fuel storage and disposal phases. The results of the studies being undertaken complete the criticality reference system of the safety analysis report.

G.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.

In addition, EDF partakes in the IAEA's co-ordinated research programme in that area, in order to assess better all aspects relating to potential hazards and impacts of surface contamination.

G.2.3 - ASN analysis

Pursuant to the law, ASN requires that the safety of every INB be reassessed approximately every 10 years.

Depending on the conclusions of the reassessment, ASN may license the facility to run or may restrict its use or lifetime, and may even order its shutdown within a given deadline. The review programme of the CEA's spent-fuel storage facilities, for example, has been conducted along those lines and has particularly led the CEA to plan the construction of new facilities to replace the older ones by 2015.

Following the adoption of the *2006 TSN Act* and the publication of *2007 Procedure Decree* both requiring that all nuclear facilities be the subject of safety reassessments, the operators of the AREVA Group have started to reassess the safety of their facilities. In that regard, the case of the safety reassessment of AREVA NC's UP3 Plant at La Hague was submitted to ASN and is currently under review.

The submission of the reassessment case of the MÉLOX facility is also under way.

Both reassessments provide opportunities to review the overall design data on which the commissioning and start-up licences were based, in order to examine their soundness compared to current safety standards. The effects of ageing and the way operators take experience feedback into account are examined in more detail.

G

G.3 - Siting projects (Article 6)

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 date 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.*

In general, all facilities involved in spent-fuel management consist of INBs.

Hence, any new facility is subject to the general INB 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.

G.4 - Facility design and construction (Article 7)

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.

All spent-fuel management facilities consist of INBs.

The general INB regulations, which include spent-fuel management facilities, 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 with regard to discharges.

With regard to technical steps for INB decommissioning, the instruments in force state that those steps must be described in a specific chapter of the safety report to be submitted in support of the creation-licence application referred to in § E.2.2.3.

The measures taken by operators to comply with those regulations are presented in § G.2.2.

ASN must ensure the actual implementation of those regulations through the analyses and inspections it performs according to the modalities described in § E.2.2.6 and E.2.2.7.

G.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).

All spent-fuel management facilities consist of INBs

A preliminary safety report must be filed in support of the creation-licence application and a provisional safety report must be filed in support of the pre-commissioning test licence. Lastly, a final safety report must be filed in support of the final commissioning licence. All those licences are mentioned in § E.2.2.

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.

Any operating licence delivered to a facility (valid for spent-fuel or waste storage facility) must contain a deadline for final commissioning, which must take place within a few years of operation and after assessment of the safety report and of the general operating rules.

Past that deadline, the licence is no longer valid and a further application process must be initiated.

G.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.

G.6.1 - Licensing process

The general INB 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.

G.6.2 - INB operators' practices

G.6.2.1 - CEA's and ILL'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, RGEs prepared by the operator and technical specifications required 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.

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.

G.6.2.2 - AREVA's operational safety practices

Operation is conducted in full compliance 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 initiatives described in § F.3.2.3 and by the human and physical resources described in § F.2.2.3, which enable AREVA to maintain its industrial know-how in the subsidiaries under its control. With regard to decommissioning, practices are described in § F.6.

The main safety-related events must be declared within 48 hours to ASN and other national authorities. An incident report including a preliminary analysis, must be addressed to ASN within two months. If the analysis requires a longer delay, a complementary analysis must be sent later.

For recent facilities, dismantling plans must be established as soon as the creation-licence application is made. For older ones, they must be established, if needed, in the framework of the administrative documents to be submitted to ASN, before shutdown and no later than the planned shutdown date. In fact, it is desirable to have at hand, over and above the benefits of the latest available technologies at dismantling time, the knowledge of the life of the facility by the operators in order to establish the plan and ensure in such predominantly-chemical facilities, the actual execution of most cleanup operations that are generally conducted by using process reactants and standard maintenance procedures.

Dismantling plans are drawn up as needed, before operation ceases, when the final shutdown of a facility is contemplated. In addition to the benefit gained from the latest available technologies at dismantling time, it is also desirable to have access to the operators' knowledge about the life of their facilities when drawing up the plans and, in primarily chemical facilities, when carrying out the majority of cleanup operations which are generally conducted using normal maintenance procedures and process reagents.

G.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 initiatives described in § F.3.2.4 and by the human and physical resources described in § F.2.2.4. With regard to dismantling, practices are described in § F.6.

G.6.3 - ASN analysis

Through its analytical, inspection and penalty systems, ASN ensures on a permanent basis that operators comply with the general INB 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.

G.7 - Final disposal of spent fuel (Article 10)

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.

In France, no spent fuel has been officially designated so far for final disposal, except in rare cases involving experimental reactors (see § B.3.3) for which reprocessing would not constitute a significant economic advantage or might raise technical issues.

In accordance with the provisions of the *2006 Planning Act*, EDF's approach is to reprocess 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 removed from reactors and the quantity of reprocessed spent fuel, with due account of the current plutonium-recycling capabilities. That situation leads to a gradual increase of the quantities of spent fuel, which tends to stabilise themselves thanks to the new fuel management methods in reactors.

According to EDF, that spent-fuel inventory should be reprocessed as soon as Generation-IV reactors are commissioned.

As a precaution, however, ANDRA examined the feasibility of a facility for the direct disposal of spent fuel before submitting its case on the feasibility of a deep geological repository in a clay formation, thus facilitating a useful comparison of French concepts and performances with international counterparts according to which many countries are considering long-term management solutions involving the direct disposal of spent fuel without any recycling.

Until now, the studies conducted by ANDRA all show that spent-fuel disposal seems possible in the clay formation being investigated through the URL at Bure.

Spent fuel, such as UOX, URE and MOX, is characterised by a significant heat discharge over a much longer timescale than the waste being conditioned through processing. Other specificities of those spent-fuel types include their size, their criticality risk, as well as larger quantities of radioiodine and gases.

Among other things, the studies to be conducted until 2015 on UOX, URE and MOX spent fuel should provide useful technical, scientific and economic elements in the framework of the public debate prescribed by the law. Among the assessment criteria is the identification of additional and even specific risks and constraints associated with spent-fuel disposal during the different phases in the lifetime of the disposal facility, including its reversibility phase.

In the last case that ANDRA submitted at the end of 2009, the repository's inventory sizing model did not retain the direct disposal of spent fuel resulting from nuclear-power generation.

Section H : SAFETY OF RADIOACTIVE WASTE MANAGEMENT (Articles 11 to 17)

H.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.

H.1.1 - ASN requirements

The requirements imposed by French regulations are consistent with those of Article 11 of the *Convention* (see Section E).

Their purpose, in fact, is to ensure the effective protection of individuals, society and the environment in order to avoid actions that impose reasonable predictable impacts on future generations greater than those allowed for the current generation.

According to the regulatory system (legislation, Order of 31 December 1999), reducing volumes and radiological toxicity must be a key objective.

The Order of 31 December 1999 and RFSes require that all aspects regarding criticality and heat discharges be taken into account.

All risks must be considered, notably in safety reports and in studies concerning disposal projects. That includes criticality risks and the consequences of thermal releases if any. All risks pertaining to toxic chemicals must also be examined.

In addition, ASN considers that it is important to examine on a periodical basis the policy and strategy of every major nuclear operator with regard to radioactive-waste management, by disposing of an overall view for each them and by emphasising the most delicate issues. Hence, EDF, the CEA and AREVA NC are required to prepare on a periodical basis in the order of 10 years a report describing their individual policy and strategy.

H.1.2 - Steps taken by INB operators

H.1.2.1 - Steps taken by waste producers (CEA and ILL, AREVA, EDF)

Waste-management activities in INBs must include the following major phases:

- “waste zoning” (see § B.4.5);
- collection;
- sorting;
- characterisation;
- treatment;
- storage, and
- shipment.

Collection and sorting constitute sensitive phases in waste-management activities in INBs.

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 and EDF 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 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 INBs.

H.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 CSFMA. The quality of those shipments must be monitored.

H.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 and III.2.f, ANDRA requires producers to quantify the amount of radionuclides that are present in the waste and are subject to the regulations for special industrial 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.

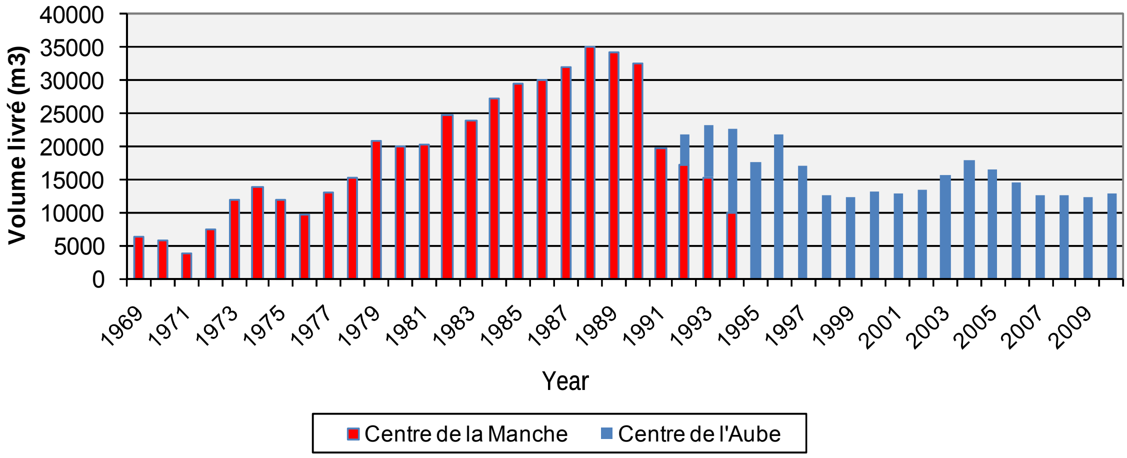

Figure 8 : Delivered volumes of LIL/SL-waste packages since 1969.

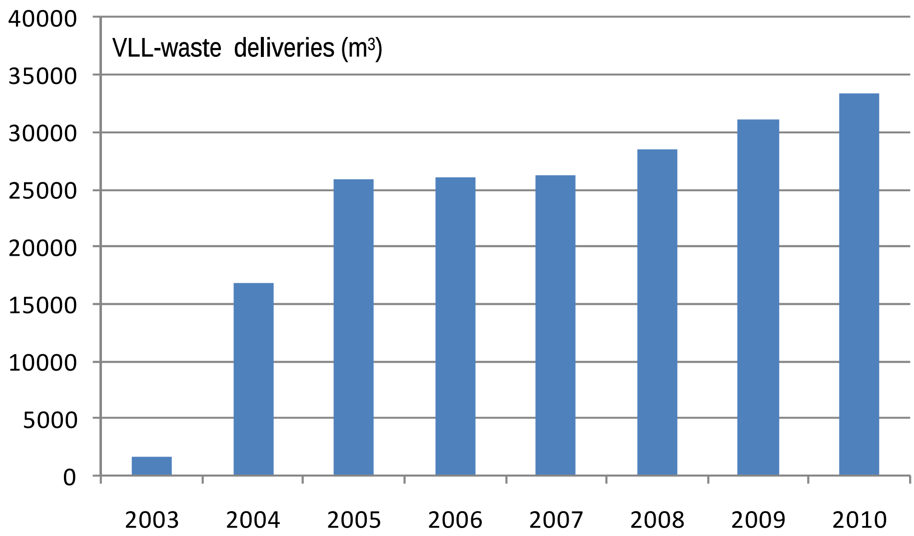

Figure 9 : Deliveries of VLL-waste packages

With regard to the safety of waste-disposal facilities, it must be noted first of all that, prior to commissioning, ANDRA prescribes detailed acceptance specifications for the waste or the waste packages to be admitted in such facilities. The purpose of those constraints is to guarantee the short-, medium- and long-term safety of the facility and to constitute a reference system for nuclear operators when detailing a new type of package. 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 was applied for all LIL-SL waste received by the CSM. It is now used at the CSFMA, where package designs are based on ANDRA specifications, in accordance with RFS III.2.e. Irrespective of their types, all waste packages received at the CSFMA must be certified prior to disposal.

A similar, but slightly adapted, process is used at the CSTFA, which is not subject to INB regulations.

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 2006 Planning 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.

H.1.3 - ASN analysis for INBs

ASN controls the steps taken by operators in order to comply with regulatory requirements, as follows:

- it reviews from a technical standpoint all cases and supporting documents submitted by operators, and
- it carries out inspections on the operator's sites and services.

Those topics are addressed in Section E and reiterated in § H.2 to H.7.

EDF's policy and strategy with regard to radioactive waste (operating and historical waste) were reviewed in 2002, whereas those of AREVA NC were in 2005. Since then, ASN has observed a certain number of delays concerning the recovery schedule of historical waste at AREVA NC (see § H.2). A new verification of the management strategy for CEA waste, sources and spent fuel is under way. 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 packagings.

More generally speaking, EDF's policy with regard to fuel use (combustion rate, MOX, URE fuel, etc.) has an impact of 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. ASN will issue its position and formulate corresponding requests in early 2011.

H.1.4 - ICPEs and mine tailings

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 case of industrial, research and medical activities taking place outside the INB regulatory framework, the general waste-management principles described in the *1995 Law* (Article L541 of the *Environmental Code*) apply, that is, to prevent or to reduce waste production and toxicity, especially by acting on product fabrication and distribution, recovering waste through reuse, recycling or any other step designed to generate reusable materials or energy from the waste.

The 9 July 2001 Circular issued by the Minister of Health specifies the steps to follow when managing any waste and effluents resulting from medical, as well as industrial and research activities. In addition, the ICPE Inspectorate may, as and when necessary, impose further requirements on a case-by-case basis.

H.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.

H.2.1 - ASN requirements for INBs

All existing INBs and ICPEs must undergo a periodic safety review. For INBs, the topic is addressed in § E.2.2.

The purpose of that approach is to provide an opportunity to judge the risks and inconveniences of the facility with due regard to its state, the acquired experience during operations and the evolutions in knowledge and regulations.

If necessary, ASN requires the operator to take all appropriate measures to improve safety. That is normally the case for certain storage facilities from the past. COGÉMA (now AREVA NC), the CEA and EDF used to store radioactive waste on certain sites (e.g., La Hague, Saclay, Marcoule, Cadarache, Chinon, Bugey, Saint-Laurent-des-Eaux). Those storage facilities were built according to the regulations and state-of-the-art techniques of the time. The absence or obsolescence of waste conditioning 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. Those notions may affect waste recovery and conditioning directly, or, if need be, involve stricter safety measures in the existing facility (see below the case of graphite silos at Saint-Laurent).

It should be noted, however, that all historical waste must be conditioned before 2030 in accordance with the *2006 Planning Act*.

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.

A special mention should be made of the Malvési Site (COMURHEX). At ASN's request, certain settling tanks are regulated by administrative provisions with a view to classify them as INBs (see ASN Resolution of 22 December 2009). In fact, due to the quantities in storage and notably to the presence of artificial radionuclides resulting from past activities, the facility now pertains to the INB nomenclature. Since the adoption of ASN's Resolution of 22 December 2009, the facility is placed under ASN's supervision. Pursuant to the provisions of the Resolution, the operator (COMURHEX) has already submitted at the end of 2010 an licence application to create the facility. The application is now under review by ASN.

H.2.2 - Steps taken by INB operators

H.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 checked that they were still compatible with the safety objectives. The measures regarding the CSM are described in § H.7.

H.2.2.2 - Steps taken by the CEA and the ILL

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:

- solid waste placed generally in drums, which are stored in pits, cells or ditches;
- solid waste buried in open ground under various forms (in bulk wrapped in vinyl, in metal drums or concrete casks), and
- liquid aqueous and organic waste, contained in tanks, carboys or drums.

Once it has undergone specific processing, the waste is sent to existing or new treatment facilities.

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%, whereas the reduction of the source term of CEA facilities is continuing until 2014 through recovery and conditioning operations on solid waste contaminated with α radiation, with a view to storing them as cemented waste in INB-164 (CEDRA). After 2017, the pursuit of such actions will take into account ANDRA's definition of IL/LL and LL/LL waste packages and the CEA will be equipped with specific package-conditioning units (*unité spécifique de conditionnement de colis*), a Storage Package Conditioning Workshop (*Atelier de conditionnement en colis de stockage*) and a Facility for Packages Pending Shipment to CIGÉOs (*Installation d'attente d'expédition des colis vers les CIGÉO*).

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

H.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 Recovery Division at La Hague, which also operates the installations of the UP2-400 Plant, while leading and carrying out the projects of the MAD/DEM Programme. The constitution of the Recovery Division at La Hague, within AREVA's Recovery Business Unit (BU), which replaced the former Project on Allocated Tools for the Design of Distributed Applications (*Outils répartis pour la conception d'applications distribuées* – ORCADE), marks an improvement by grouping projects and operations 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, except for solutions with high molybdenum concentrations, which are not compatible with the current vitrification solution in hot crucible (corrosion aspect), but will be vitrified starting in 2011 thanks to a new technology for cold crucibles.

Technological waste contaminated with α radiation, which had been stored in steel drums and placed in Building No. 19 and are being recovered; the operation should be completed by 2013. 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.

The sludges, which have been stored in the STE2 Workshop will be recovered starting in 2018 in order to be treated thermally by a drying process and compacted, as a substitute for bitumisation, as originally planned. The new process will 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, if need be.

All GGR waste contained in Silos Nos. 115 and 130 and in the SOD will be recovered in intermediary boxes (*boîtes intermédiaires* – BI) through recovery cells to be installed above those silos, then conditioned in a new building close to Silo No. 115 by blocking BIs in 10-m³ fibrous-concrete graphite packages; a storage facility for 10-m³ graphite packages will also be built, due to the delayed commissioning of the facility for the final disposal of LL/LL waste. Recovery operations are due to start in 2016.

There are also plans for building a multipurpose cementing plant (*installation de cimentation polyvalente* – CIPOL) for conditioning sludges (from Silo No. 130, the SOD and ditch No. 26 of the NW zone), powdery waste (from Silo No. 15) and resins from the settling of the Decladding Workshop (*Atelier de dégainage*), except for Settling tank No. 4, whose resins will be reconditioned at the existing ACR facility.

H.2.2.4 - Steps taken by EDF

H.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 in 1999 (see § B.6.1.1) and of ANDRA's CSTFA for VLL waste.

In addition, EDF has built and commissioned dedicated, regulated areas for VLL waste on its 19 NPP sites pending removal, thus enabling the LL/IL waste intended for the CSFMA 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 INBs and intended for disposal at the CSTFA.

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 CSFMA;
- the decrease in the quantity of non-conforming packages that may delay their shipment;
- 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, combustible/non-combustible waste, etc.);
- the incineration of larger volumes of evaporation concentrates;
- the development of a sludge-encapsulation process involving a mobile machine (encapsulation in a hydraulic-binder matrix);
- "waste zoning", and
- specific processing systems for special waste: neon tubes, electronic waste, etc.

Those actions are ongoing and are consistent with the application on sites of the new operating rules for the management of radioactive waste in their facilities.

H.2.2.4.2 - Waste conditioning and evacuation on EDF dismantling sites

All waste resulting from dismantling 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 *2006 Planning Act*.

According to current studies, the ongoing deconstruction of 10 INBs, 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:

- 800,000 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
- 175,000 t of mostly SL radioactive waste (18%), 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 100,000 t and has been stored at the CSTFA since August 2003;
- LIL-SL waste consists mostly of equipment that was used to contain or to transport radioactive fluids (pipes, valves, tanks, etc.) and represents about 56,000 t. There is also safe, permanent storage at ANDRA's CSFMA;
- 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 2006 Planning Act to come into operation (deep geological repositories being the benchmark solution, for commissioning by 2025) and to adhere to the 25-year timetable for the NPP dismantling, 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 2006 Planning Act, when available, and
- LL-LL radioactive waste from GGRs (around 18,500 t), for which the 2006 Planning Act provides for the commissioning of a waste repository, on which the successful completion of GGR-dismantling 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 will then be stored on site for about 30 years, during which their radioactivity level will decrease close to that of natural radioactivity.

H.2.3 - ASN analysis on INBs

For facilities in operation, the principle of a periodical safety review ensures that their safety has been examined in the light of the most recent knowledge and regulations.

Waste-disposal facilities, which are no longer in operation, retain their ICPE or INB status and are therefore subject to the same requirements as those in operation. More particularly, the status of a disposal facility is re-examined periodically and, if necessary, the need for a potential intervention is examined.

Due to their past activities, COGEMA (AREVA NC), the CEA and EDF have stored radioactive waste on certain sites, such as La Hague, Saclay, Marcoule, Cadarache, Chinon, Bugey and Saint-Laurent-des-Eaux. Those storage facilities were operated in accordance with the most recent regulations and rules of the time. The absence of waste conditioning or the age of the waste, combined with the initially planned lifetime of those storage facilities, and the implementation of ever-stricter safety requirements since then, means that such waste must be recovered for long-term conditioning purposes.

Current or future actions are different in nature and include the following:

- a precise characterisation of historical waste;
- a study on the treatment and conditioning processes of historical waste;
- the implementation of dedicated installations (new or retrofitted facilities);
- waste recovery and conditioning, and
- the deployment of storage facilities designed for a lifetime compatible with the commissioning objectives of the storage facilities for that waste.

Advances in that field were observed, but in general, the process is delicate and ASN was led to require operators to intensify their efforts to meet the deadlines imposed by the safety of the storage facilities and the 2030 objective prescribed by the *2006 Planning Act* for the completion of RCD operations.

The following significant examples are detailed below:

- graphite sleeves stored by EDF;
- sludges resulting from the processing of UP2-400 effluents at La Hague (AREVA NC);
- 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 INB-56 (CEA);
- waste from INB-72 (CEA), and
- waste from INB-35 (CEA).

H.2.3.1 - Graphite sleeves stored by EDF

Graphite sleeves consist of structural waste from the fuel of the old GGR system. Plans call for that waste to be disposed of at ANDRA's proposed disposal facility for LL-LL waste. For the time being, they are stored mainly in silos at Saint-Laurent-des-Eaux. They weigh approximately 2,000 t (compared to the 970 t and 760 t that are stored at La Hague and Marcoule, respectively.

The facility does not meet current safety criteria. In order to respond to ASN's request concerning the preparation of a strategy pending the availability of the disposal facility for graphite waste, EDF proposed in July 2007 to implement a containment barrier around the silos. In July 2008, ASN issued a favourable opinion regard the principle of EDF's proposed geotechnical enclosure, provided that a certain number of complements be brought, as they were in 2009. The work for implementing the geotechnical enclosure were carried out in 2010. EDF submitted to ASN a safety-reassessment case for the facility thus modified. That case is currently under review by ASN. That review will include notably a verification of the behaviour of the geotechnical enclosure.

In its Resolution of 26 January 2010, ASN has set the relevant prescriptions for water intakes and liquid-efflluent discharges at INB-74.

H.2.3.2 - Sludges resulting from the treatment of sludges at the UP2-400 Plant

Effluents from the UP2-400 Plant were treated in the STE2 facility by chemical co-precipitation, and resulting sludges (9,300 m^3 in volume) were stored in silos.

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 sludges and of their characteristics, ASN adopted a Resolution, on 2 September 2008, with a view to requiring another treatment and conditioning process.

H.2.3.3 - Alpha waste from Building No. 119 at La Hague

Building No. 119 is divided into cells containing drums of technological waste with an alpha-prevailing spectrum of organic materials resulting from the operation of the UP2-400, UP2-800 and UP3 Plants, and from the MÉLOX and the ATPu Facilities. Similar waste is still being produced.

Since ASN and its technical-support organisation feel that the safety of the building is not satisfactory with regard to seismic and fire risks, ASN has requested the operator to empty the building by 2010.

The operator destocked a large part of the stored drums (Cf. § H.2.2.3).

With regard to the waste itself, the operator has proposed to compact it and to insert it in stainless-steel containers. Through its Resolution of 23 February 2010, ASN announced that such package type would not provide sufficient guarantees for long-term storage or deep geological disposal.

Consequently, the operator must undertake further studies to design a new conditioning mode and to examine the impact of that new work on storage needs and capacities.

H.2.3.4 - Waste from Silo No. 130 at La Hague

Silo No. 119 includes two ditches. The first contains approximately 750 t of waste, consisting mainly of GGR-type structural elements, as well as earth, rubble and water, whereas the second includes 1,400 m^3 of effluents and sludges.

Confronted with the delay in the waste-recovery project within a building that does not bear a satisfactory safety level, ASN decided on 29 June 2010 to set a waste-recovery schedule for the waste to be recovered, as follows:

- 2020 for solid waste, and
- 2022 for effluents and sludges.

In addition, ASN requires that appropriate means be implemented in order to detect any potential water leakage from the silo and to limit any potential impact, if need be.

H.2.3.5 - Tritiated waste (CEA and "small-scale" nuclear industry)

Most tritium-bearing waste (also known as "tritiated waste") currently result from National-Defence activities and amount to about 3,500 m^3. In the future, significant quantities will be generated by the operation and dismantling of ITER facility for research on nuclear fusion.

Current operating systems for the evacuation of tritiated waste concern only VLL waste. For the remaining waste, it does not appear possible to accommodate it for the time being in ANDRA's surface storage facilities, due to the high mobility of tritium through the media containing some, since that could mean that underground waters are marked with tritium around the disposal facility.

The selected solution consists in storing them for a sufficiently long period of time in order for radioactive decay to occur before disposal, with due account of the fact that the radioactive half-life is tritium is close to 12 years. Pursuant to the 15 April 2008 Decree, the CEA issued a useful report to draw the inventory of the total amount of tritiated waste generated in France and to propose sizing options for the facilities to be scheduled per waste family (six in total) in order for storage activities to extend over several decades. The PNGMDR reiterates notably ASN's recommendations with regard to the construction of storage facilities by the CEA and the preparation by ANDRA of a study specifying the management modalities for solid tritiated waste generated by "small-scale" nuclear industries.

H.2.3.6 - CEA historical waste at Cadarache

The CEA's historical waste at Cadarache is stored in INB-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.

In early 2011, the CEA has resumed waste-recovery operations in the T2 Trench after having interrupted them due to uncertainties on the stability of the foundations and the walls of the slope. In order to protect interveners in trenches, the CEA installed a geotextile membrane against the localised fall of boulders and rocks.

The expected date for the extraction of the historical waste stored in Unit 2 is deferred until the end of 2011.

In the case of the other trenches, the CEA's intention is to reduce human interventions and to favour a single and fixed conditioning workshop for the four trenches involved. However, ASN noted that the CEA's initial objective to complete the work by the end of 2013 is not likely to be met, since the recovery of the T1, T3, T4 and T5 trenches is not scheduled, while work is still under way at the T2 Trench in order to benefit from the experience feedback on that facility.

In the old ditches of INB-56 is also stored some irradiating IL waste under conditions that are no more consistent with current safety requirements. In April 2009, ASN agreed to the recovery of the waste contained in the most recent ditches (F5 and F6), provided that a certain number of requests be answered. The worksite was stopped due to contamination by a package. That sort of event, combined with problems between the operator and one of his subcontractor will probably generate a delay with regard to waste recovery operations in the F5 and F6 ditches, which was initially scheduled to start by the end of 2013.

The recovery of the waste contained in older ditches (F1, F2 and F4 ditches) includes some risks due to the presence of alpha radionuclides, and therefore, some technical complexity. ASN will be particularly vigilant to the quality of the measures to be taken by the operator, since important technical means already seem to be in preparation.

ASN must ensure that the significant recourse to subcontractors for the destocking of INB-56 occurs under sound conditions for the safety of the facility and that the operator monitors his service providers accordingly.

H.2.3.7 - CEA historical waste at Saclay

For several years or even decades now, INB-72 has been storing irradiated fuel, irradiating waste in shafts, sources with no further uses, as well as miscellaneous waste, especially VLL in nature. Following the safety reassessment of INB-72 at Saclay, in early 2009, ASN required the CEA not only to evacuate the fuel contained in the facility, but also to initiate a procedure to shut it down and to dismantle it within the same timeframe.

With regard to INB-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 2013. The hauling operations of the corresponding vessels are already under way.

Those various examples illustrate the inherent issues to the recovery and conditioning of historical waste, since those residues are not always well known due to the lack of traceability at the time under the same conditions as today. That waste often involves problems with treatment and conditioning, as in the case of sludges at the STE2 or alpha organic waste. Such *de facto* situation often leads to delays and cost overruns. However, ASN is very careful that they do not have an impact on the safety level of the storage facilities.

ASN also ensures compliance with regulatory requirements regarding the subcontracting modalities for safety-related activities, sound skills and quality, as well as matching controls.

In conclusion, ASN requires that all operators assume fully their responsibility with respect to the safety of older storage facilities and to the recovery and conditioning of historical waste. More particularly, ASN ensures that appropriate means are taken with a view to replacing the older waste-storage facilities, which have been inherited from the past, by new ones that are consistent with current prescriptions. The destocking of the Cadarache storage park (INB-56) and the management of its waste is a good example of that approach. it is also the case for the replacement of older effluent-treatment facilities by new workshops, such as STELLA at Saclay and AGATE at Cadarache, or the storage facility for the CEA's military tritiated waste.

When necessary, ASN requires that safety measures be reinforced, as in the case of Silo No. 130 at Saint-Laurent.

ASN may also be led to issue a Resolution in order to prescribe waste-evacuation deadlines for Site No. 130 at La Hague.

At various meetings, ASN verifies the status report of the projects and identifies the various technical and administrative points of contention in order for the operator to be warned in advance.

Lastly, ASN conducts inspections at the facilities, including the recourse to subcontractors, which might be significant in the case of RCD operations.

H.2.4 - Historical waste from non-INBs

The current policy and practices regarding historical waste from non-INBs 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.

All contaminated soil from former sites from the 1940s to the 1960s have been inventoried and characterised according to the method used for any other type of pollution.

If necessary, the departmental ICPE Inspectorate may propose standard restrictions to the Prefect.

No universal soil-contamination limit has been set, because the case-by-case principle seems to be more appropriate, due to the diversity of situations.

For all types of waste, a responsible officer must be designated as the waste producer and must operate an interim storage facility placed under his own responsibility. In France, some facilities are scheduled to accommodate contaminated soil.

In certain specific cases where no responsible party is traceable, special mechanisms, which are described in the 17 November 2008 Circular, are set in place in order to ensure the relevant administrative and financial guarantees.

H.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.

H.3.1 - ASN requirements for INB projects

The siting procedure for any future INB 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.

Those documents describe the objectives and specify the qualitative criteria to which the proposed facility sties must adhere.

It should be noted that 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 consisted in a URL. In that regard, 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. The law had also prescribed that the licence 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.

The *2006 Planning Act* prescribes a certain number of specific requirements concerning the creation-licence application for a deep geological repository (Article 12), one of which requires that such application refer a given geological formation, which has been investigated through a URL.

The list of documents to be submitted in support of a licence application to create an INB appears in the *Decree of 2 November 2007*. The future operator must submit *inter alia* an environmental impact study, as defined in the *Environmental Code* and a preliminary safety report. That request may only be made if the site-selection process and the preliminary studies are advanced enough.

The *2006 TSN Act* 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 particular case of the deep geological repository, the *2006 Planning Act* include specific modalities regarding the organisation of a public debate, the prerequisite adoption of a reversibility law, etc.

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 *Environmental Code* and Article 13-II of *Decree of No. 2007-1557* provide for information and consultation measures with the involvement of the State. In addition, Article 16 of 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".

H.3.2 - Steps taken by INB operators

H.3.2.1 - Steps taken by ANDRA

In the context of the investigations conducted under the *2006 Planning Act,* ANDRA is in charge of the R&D Programme for the implementation of the deep geological repository to be commissioned in 2025. 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).

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. Investigations and studies also help to delineate a "transposition zone" where the properties of the clay rock appear to be similar to those located perpendicularly to the URL. The transposition zone covers an area of about 250 km² to the north and west of the Laboratory.

Pursuant to the *Decree of 16 April 2008* describing the PNGMDR prescriptions, ANDRA made the following proposals to the Ministers in charge of energy, research and the environment at the end of 2009:

- an interest zone for in-depth reconnaissance, that is suitable for the implementation of the deep geological repository in which detailed exploration techniques will be implemented (within the "transposition zone", as defined above);
- design, operational and long-term safety, as well as reversibility options;
- a waste-inventory model to be taken into account, and
- storage options, as complements to disposal.

The interest zone for in-depth reconnaissance purposes was validated by the government in March 2010 after ASN and the CNE had provided their respective opinions. Those operations involving seismics 3D took place during the summer of 2010. A first reflection was also conducted on surface-implementation scenarios. The study and consultation approach will be pursued in order for the implementation of a disposal facility to be proposed during the public debate to be held in 2013. The recommendations of the assessors after reviewing the technical options submitted for the disposal facility serve as orientations for the further studies to be conducted in order for the licence application for the creation of the disposal facility to be ready by 2015.

In addition, ANDRA is in charge of the disposal project for LL-LL waste without any management system so far. Those residues include graphite waste consisting of stacks and sleeves resulting from old GGRs as well as radium-bearing waste. On the basis of preliminary documentary studies, ANDRA identified a number of zones with potentially favourable geological characteristics for the implementation of a repository. In June 2008, following the request of the Minister for the Environment to launch a call for expressions of interest among local communities within the perimeter of the above-mentioned zones, ANDRA sent an information portfolio to all local elected officials involved (regional councils, general councils, communes). More than 3,115 communes are concerned out of the total number of French communes, which slightly exceeds 36,000. Following that procedure, about 40 communes applied. ANDRA forwarded its analysis report of the applications to the government at the end of 2008. On that basis, the government consulted first with ASN and the CNE, followed by elected officials from the territories involved. From those consultations emerged two communes from the Aube *département* that seem to gather the best conditions for the pursuit of the project. Hence, the government set them aside for further geological investigations. However, both communes withdrew their respective applications during the summer of 2009 due to the pressure of opponents, while the State and ANDRA acknowledged their decisions.

In the framework of the 2010-12 PNGMDR, the State has requested ANDRA to reopen the different management options for graphite and radium-bearing waste, by studying notably the possibility for their separate management and by pursuing discussions with the territories and communes that already have submitted their applications, while granting ample time to consultations. In parallel, the HCTISN has implemented a working group on the experience feedback from the site-selection approach.

H.3.2.2 - Steps taken by the CEA

The CEDRA facility (INB-164) was commissioned in 2006.

Other public inquiries for other facilities have also been conducted over the last few years.

In addition, the new Advanced Effluent Management and Treatment Workshop (*Atelier de gestion avancée et de traitement des effluents* – AGATE), was the subject of a public inquiry in Cadarache at the end of 2006. The creation-licence decree was issued on 28 March 2009. The construction of a new storage facility for irradiating waste is planned at Marcoule and will be submitted to a public inquiry in 2012 with a view to having it commissioned by 2013.

H.3.3 - ASN analysis for INBs

ASN ensures full compliance with relevant regulations by reviewing the reports filed by operators.

H.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;
- 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 the monitored by their operators until such time when their radiological impact on the environment is acceptable.

H.4 - FACILITY DESIGN AND CONSTRUCTION (ARTICLE 14)

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.

H.4.1 - ASN requirements for INBs

The general regulations for INB 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.

In such cases, the prescriptions must accompany the creation-licence decree of the facility.

In the case of a deep geological repository, ASN's safety guide specifies that the geological environment must be chosen and the facility must be designed in such a way that its safety be guaranteed passively after closure in order to protect human beings and the environment without any intervention against the radioactive substances and toxic chemicals contained in the radioactive waste. The guide further states that the characteristics of the selected site for the implementation of the disposal facility, the design of its man-made components (packages, engineered components) and the quality of their execution must constitute the basis for the safety of the facility.

For other facilities than disposal facilities, the operator must take all necessary measures as early as the design stage in order to facilitate its dismantling and to limit the production of resulting waste.

According to the *TSN Act*, the operator must demonstrate, as early as his creation-licence application, that his proposed general dismantling 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. *Decree No. 2007-1557* specifies that the creation-licence application must include a dismantling plan describing the proposed principles and phases for the dismantling of the facility, as well as for the rehabilitation and subsequent monitoring of the site. It must also justify the dismantling timeframe between the final shutdown and the dismantling of the facility. The same decree also states that, for any radioactive-waste disposal facility, the dismantling plan is replaced by a document describing the planned modalities, as early as the design stage, for the final shutdown and subsequent monitoring of the facility. In that regard, 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 dismantling operations (easy access to unbolting and handling equipment, etc.) and the evacuation of contaminated equipment and structures. They must also include those relating to civil engineering in order to ensure the stability of the structures during dismantling;
- 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 dismantling and to limit the production of resulting waste used to be rather brief in the past. It has now become more comprehensive for new INBs, as in the case of EDF's activated waste in the proposed ICEDA facility to be located at Bugey, in the Ain département.

According once again to the *TSN Act*, the operator must, as early as he submits his licence application for the creation of disposal facility for radioactive waste, demonstrate that the facility's maintenance and monitoring are able to prevent and to limit the risks and inconveniences of the facility after its final shutdown. The *Decree of 2 November 2007* specifies that, in the case of a disposal facility for radioactive waste, the dismantling plan is replaced by a document presenting the planned modalities, as early as the design stage, for the final shutdown, the transition to a safe state and the subsequent monitoring of the facility.

H.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.

H.5 - Safety assessment of facilities (Article 15)

Article 15: 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).

H.5.1 - ASN requirements for INBs

The INB general regulations apply to radioactive waste-management facilities pertaining to that category 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 in accordance with the *TSN Act*, the applicant must provide a certain number of data and studies, notably a preliminary safety report and the impact study prescribed by the *Environmental Code*. All lifetime phases of the facility must be reviewed (including its dismantling 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 Ministers for the drafting of the decree licensing or denying the creation of the facility.

The requirements for the content of the preliminary safety report are prescribed in Article 10 of the *Decree of 2 November 2007*. Together with the other prescriptions of the *TSN Act*, they form the legal basis for safety reports. Those requirements will be clarified in the near future by a Resolution from ASN.

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.

Hence, systematic safety and environmental assessments are conducted before the construction of any disposal facility for radioactive waste and cover all its lifetime phases. Licensing is granted by decree, once ASN and relevant organisations have provided their opinions and a public inquiry has been held.

Once the facility is built and for the facility commissioning, the operator must submit a specific report to ASN as specified in § E.2.2.4.1.

ASN and its technical support must review the case and, if the conclusions of that review are favourable, ASN may license the commissioning of the facility. In its Resolution, ASN 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, a periodic safety review 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.

As mentioned in § H3.1, ASN has issued basic rules and safety guides in order to describe the objectives to be adopted right from the early beginning in order to ensure the safety of the facility, including after shutdown in the case of a disposal facility. Those basic rules and guides will be completed in the near future by a new order detailing the general technical regulations applicable to INBs, together with ASN Resolutions aiming at clarifying the requirements prescribed by the Order. Those same rules and guides also apply to periodical safety reassessments.

More particularly, ASN requests that the design of any disposal facility for radioactive waste be consistent with a defence-in-depth approach, which is a recognised principle throughout the world for the design and operation of nuclear facilities. The principle leads to the implementation of suitable successive lines of defence for preventing the appearance or, as the case may be, for limiting the consequences of technical, human or organisational deficiencies likely to generate accident situations that may jeopardise the protection of human beings and the environment.

Radiological- and chemical impact assessments must ne performed. Two types of situations must be taken into account after the final shutdown of any disposal facility, as follows:

- 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 and the probability of the events under review, if it is possible to estimate.

For instance, in the case of the CSFMA 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.

For the time being, there are no detailed requirements on how to preserve the memory of a disposal facility. ANDRA is examining that issue, which was addressed briefly in its *Dossier 2009*. The Agency already has acquired some experience at the CSM and is also studying a project concerning "memory centres for radioactive-waste disposal facilities" (*centres de la mémoire des stockages de déchets radioactifs*), one objective of which is to facilitate the appropriation by local populations of the disposal facilities and of their history. That project may call upon a wide range of disciplines.

The minimum value of 500 years for the memory conservation of a disposal facility, whether a surface one or a deep geological repository, must not be confused with the 300-year period, which has constituted and still constitutes the base of the concept for surface disposal. That value of 300 years corresponds to approximately 10 times the longest radioactive half-life of SL radionuclides (Sr-90 and Cs-137), which means that, after 300 years, the activity of those radionuclides will be divided by a factor in the order of 1,000. Provided that it complies with the radiological inventory referred to in the safety report, their impact if then sufficiently low not to justify the disposal facility after 300 years.

H.5.2 - Steps taken by INB operators

H.5.2.1 - ANDRA practices

For the creation of the CSFMA, 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 CSFMA 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 INB.

H.5.2.2 - Practices of other operators

The CEA, AREVA and EDF practices are identical to those implemented for spent-fuel management facilities as described in § G.2.2.

H.5.3 - ASN analysis for INBs

As mentioned above, the impact and safety of management facilities for radioactive waste are assessed prior to the delivery of their licence to create them and to commission them.

In his supporting documentation, the applicant must justify the measures he has taken with regard to safety, including over the long term. As mentioned above, ASN and its technical support organisations (IRSN, GPE) analyse that documentation and ASN carries out the necessary inspections to verify at random the sound implementation of the measures submitted by the applicant, especially during construction and before commissioning. That process, which spreads over a certain timeframe, must be taken into account by the operator in his projects.

H.5.4 - ICPEs and mine tailings

Assessing the design choices made by the applicant exploitant 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.2.3 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.

H.6 - Operation of facilities (Article 16)

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.

H.6.1 - ASN's legal framework and requirements

The requirements referred to in Article 16 of the *Joint Convention* are well consolidated in the French regulations.

More particularly, 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 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. 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.

As in the case for all other nuclear facilities, all events and incidents or accidents 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 reassessment, 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 dismantling plan must also be submitted by the applicant as early as his licence application to create an INB other than a disposal facility for radioactive waste (see § H.4.1). In the case of a disposal facility, the dismantling 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).

An important aspect during the operation of a disposal facility concerns the quality of waste packages and the corresponding acceptance criteria. In that regard, ASN published in 1986 an RFS concerning quality of waste packages to be disposed of in surface facilities. That RFS, which was revised in 1995, specifies the roles of producers and ANDRA, the major criteria with which packages must comply, as well as the waste-acceptance modalities.

ANDRA is legally responsible for developing acceptance specifications for waste packages in disposal facilities. The conformity of waste packages with those specifications must be verified. In order to achieve that goal, 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) that are consistent with RFS III.2.e. ASN checks periodically through inspections at ANDRA that such system has the required robustness to ensure the safety of the facilities.

All disposal facilities currently in service; whether they fall under the INB or ICPE regulations, all have waste-acceptance specifications and a relevant procedure for all incoming radioactive waste.

Acceptance criteria depend directly upon the safety demonstration of the facility. In the case of the CSFMA and of the CSTFA, the criteria are reflected as requirements concerning the radiological content, the limitation of chemicals, package resistance, etc. (mechanical strength of packages, durability or not of containers, etc.).

With regard to the limitation of alpha radionuclides of the packages intended for surface disposal, it is clearly indicated that the activity of the packages must be calculated after 300 years and must include daughter products.

For certain radioactive waste, and notably HL/IL-LL waste, a repository is under review, but its commissioning is not planned before 2025, as prescribed by the *2006 Planning Act*. 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 repository to be submitted.

COGÉMA (now AREVA NC) has been developing production specifications for its packages in its treatment plant at La Hague since 1991 and is still continuing 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 on the redhibitory character or not of conditioning projects. In fact, pursuant to Article 14 of the *2006 Planning Act*, ANDRA must establish specifications for the disposal of radioactive waste that are consistent with nuclear-safety rules and provide its opinion to competent administrative authorities on the specifications of the operators for conditioning their waste.

In the framework of the design studies and in view of the safety demonstration of the future repository, ANDRA wanted to benefit from a sound knowledge of waste and of disposal packages in deep geological formations. ANDRA established requirements with respect to process qualification and the production control of all waste producers in order to implement monitoring actions and to identify non-conforming packages. In 2003, ANDRA examined the approach adopted by operators in order to acquire a sufficient knowledge and control of the characteristics of the packages in order to integrate them in the design specifications of the deep geological waste repository.

ASN is currently drafting a Resolution with a view to clarifying the following:

- the modalities according to which any INB operator may proceed with the conditioning of radioactive waste for disposal purposes, and
- acceptance modalities for waste packages in a disposal facility.

The draft Resolution was published on ASN's website in 2010 for consultation purposes. The final version will be issued after the publication of the future order on INB general regulations for consultation purposes.

H.6.2 - Steps taken by INB operators

H.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 CSFMA in service, but also at the CSM, now in its monitoring phase.

In the case of the CSTFA, 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).

H.6.2.2 - Operational safety practices of CEA, AREVA and EDF

Radioactive-waste and spent-fuel management facilities all constitute INBs. 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.

H.6.3 - ASN analysis for INBs

As mentioned above, the purpose of the provisions described in § E.2.2 concerning INB 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 addition, ASN receives every year ANDRA's status reports on the quality of the packages received at the CSFMA, Aube *département*, from every major waste producer. ASN conducts inspections in order to verify the soundness and efficiency of the system set in place by ANDRA.

H.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.2.3.1), taken in application of the *Environmental Code,* notably of its Book V, as described in § L.3. With regard to mine tailings, since all facilities are no longer in operation, practices with regard to closure are described in § H.7.2.

H.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.

H.7.1 - Waste generated by INBs or ICPEs

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*). Operations stopped in July 1994 and the facility entered into its monitoring phase in January 2003.

The different characteristics of the CSN monitoring phase are detailed above in § D.3.3.1.

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 be revised every 10 years, at the same time as the safety report, the RGEs and the emergency plan. Those documents must be submitted to ASN for review and take experience feedback into account. Similarly to the CSM case, the approach must be gradual and cautious.

It should be noted that the influence of the public on the measures taken for the CSM was mostly felt during the licensing procedure for the monitoring phase of the facility, which took place as follows:

- in 1995, a public inquiry;
- in 1996, a mission entrusted by the government upon the Turpin Commission to assess the status of the facility and to provide an opinion on its impact on the environment;
- in September 1998, the submission of a new licence application (completed in September 1999) in order to move unto the monitoring phase. The safety documents prepared in support of the application were submitted to ASN, which, in turn, approved them in early 1999;
- in 2000, a second public inquiry on the basis of ANDRA's new licence application and on the revised licence application for discharges granted in 1999, and
- the assessment made by ASN and its technical support organisations.

ANDRA provided responses to the recommendations made by the committees in charge of public inquiries and the commission appointed by the government. A few examples of those recommendations include the following:

- 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.

Long-term archiving also constitutes a significant component. The technical prescriptions relating to the monitoring phase require that the following information be archived over the long term:

- site data;
- information relating to the components of the disposal facility: structures, cover, effluent-collection and transport networks, etc. (plans, characteristic locations, drainage system);
- data on disposed waste (origin, nature, mass, radioactivity, toxic substances, conditioning, location in disposal structures);
- monitoring results of the disposal facility and of the environment, as well as all useful data for the interpretation of those results, and
- files relating to incidents, non-conformities or deficiencies, which have had or may have had safety-related consequences.

In accordance with recommandations from the CSM Assessment Commission, ANDRA achieved in March 2008 an intermediate version of the “computerised memory” for keeping essential information on CSM for next generations.

The operator must describe in a monitoring plan (see § D.3.3.1) the overall steps being implemented in order to meet safety objectives. Every year, he must file a report with ASN concerning the implementation of his monitoring plan, present the interpretation of the results achieved and publish a summary of that report.

Cases elaborated by ANDRA in 2009 pursuant to *10 January 2003 Decree* (Cf.§ D.3.4.1) have been presented to GPE in December 2009. Early 2010, ASN took position on complementary studies and actions to be carried out by ANDRA for a step by step implementiation of new dispositions aiming at reinforcing the CSM cover, improving its environmental monitoring and the work carried out on information memory. Actions for reinforcing some embankments located at the basis of the cover are being implemented.

As a consequence, ASN asked ANDRA to maintain the monitoring effort and the work on the long-term behaviour of the disposal facility. First conclusions on the CSM covering should be presented to ASN within a 5 year timeframe. In addition, some trials should be organised by ANDRA for testing implemented dispositions for memory keeping.

H.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.

Until now, site rehabilitation has been designed and 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 is to avoid excessive site-monitoring or maintenance constraints over the long term.

On-going verifications or already done with regard to the storage of Uramium mine tailings are developed in § B.6.3.

With regard to the Bois-Noirs Site, an environmental status report of the site was submitted end of June 2011, pursuant to the *22 July 2009 Circular* that requires AREVA to provide environmental status reports on historical sites. The report includes includes notably the planned rehabilitation project. In fact, the waste-disposal solution under a water space by using a dyke does not seem to be a perennial option.

Section I : TRANSBOUNDARY MOVEMENTS (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) 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

   iv) 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:*

   i) the exercise, by ships and aircraft of all States, of maritime, river and air navigation rights and freedoms, as provided for in international law;

   ii) 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;

   iii) the right of a Contracting Party to export its spent fuel for reprocessing, and

   iv) the rights of a Contracting Party to which spent fuel is exported for reprocessing to return, or provide for the return of, radioactive waste and other products resulting from reprocessing operations to the State of origin.

I.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 *2006 Planning Act*, whose Article 8 prohibits the disposal of any radioactive waste in France that originates from abroad or results from the reprocessing 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 an intergovernmental agreement, 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 *Environmental 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.

I.2 - CONTROL OF TRANSPORT SAFETY

I.2.1 - Organisation of safety control for the transport of radioactive materials

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 were confirmed by the *TSN Act*.

It should be noted that transport regulations for radioactive materials 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 weapons), for which the High Civil Servant for Defence (*Haut fonctionnaire de défense* – HFD) reporting to the Minister of Economy, Finance and Industry, is 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,* which governs the transport of radioactive and fissile materials 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 materials, 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, and
- take all enforcement measures (formal notice, consignation, 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.

I.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 interministerial 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.

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 the Regulatory Transport Safety Group (RTSG) whose membership includes representatives from several countries.

In addition, ASN is also a member of the Standing Working Group on the Safe Transport of Radioactive Materials of the Directorate-General for Transport and Energy of the European Commission.

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 reprocess 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 *2006 Planning Act*.

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 radioactive materials containing no radioactive waste, the general safety provisions apply.

I.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 INBs.

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 1,000 inspections have been carried out in that field, including about 100 in 2010.

I.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), 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. Any event involving regulatory non-conformities, but not impairing the safety function, must not be included in that report. In case of contamination, an analytical report must be sent to ASN within two months after the event.

Section J : DISUSED SEALED SOURCES (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 reentry 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 sources.*

J.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 CSFMA, 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.

J.2 - CEA's role

Given its past role as one of the main French suppliers of sources, the CEA now has to manage all disused sources that are being returned by the industry and hospitals 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 no 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, ANDRA stores a large number of sources, 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 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, as revised in 2009, 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 (CSTFA or CSFMA) 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 timeframe ranging from 10 to 12 years the recovery and elimination of all sealed sources it supplied or manufactured in the past.

J.3 - Storage of disused sealed sources

Pursuant to *the 2006 Planning Act* and to the 16 April 2008 Decree setting forth 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 (CSTFA, CSFMA, future disposal facilities for LL-LL and HL/IL-LL waste). In 2001, Andra established acceptance limits for sealed-source packages at the CSFMA, 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.

Since 2007, certain disused short-lived sealed sources with a radioactive half-life equal or inferior to that of caesium-137 (i.e., 30 years) and with activities lower than certain thresholds, depending on the radionuclide involved, may be disposed of at the CSFMA. Those activity limits or thresholds result from a compatibility assessment with the safety of the disposal facility on the same bases as the other waste types, and were completed by integrating the specificity of the sources, notably via inherent scenarios to sealed sources.

In fact, the specificity of sealed sources refers to their concentrated activity and their potential attractiveness. In case of human intrusion once the memory of the disposal facility is lost, that attractiveness might lead to the recovery of the disused sealed sources by individuals who might ignore the relevant hazards. If the resulting impact of the recovery would be considered to be excessive, the disused sealed source would not be acceptable in the disposal facility.

Except for disused liquid and gaseous sealed sources, disposal systems would be able to manage disused sealed sources as is, without any physical denaturation. Hence, approximately 83% of the 2 million disused sealed sources appearing in the inventory would be disposed of in a shallow disposal facility, while 15% would be intended for surface disposal and 2% for deep geological disposal.

The 2010-12 PNGMDR mentions that Andra's report may be considered as a noticeable advance, since it sets the first orientation and elimination master plan for disused sealed sources, although it will need to be clarified and furthered over the next few years in order to ensure its operational implementation. More particularly, the 2010-12 PNGMDR requests that Andra, together with suppliers, clarify the collection modalities for disused sources to be eliminated in a disposal facility by taking into account their conditioning and the various storage and disposal systems.

Section K : PROPOSED SAFETY IMPROVEMENT ACTIONS

K.1 - National measures

K.1.1 - ASN objectives

K.1.1.1 - Objective concerning radioactive materials and waste

In France, close to 90% of the total volume of radioactive waste are covered by long-term management systems , whereas the other types of waste are being stored, pending the implementation of adequate long-term solutions. Even if the management framework set in place is robust, a few more advances must be achieved, especially in order for all radioactive waste to be handled according to their own long-term management system in accordance with the PNGMDR.

The first edition of the PNGMDR in 2007 had already identified several types of waste that required new management systems or the improvement of existing systems.

The second edition now covers the period from 2010 to 2012. It relies notably on the *National Inventory of Radioactive Materials and Waste*, published by Andra in mid-2009, which assesses both waste production and storage needs over the next decades.

That new version of the PNGMDR was tabled before Parliament at the end of 2009 and assessed by the OPECST. It proposes that all committed actions be pursued and even intensified. A new decree prescribing the new PNGMDR provisions will be issued in order to formulate the accruing requests to the Plan. The major areas concerned are described below.

Storage and disposal facility projects

- *Disposal of HL/IL-LL waste in deep geological formations:* ASN considers that key steps in the development of the project will be addressed during the next few years, especially during the public debate to be held in early 2013 and through the submission of the creation-licence application in late 2014. Through the opinion scheduled to be issued soon concerning the report that Andra published in 2009 concerning safety and reversibility options, ASN will formalise the major work areas that Andra will have to further before submitting a high-quality creation-licence application within deadlines, which constitutes a significant step in the development of that project. The application case to be submitted will need to describe the relevant reversibility conditions of the project in order to ensure its compatibility with the long-term safety of the disposal facility.
- *Disposal of LL-LL waste:* ASN feels that it is necessary for France to be equipped with a suitable disposal facility for that type of waste. Consequently, it will follow with great care Andra's siting process and the development of relevant disposal concepts. ASN will duly provide its opinion to the government according to schedule. In line with the progress of the project, it will be required to take a stand whether to create to create an interim storage facility for the large amount of graphite waste resulting from the dismantling of GGRs.
- Storage of tritiated waste: the concepts proposed by the CEA for storage facilities for tritiated waste provide a concrete safety solution over the short and medium terms for the management of those waste types, pending their take-over by existing or future elimination systems. It is now time for those facilities to be implemented. In addition, a solution for tritiated waste without a proper management system, originating from the nuclear small-scale activities, whose management modes are often inappropriate, will need to be investigated.

Waste conditioning, especially of historical waste

- ASN considers that investigations need to be pursued and intensified during the next few years in order to describe and to implement adapted conditioning modes for IL/LL waste containing organic residues and for non-conditioned historical waste whose conditioning is prescribed by law before 2030.
- A detailed state of storage facilities for historical waste has been drawn. It includes all relevant actions, whether already committed or yet to be committed.
- ASN will follow with great care the evolution of the recovery and conditioning programmes for historical waste and will ensure that all actions undertaken by operators are appropriate in order to meet the prescribed deadlines.

Mine tailings

In the light of the results of impact assessments over the long term, the reinforcement in the quality of covers for mine tailings on several disposal sites appears as an efficient solution to reduce exposures over the long term. That reinforcement must be investigated further in order to assess its feasibility and its relevancy throughout disposal sites for mine tailings. Special provisions regarding the knowledge improvement regarding the environmental and health impact of older uranium mines the management of tailings are under way and must be pursued.

Sealed sources

Several work areas for the management of disused sealed sources need to be implemented on the basis of the studies submitted by Andra. More particularly, outlets have already been identified. It would now be appropriate for Andra and the major source holders to determine the operating conditions for their management (especially the treatment of liquid and gaseous sources and their conditioning process).

Residues containing reinforced natural radioactivity

The waste inventory of residues containing reinforced natural radioactivity needs to be consolidated. A status report on the application of the circular concerning the acceptance of such waste in the disposal facility for conventional ultimate waste is necessary. A list of recovery systems for residues containing reinforced natural radioactivity must also be drawn. Lastly, storage solutions for industrialists producing sporadically residues containing reinforced natural radioactivity must be found.

Polluted sites

In 2011, ASN will publish its doctrine pertaining to the management of sites contaminated with radioactive substances. For ASN, the solution to leave contamination on site must by no means remain the reference solution for their management.

Recovery of radioactive waste

In the nuclear sector, recycling the waste resulting from the dismantling of nuclear facilities must be encouraged. ASN considers that all major nuclear operators, such as AREVA, the CEA and EDF, together with Andra, must combine and increase their efforts in order to study the technico-economic feasibility of recycling solutions and to implement appropriate systems.

Radioactive materials

The actual recoverability of radioactive materials, such as uranium and plutonium, is presented and analysed in the PNGMDR. However, as a precaution, operators have been entrusted with the responsibility to determine potential management systems in case those materials might be considered as waste in the future. ASN recommends that a mechanism be applied in order to ensure the financial management of those materials. Special attention needs to be given to thorium-bearing materials.

K.1.1.2 - Objectives pertaining to dismantling

Besides finalising its two guides, ASN plans to pursue its control of nuclear facilities undergoing dismantling.

Along other initiatives, it will focus on:

- preparing a draft decree for the partial dismantling of the Brennilis NPP and prescriptions relating to the facility's discharges;
- participating in the preparation of draft decrees for the final shutdown and decommissioning of the installations constituting the UP2 400 Plant at La Hague, and
- reviewing the operators' proposals regarding preparatory operations for the final shutdown of the PHÉNIX, COMURHEX and EURODIF facilities.

In addition, ASN will finalise its review of EDF's case in the framework of the update of its decommissioning strategy. Similarly, ASN will also examine the information submitted by the CEA, while taking into account the experience feedback from accumulated delays.

K.1.1.3 - Objectives pertaining to the fuel management

In September 2010, ASN launched an overall review process for the safety and radiation-protection management of the AREVA Group and plans to reach its conclusions in 2011.

Tricastin Site

- Pollution control and the progress of the projects relating to the treatment stations for the site's effluents and waste remain the main stake for the site, and
- ASN will examine with special care AREVA's overall planned projects, whether they involve the preparatory operations for the shutdown of above-mentioned plants (EURODIF and COMURHEX) or significant evolutions in existing plants (SOCATRI and GB II).

MÉLOX Plant

- The safety re-assessment of the MÉLOX Plant, scheduled in 2011, constitutes an important item. Its purpose is to verify the conformity level of the facility to regulations and to the safety reference system, while determining the safety-improvement programme over the next 10 years.
- Dosimetry control and the capability to prevent any hazards associated with human and organisational factors and with the criticality risk will remain control priorities.

La Hague Site

In the case of La Hague Plants, ASN feels that efforts should be pursued, especially with regard to the integration of experience feedback and to the declarations of significant events. In the framework of the safety re-assessment, a certain number of items will be given special attention, such as verifying the conformity of the UP3 Plant with regulations, the ageing effects on structures and equipment, as well as general operating rules. In addition, ASN will ensure that AREVA implement its recovery strategy for all historical waste that on site.

K.1.1.4 - Objectives pertaining to the regulatory framework

ASN will continue to revise the regulations and accruing decrees resulting from the adoption of the *TSN Act* in the light of the future INB Order. Through various Resolutions, it will clarify a certain number of INB provisions, with regard to different areas, such as the production, conditioning, storage and disposal of radioactive waste.

Lastly, ASN will remain strongly involved in international activities by maintaining its participation in several working groups, notably in the framework of the IAEA's Waste Safety Standards Committee (WASSC) and of WENRA (See § K.2.1.1). it will also participate in the reflections of the different international organisations on disposal facilities for radioactive waste, notably with regard to reversibility.

K.1.2 - Operators' objectives

K.1.2.1 - ANDRA objectives

The adoption of the *2006 Planning Act* and the implementation of the PNGMDR have expanded and reinforced ANDRA's missions in its capacity as State operator. A new contract was signed with the State in 2009, thus drawing conclusions from the previous contract and falling in line with the *Grenelle Environnement* approach, in order to specify the new objectives for 2009-12, which revolve around four areas, as follows:

- exemplary industrial performance in the continuous improvement in the operation of disposal facilities for radioactive waste with a view to protection human beings and the environment, the improvement of services and the local insertion of the facilities;
- an innovative designer-turnkey builder benefiting from high-level research capabilities to develop disposal solutions, to ensure their integration through dialogue with stakeholders and to prepare for their industrialisation, to apply a research and innovation policy for all types of radioactive waste;
- a public expert guaranteeing the comprehensiveness of the management solutions for radioactive waste in order to draw the inventory of all radioactive materials and waste, to optimise management systems for ultimate waste, to audit the radioactive liabilities of the sites whose responsible entity is defaulting and to ensure the collection of historical radioactive waste, and
- a centre in France and abroad for disseminating and promoting knowledge on the nature and management of radioactive waste.

During the first quarter of 2012, ANDRA will be audited by the Assessment Agency for Research and Tertiary Education (Agence d'évaluation de la recherche et de l'enseignement supérieur – AERES) on its governance and its R&D activities.

K.1.2.2 - CEA objectives

The CEA has also renewed its contract with the State for 2010-2013 and still maintains the highest safety levels in its INBs as one of its top priorities.

To that end, the CEA reassesses its safety every 10 years. It also conducts an extensive renovation programme of its transport packages in order to meet its own needs and to keep abreast with regulatory changes.

Personnel training and awareness-raising programmes aimed at consolidating the security, radiation-protection and nuclear-safety culture among the staff, continue to be implemented, along with the progress approach on which the safety policy of the facility is based and which involves the responsibility of the entire management line, in terms of objectives and financial resources.

With regard to radiation protection, the CEA is reinforcing its concrete drive with regard to the provisional reduction and management of exposure risks with the full involvement of the employees concerned.

Insofar as nuclear safety is concerned, the CEA is developing a policy aimed at improving public confidence and based on the following principles:

- transparency (knowledge of past experience; quantified objectives for reducing effluents, discharges and waste; clarification of safety objectives per facility and improving prevention thanks to lessons learnt from operating incidents), by means of sustained internal communication;
- quality (ISO-9000 and ISO-14000 certifications, as a nuclear facility operator; implementation of forecasting and reporting tools and performance indicators as part of an integrated information system);
- competence (network of competitive clusters and recognised experts), and
- initiative and autonomy (which, above all, require a five-year safety and security improvement plan, undertaken at the operator's initiative).

K.1.2.3 - EDF objectives

EDF's objective is to have optimised systems at its disposal for managing all its waste.

In the framework of the PNGMDR and in consultation with ANDRA and the other producers, it endeavours to develop such systems 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 *2006 Planning Act*.

K.2 - INTERNATIONAL CO-OPERATION MEASURES

K.2.1 - Co-operation between ASN and its technical supports

K.2.1.1 - ASN's co-operation programmes

The regulatory aspects of safety and radiation protection lead to numerous exchanges and extensive international co-operation.

ASN activities on the international scene have expanded not only with international organisations, such as the IAEA, the OECD/NEA, the European Union, associations of regulatory bodies (e.g., WENRA), but also in the framework of sustained bilateral relations with approximately 15 foreign safety authorities.

WENRA brings together the Western European nuclear safety authorities (17 countries having NPPs) with a view to providing European institutions with an independent assessment of safety and safety control in candidate States to the European Union and to develop a common approach to nuclear safety and its control within the European Union.

With regard to harmonisation work, WENRA members consider that, although nothing shows that safety is unsatisfactory in relation to the current national requirements of each country of the European Union, their common goal remains the constant improvement of safety. Consequently, a working group was set up to review the main differences in safety requirements for power reactors currently in service, from deterministic or probabilistic design up to safety management and safety culture. A second working group was set up later to harmonise the safety approaches not only for the storage of spent fuel and radioactive waste, but also for the dismantling of nuclear facilities. Reference safety levels were developed and the verification work for the integration of those levels in the regulations and in practices is under way. The final adoption of reference levels may require an update of French regulations in those fields.

In that context:

- a working group was created with a view to studying the major differences among safety requirements, between the deterministic and probabilistic approaches and up to safety-management and safety-culture issues for power reactors that a re currently in service, and
- a second working group was also created in order to harmonise safety approaches regarding both the storage of spent fuel and radioactive waste, and the dismantling of INBs.

In 2006, the members of WENRA have developed national action plans for nuclear-power reactors in order to ensure the consistency of national practices with the reference levels specified in 2005 in all technical fields in which differences had been identified. The goal to harmonise all national practices by 2010 has been achieved. The new INB Order, which is based directly on WENRA's work, is currently being drafted

Besides pursuing its committed activities in 2008, WENRA also launched new activities regarding the harmonisation of safety objectives for new reactors. A report was prepared and adopted by consensus by the members, in November 2010.

In the framework of the activities of the second working group, a new version of the reference levels for radioactive waste and spen fuel storage was the subject of a consulting process in 2010. In addition, in 2010, the working-group efforts were on the update of the reference levels for dismantling.

K.2.1.2 - IRSN's co-operation programmes

With regard to the safe management of radioactive waste and to the sae 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 a consensus on scientific and technical issues;
- research on deep earthquakes and their impact on rock fracturing and groundwater circulations;
- studies on seismic forecasts;
- studies on the applicability of instrumentation means, notably on investigation techniques for disposal sites;
- 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;
- the development of international co-operation projects on topics dealing with spent fuel and deep geological repositories for radioactive waste;
- 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 Technical Assistance to the Commonwealth of Independent States (TACIS), 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 dismantling of nuclear facilities and the safety of storage and disposal facilities for radioactive waste, and
- safety-training actions for waste management actions (dismantling, disposal) for the representatives of the French civil society or foreign safety authorities.

The IRSN's major partners include the following:

- the Gesellschaft für Realtorsicherheit [GRS] (Company for Reactor Safety) from Germany and the Vinçotte Nuclear Safety (VNS) from Belgium, for safety analyses of disposal facilities and the modelling of their behaviour over the long term;
- the Japan Nuclear Energy Safety Organization (JNES) and the Japan Atomic Energy Agency (JAEA), for safety interventions in waste disposal facilities;
- the State Scientific and Technical Centre of Nuclear and Radiation Safety (SSTC) from Ukraine and both the Scientific and Engineering Centre for Nuclear and Radiation Safety (SEC-NRS) and the Institute of Nuclear Energy Safety (IBRAE) from Russia for improving waste and spent-fuel management and corresponding safety assessments, and
- the Canadian Nuclear Safety Commission (CNSC) 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:

- the Understanding and Physical and Numerical Modelling of the Key Processes in the Near-field, and their Coupling Project (NF-PRO) regarding the modelling of physico-chemical parameters within a deep geological waste repository
- the Community Waste Management In Practice Project (CIP) regarding waste-management governance;
- the Performance Assessment Methodologies in Application to Guide the Development of the Safety Case Project (PAMINA) regarding the performance assessment of deep geological repositories un order to orient the development of reference cases;
- the Fate of Repository Gases Project (FORGE) regarding the study of the impact of gas formations within deep geological repositories, and
- the Redox Phenomena Controlling Systems Project (RECOSY) regarding the study of chemical interactions in a disposal facility.

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.

Lastly, IRSN is also a member of various international working groups involved in the drafting of technical recommendations, guides and standards on dismantling 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 sharing experience on sound practices for the safety of deep geological repositories (GEOSAF), surface disposal facilities (PRISM), facility dismantling (FASA) and the management of the resulting waste (SADRWMS and SAFRAN). Furthermore, it is also involved in the activates of the NEA expert groups on radioactive-waste management and deep geological repositories, such as the "Clay-Club" of Radioactive Waste Management Committee (RWMC), the RWMC itself and the Integration Group for the Safety Case (IGSC).

K.2.1.3 - Participation of France in ENSREG

The European Nuclear Safety Regulators Group (ENSREG) was created by decision of the 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. It is composed of representatives not only from regulators dealing with nuclear safety or the safe management of radioactive waste, but also from the European Commission.

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, which the DGEC chaired until the middle of 2009. France is particularly active in that circle for exchanging information and sound practices as well as providing the EC with proposals that have been certified among national experts. France was particularly active in the preparation of the ENSREG's position in the prospect of European Directive No. 2011/70 for the safe and responsible management of spent fuel and radioactive waste.

K.2.1.4 - ANDRA's international co-operation

The international aspect is an important part of ANDRA's activities. The *2006 Planning 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 approach 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. Since 2007, ANDRA's Chief Executive Officer has been chairing the NEA's RWMC;
- 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*).

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. More particularly, ANDRA is leading the project of Monitoring Developments for Safe Repository Operation and Staged Closure (MoDeRn).

K.2.2 - Co-operation programmes of waste and spent-fuel producers

K.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 United States, together with research on the long-term conditioning and behaviour of waste packages.

K.2.2.2 - AREVA's international co-operation programmes

With regard to facilities deaking with the fuel cycle and waste management, international exchanges an co-operation programmes in which AREVA is involved may be divided into three main areas, ads 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 peforming transport activities, and
- international projects.

In the framework of the activities conducted in Europe regardin safety and radiation protection, AREVA participates in the European Nuclear Installations Safety Standards (ENISS), an association of European operators thathas been created with a view to establishing adialogu 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 dismantling of INBs. AREVA participates also in the work of the European Nuclear Energy Forum (ENEF), which groups stakeholdes in the nuclear sector and whose work seals also with safety and waste.

In addition, AREVA shares its skills by attending technical meetings to prepare or to revise the IAEA s safety standards, or through various interprofessional associations.

AREVA carries out a significant part of its activities outside France by operating fuel-cycle facilities and by providinget 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, AREA 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.

Furthermore, AREVA and its partners, such as Mitsubishi Heavy Industries, Ltd. (MHI), the leader in fast reactors. Japan Nuclear Fuel Limited (JNFL), a recycling specialist; URS, an engineering firm; Babcock and Wilcox Technologies (BWXT), a security expert, and Battelle, dealing with R&D/innovation, are continuing to co-operate with the U.S. Department of Energy (USDOE) in order to design and build at term a spent-fuel recycling plant that would mitigate first, then inverse the accumulation of spent fuel in the reactor pools and in dry storage facilities. The plant would also optimise the use of available space within a deep geological repository by reducing the volume, toxicity and thermal discharges from the waste intended for disposal.

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.

K.2.2.3 - EDF's international co-operation programmes

EDF's international activities concern a number of key areas:

- international activities within the EDF Group (Energie Baden-Württemberg AG [EnBW], etc.) and foreign nuclear development projects (China, Italy, Poland, South Africa, United States, United Kingdom, etc.); exchanges of knowledge are conducted with EDF Energy ;
- bilateral exchanges of experience, mainly via twinning agreements;
- participation in international organisations, 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), etc.;
- contract-based advice and service activities (Daya Bay, Koeberg, etc.), and
- preparation and planning for future reactors, and technology-watch activities (EUR, etc.).

The first area for EDF's international co-operation is exchange of experience. Twinning operations between French and foreign NPPs 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, etc.

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.).

Section L : ANNEXES

Of the facilities concerned by radioactive-waste management for spent-fuel management, as presented in Section D, the more important ones belong to the INB category, as defined in § E.1.1, and are scattered throughout France, as shown in Figure 10.

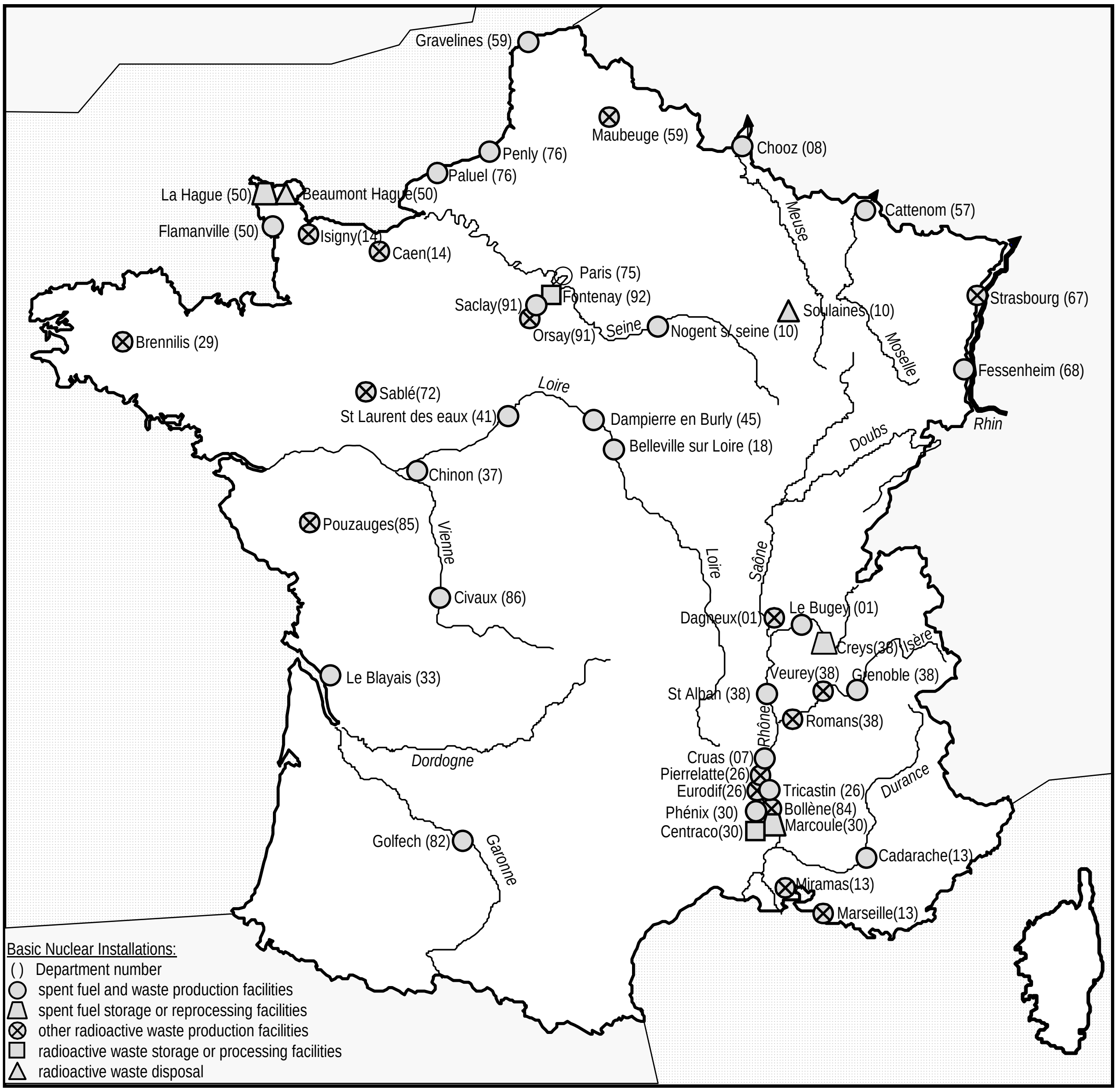

Figure 10 : Location of INBs in France

It should be noted that INBs include the two disposal facilities for LL/IL-SL radioactive waste mentioned in this report:

- the CSM, located at Digulleville near Beaumont-Hague, Manche *département*, and
- the CSFMA, located at Soulaines, Aube *département*.

The CSTFA, Aube *département*, is an ICPE and is located close to Soulaines.

L.1 - SPENT FUEL FACILITIES ON 30 JUNE 2011

L.1.1 - Spent-fuel generating facilities

Spent fuel is generated or likely to be generated in the INBs shown in Table 25.

INB No.	Name and location of facility	Operator	Type of installation	Declaration date	Licensing date	Publication date in *J.O.*	Remarks
18	ULYSSE (Saclay) 91191 Gif-sur-Yvette Cedex	CEA	Reactor	27.05.64			Operation stopped, fuel removed
24	CABRI and SCARABÉE (Cadarache) 13115 Saint-Paul-lez-Durance	CEA	Reactors	27.05.64			
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	
41	HARMONIE (Cadarache) 13115 Saint-Paul-lez-Durance	CEA	Reactor		08.06.65	12.06.65	Reactor dismantled, pending administrative downgrading
42	ÉOLE (Cadarache) 13115 Saint-Paul-lez-Durance	CEA	Reactor		23.06.65	28 and 29.06.65	
67	HIGH FLUX REACTOR (HFR) 38041 Grenoble Cedex	ILL	Reactor		19.06.69 05.12.94	22.06.69 06.12.94	Modification to perimeter: Decree of 12.12.88 *Journal officiel* of 16.12.88
71	PHÉNIX NPP (Marcoule) 30205 Bagnols-sur-Cèze	CEA	Reactor		31.12.69	09.01.70	
75	FESSENHEIM NPP (Reactors 1 and 2) 68740 Fessenheim	EDF	Reactors		03.02.72	10.02.72	Modification to perimeter: Decree of 10.12.85 *Journal officiel* of 18.12.85
78	BUGEY NPP (reactors 2 and 3) 01980 Loyettes	EDF	Reactors		20.11.72	26.11.72	Modification to perimeter: Decree of 10.12.85 *Journal officiel* of 18.12.85
84	DAMPIERRE NPP (Reactors 1 and 2) 45570 Ouzouer-sur-Loire	EDF	Reactors		14.06.76	19.06.76	
85	DAMPIERRE NPP (Reactors 3 and 4) 45570 Ouzouer-sur-Loire	EDF	Reactors		14.06.76	19.06.76	
86	BLAYAIS NPP (reactors 1 and 2) 33820 Saint-Ciers-sur-Gironde	EDF	Reactors		14.06.76	19.06.76	
87	TRICASTIN NPP (reactors 1 and 2) 26130 Saint-Paul-Trois-Châteaux	EDF	Reactors		02.07.76	04.07.76	Modification to perimeter: Decree of 10.12.85 *Journal officiel* of 18.12.85
88	TRICASTIN NPP (reactors 3 and 4) 26130 Saint-Paul-Trois-Châteaux	EDF	Reactors		02.07.76	04.07.76	Modification to perimeter: Decree of 10.12.85 *Journal officiel* of 18.12.85
89	BUGEY NPP (reactors 4 and 5) 01980 Loyettes	EDF	Reactors		27.07.76	17.08.76	Modification to perimeter: Decree of 10.12.85 (*J.O.*, 18.12.85)
92	PHÉBUS (Cadarache) 13115 Saint-Paul-lez-Durance	CEA	Reactor		05.07.77	19.07.77	Modification: Decree of 07.11.91 *Journal officiel* of 10.11.91
95	MINERVE (Cadarache) 13115 Saint-Paul-lez-Durance	CEA	Reactor		21.09.77	27.09.77	
96	GRAVELINES NPP (Reactors 1 and 2) 59820 Gravelines	EDF	Reactors		24.10.77	26.10.77	
97	GRAVELINES NPP (Reactors 3 and 4) 59820 Gravelines	EDF	Reactors		24.10.77	26.10.77	
100	SAINT-LAURENT-DES-EAUX NPP (reactors B1 and B2) 41220 La Ferté-Saintt-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	

INB No.	Name and location of facility	Operator	Type of installation	Declaration date	Licensing date	Publication date in *J.O.*	Remarks
103	PALUEL NPP (Reactor 1) 76450 Cany-Barville	EDF	Reactor		10.11.78	14.11.78	
104	PALUEL NPP (Reactor 2) 76450 Cany-Barville	EDF	Reactor		10.11.78	14.11.78	
107	CHINON NPP (Reactors B1 and B2) 37420 Avoine	EDF	Reactors		04.12.79	08.12.79	Modification: Decree of 21.07.98 *Journal officiel* of 26.07.98
108	FLAMANVILLE NPP (reactor 1) 50830 Flamanville	EDF	Reactor		21.12.79	26.12.79	
109	FLAMANVILLE NPP (reactor 2) 50830 Flamanville	EDF	Reactor		21.12.79	26.12.79	
110	BLAYAIS NPP (reactors 3 and 4) 33820 Saint-Ciers-sur-Gironde	EDF	Reactors		05.02.80	14.02.80	
111	CRUAS NPP (reactors 1 and 2) 07350 Cruas	EDF	Reactors		08.12.80	31.12.80	Modification to perimeter: Decree of 10.12.85 *Journal officiel* of 18.12.85
112	CRUAS NPP (reactors 3 and 4) 07350 Cruas	EDF	Reactors		08.12.80	31.12.80	
114	PALUEL NPP (reactor 3) 76450 Cany-Barville	EDF	Reactor		03.04.81	05.04.81	
115	PALUEL NPP (reactor 4) 76450 Cany-Barville	EDF	Reactor		03.04.81	05.04.81	
119	SAINT-ALBAN - SAINT-MAURICE NPP (Reactor 1) 38550 Le Péage-de-Roussillon	EDF	Reactor		12.11.81	15.11.81	
120	SAINT-ALBAN - SAINT-MAURICE NPP (Reactor 2) 38550 Le Péage-de-Roussillon	EDF	Reactor		12.11.81	15.11.81	
122	GRAVELINES NPP (Reactors 5 and 6) 59820 Gravelines	EDF	Reactors		18.12.81	20.12.81	Modification to perimeter: Decree of 10.12.85 *Journal officiel* of 18.12.85
124	CATTENOM NPP (Reactor 1) 57570 Cattenom	EDF	Reactor		24.06.82	26.06.82	
125	CATTENOM NPP (Reactor 2) 57570 Cattenom	EDF	Reactor		24.06.82	26.06.82	
126	CATTENOM NPP (Reactor 3) 57570 Cattenom	EDF	Reactor		24.06.82	26.06.82	
127	BELLEVILLE NPP (Reactor 1) 18240 Léré	EDF	Reactor		15.09.82	16.09.82	
128	BELLEVILLE NPP (Reactor 2) 18240 Léré	EDF	Reactor		15.09.82	16.09.82	
129	NOGENT-SUR-SEINE NPP (Reactor 1) 10400 Nogent-sur-Seine	EDF	Reactor		28.09.82	30.09.82	Modification to perimeter: Decree of 10.12.85 *Journal officiel* of 18.12.85
130	NOGENT-SUR-SEINE NPP (Reactor 2) 10400 Nogent-sur-Seine	EDF	Reactor		28.09.82	30.09.82	Modification to perimeter: Decree of 10.12.85 *Journal officiel* of 18.12.85
132	CHINON NPP (Reactors B3 and B4) 37420 Avoine	EDF	Reactors		07.10.82	10.10.82	Modification: Decree of 21.07.98 *Journal officiel* of 26.07.98
135	GOLFECH NPP (Reactor 1) 82400 Golfech	EDF	Reactor		03.03.83	06.03.83	
136	PENLY NPP (Reactor 1) 76370 Neuville-lès-Dieppe	EDF	Reactor		23.02.83	26.02.83	
137	CATTENOM NPP (Reactor 4) 57570 Cattenom	EDF	Reactor		29.02.84	03.03.84	
139	CHOOZ B NPP (Reactor 1) 08600 Givet	EDF	Reactor		09.10.84	13.10.84	Deferment of commissioning: Decrees of 18.10.93 *Journal officiel* of 23.10.93 and 11.06.99 *Journal officiel* f 18.06.99
140	PENLY NPP (Reactor 2) 76370 Neuville-lès-Dieppe	EDF	Reactor		09.10.84	13.10.84	

INB No.	Name and location of facility	Operator	Type of installation	Declaration date	Licensing date	Publication date in *J.O.*	Remarks
142	GOLFECH NPP (Reactor 2) 82400 Golfech	EDF	Reactor		31.07.85	07.08.85	
144	CHOOZ B NPP (reactor 2) 08600 Givet	EDF	Reactor		18.02.86	25.02.86	Deferment of commissioning: Decrees of 18.10.93 *Journal officiel* of 23.10.93 and 11.06.99 *Journal officiel* of 18.06.99
158	CIVAUX NPP (Reactor 1) BP 1 86320 Civaux	EDF	Reactor		06.12.93	12.12.93	Deferment of commissioning: Decree of 11.06.99 *Journal officiel* of 18.06.99
159	CIVAUX NPP (Reactor 2) BP 1 86320 Civaux	EDF	Reactor		06.12.93	12.12.93	Deferment of commissioning: Decree of 11.06.99 *Journal officiel* of 18.06.99

Table 26 : Spent-fuel-generating INBs

L.1.2 - Spent-fuel storage or reprocessing facilities on 30 June 2011

Spent fuel is stored or reprocessed in the INBs shown in Table 26.

INB No.	Name and location of facility	Operator	Type of installation	Declaration date	Licensing date	Publication date in *J.O.*	Remarks
22	INSTALLATION DE STOCKAGE PROVISOIRE dite PÉGASE/CASCAD (Cadarache) 13115 Saint-Paul-lez-Durance	CEA	Disposal of radioactive substances	27.05.64	17.04.80	27.04.80	Shutdown of ex-reactor on 19.12.75. Modification: Decree of 04.09.89, *Journal officiel* of 08.09.89
33	USINE DE TRAITEMENT DES COMBUSTIBLES IRRADIÉS (UP2 et AT1) (La Hague) 50107 Cherbourg	AREVA	Transformation of radioactive substances	27.05.64			Modification: Decree of 17.01.74, J.O. du 05.02.74. New operator: Decree of 09.08.78, *Journal officiel* of 19.08.78
47	ATELIER ELAN IIB (La Hague) 50107 Cherbourg	AREVA	Transformation of radioactive substances		03.11.67	09.11.67	New operator: Decree o09.08.78 *Journal officiel* of 19.08.78
50	LABORATOIRE D'ESSAIS SUR COMBUSTIBLES IRRADIÉS (LECI) (Saclay) 91191 Gif-sur-Yvette Cedex	CEA	Use of radioactive substances	08.01.68			Modification: Decree of 30.05.00 *Journal officiel* of 03.06.00
55	LABORATOIRE D'EXAMENS DES COMBUSTIBLES ACTIFS (LECA/STAR) (Cadarache) 13115 Saint-Paul-lez-Durance	CEA	Use of radioactive substances	08.01.68			Extension: Decree of 04.09.89 *Journal officiel* of 08.09.89
56	PARC D'ENTREPOSAGE DES DÉCHETS RADIOACTIFS (Cadarache) 13115 Saint-Paul-lez-Durance	CEA	Disposal of radioactive substances	08.01.68			
72	ZONE DE GESTION DE DÉCHETS RADIOACTIFS SOLIDES (Saclay) 91191 Gif-sur-Yvette Cedex	CEA	Disposal or deposit of radioactive substances		14.06.71	22.06.71	
80	ATELIER HAO (HL oxide) (La Hague) 50107 Cherbourg	AREVA	Transformation of radioactive substances		17.01.74	05.02.74	New operator: Decree of 09.08.78 *Journal officiel* of 19.08.78
91	RÉACTEUR SUPERPHÉNIX 38510 Morestel	EDF	Fast-neutron nuclear reactor		12.05.77 10.01.89	28.05.77 12.01.89	Modification to perimeter: Decree of 24.07.85, *Journal officiel* of 31.07.85. Report de mise en service: Decree of 25.07.86 , *Journal officiel* of 26.07.86. Decree of 30.12.98 for final shutdown and new operator, *Journal officiel* of 31.12.98
94	ATELIER DES MATÉRIAUX IRRADIÉS (Chinon) 37420 Avoine	EDF	Use of radioactive substances	29.01.64			Modification: Decree of 15.04.85 *Journal officiel* of 19.04.85
116	USINE DE TRAITEMENT D'ÉLÉMENTS COMBUSTIBLES	AREVA	Transformation of radioactive		12.05.81	16.05.81	Deferment of commissioning:

INB No.	Name and location of facility	Operator	Type of installation	Declaration date	Licensing date	Publication date in *J.O.*	Remarks
	IRRADIÉS PROVENANT DES RÉACTEURS NUCLÉAIRES À EAU ORDINAIRE «UP3-A » (La Hague) 50107 Cherbourg		substances				Decree of 28.03.89 J.O. du 07.04.89. Modification: Decree of 18.01.93, *Journal officiel* of 24.01.93
117	USINE DE TRAITEMENT D'ÉLÉMENTS COMBUSTIBLES IRRADIÉS PROVENANT DES RÉACTEURS NUCLÉAIRES À EAU ORDINAIRE «UP2 800 » (La Hague) 50107 Cherbourg	AREVA	Transformation of radioactive substances		12.05.81	16.05.81	Deferment of commissioning: Decree of 28.03.89 *Journal officiel* of 07.04.89. Modification: Decree of 18.01.93 *Journal officiel* of 24.01.93
141	ATELIER POUR L'ÉVACUATION DU COMBUSTIBLE (Creys-Malville) 38510 Morestel	EDF	Disposal or deposit of radioactive substances		24.07.85	31.07.85	Deferment of commissioning: Decree of 28.07.93, *Journal officiel* of 29.07.93. New operator: Decree of 30.12.98, *Journal officiel* of 31.12.98
148	ATALANTE CEN VALRHO Chusclan 30205 Bagnols-sur-Cèze	CEA	R&D Laboratory and studies on actinide production		19.07.89	25.07.89	Deferment of commissioning: Decree of 22.07.99 *Journal officiel* of 23.07.99
22	INSTALLATION DE STOCKAGE PROVISOIRE dite PÉGASE/CASCAD (Cadarache) 13115 Saint-Paul-lez-Durance	CEA	Disposal of radioactive substances	27.05.64	17.04.80	27.04.80	Shutdown of ex-reactor on 19.12.75. Modification: Decree of 04.09.89, *Journal officiel* of 08.09.89
33	USINE DE TRAITEMENT DES COMBUSTIBLES IRRADIÉS (UP2 and AT1) (La Hague) 50107 Cherbourg	AREVA	Transform. of radioactive substances	27.05.64			Modification: Decree of 17.01.74, *Journal officiel* of 05.02.74. New operator : Decree of 09.08.78, *Journal officiel* of 19.08.78
47	ATELIER ELAN IIB (La Hague) 50107 Cherbourg	AREVA	Transform. of radioactive substances		03.11.67	09.11.67	New operator: Decree of 09.08.78 J.O. du 19.08.78
50	LABORATOIRE D'ESSAIS SUR COMBUSTIBLES IRRADIÉS (LECI) (Saclay) 91191 Gif-sur-Yvette Cedex	CEA	Use of radioactive substances	08.01.68			Modification: Decree of 30.05.00 *Journal officiel* of 03.06.00
55	LABORATOIRE D'EXAMENS DES COMBUSTIBLES ACTIFS (LECA/STAR) (Cadarache) 13115 Saint-Paul-lez-Durance	CEA	Use of radioactive substances	08.01.68			Extension: Decree of 04.09.89 *Journal officiel* of 08.09.89
56	PARC D'ENTREPOSAGE DES DÉCHETS RADIOACTIFS (Cadarache) 13115 Saint-Paul-lez-Durance	CEA	Disposal of radioactive substances	08.01.68			
72	ZONE DE GESTION DE DÉCHETS RADIOACTIFS SOLIDES (Saclay) 91191 Gif-sur-Yvette Cedex	CEA	Disposal or deposit of radioactive substances		14.06.71	22.06.71	
80	ATELIER HAO (HL oxide) (La Hague) 50107 Cherbourg	AREVA	Transform. of radioactive substances		17.01.74	05.02.74	New operator: Decree of 09.08.78 *Journal officiel* of 19.08.78
91	RÉACTEUR SUPERPHÉNIX 38510 Morestel	EDF	Fast-neutron nuclear reactor		12.05.77 10.01.89	28.05.77 12.01.89	Modification to perimeter: Decree of 24.07.85, *Journal officiel* of 31.07.85. Deferment of commissioning: Decree of 25.07.86, *Journal officiel* of 26.07.86. Decree of 30.12.98 for final shutdown and new operator, *Journal officiel* of 31.12.98
94	ATELIER DES MATÉRIAUX IRRADIÉS (Chinon) 37420 Avoine	EDF	Use of radioactive substances	29.01.64			Modification: Decree of 15.04.85 *Journal officiel* of 19.04.85
116	USINE DE TRAITEMENT D'ÉLÉMENTS COMBUSTIBLES IRRADIÉS PROVENANT DES RÉACTEURS NUCLÉAIRES À EAU ORDINAIRE «UP3-A » (La Hague) 50107 Cherbourg	AREVA	Transform. of radioactive substances		12.05.81	16.05.81	Deferment of commissioning: Decree o28.03.89 *Journal officiel* of 07.04.89. Modification: Decree of 18.01.93, *Journal*

INB No.	Name and location of facility	Operator	Type of installation	Declaration date	Licensing date	Publication date in *J.O.*	Remarks
117	USINE DE TRAITEMENT D'ÉLÉMENTS COMBUSTIBLES IRRADIÉS PROVENANT DES RÉACTEURS NUCLÉAIRES À EAU ORDINAIRE «UP2 800 » (La Hague) 50107 Cherbourg	AREVA	Transform. of radioactive substances		12.05.81	16.05.81	*officiel* of 24.01.93 Deferment of commissioning: Decree of 28.03.89 *Journal officiel* of 07.04.89. Modification: Decree of 18.01.93 *Journal officiel* of 24.01.93
141	ATELIER POUR L'ÉVACUATION DU COMBUSTIBLE (Creys-Malville) 38510 Morestel	EDF	Disposal or deposit of radioactive substances		24.07.85	31.07.85	Deferment of commissioning: Decree of 28.07.93, *Journal officiel* of 29.07.93. New operator: Decree of 30.12.98, *Journal officiel* of 31.12.98
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 *Journal officiel* of 23.07.99

Table 27 : Other radioactive-waste storage or reprocessing facilities

L

L.2 - Radioactive-waste management facilities on 30 June 2011

L.2.1 - Other INBs generating radioactive waste

Apart from the INBs managing radioactive fuel mentioned in § L.1, radioactive waste is generated in the INBs shown in Table 27.

INB No.	Name and location of facility	Operator	Type of installation	Declaration date	Licensing date	Publication date in *J.O.*	Remarks
19	MÉLUSINE 38041 Grenoble Cedex	CEA	Reactor	27.05.64			Shut down on 30.06.93
20	SILOÉ 38041 Grenoble Cedex	CEA	Reactor	27.05.64			Shut down on 23.12.97
21	SILOETTE 38041 Grenoble Cedex	CEA	Reactor	27.05.64			
25	RAPSODIE/LDAC (Cadarache) 13115 Saint-Paul-lez-Durance	CEA	Reactor	27.05.64			Shut down on 15.04.83
29	USINE DE PRODUCTION DE RADIOÉLÉMENTS ARTIFICIELS (Saclay) 91191 Gif-sur-Yvette Cedex	CEA (Oris-Industrie)	Fabrication or transformation of radioactive substances	27.05.64			
32	ATELIER DE TECHNOLOGIE DU PLUTONIUM (ATPu) (Cadarache) 13115 Saint-Paul-lez-Durance	CEA	Fabrication or transformation of radioactive substances	27.05.64			
43	ACCÉLÉRATEUR LINÉAIRE (Saclay) 91191 Gif-sur-Yvette Cedex	CEA	Particle accelerator		08.10.65	13.10.65	
44	RÉACTEUR UNIVERSITAIRE DE STRASBOURG 67037 Strasbourg Cedex	Université Louis-Pasteur	Reactor		25.06.65	01.07.65	
45	CENTRALE NUCLÉAIRE DU BUGEY (Reactor 1) 01980 Loyettes	EDF	Reactor		22.11.68	24.11.68	Modification to perimeter: Decree of 10.12.85 *Journal officiel* of 18.12.85. Shutdown of reactor on 27.05.94. Decree of 30.08.96 for final shutdown, *Journal officiel* of 07.09.96
46	CENTRALE NUCLÉAIRE DE SAINT-LAURENT-DES-EAUX (Reactosr A1 and A2) 41220 La Ferté-Saint-Cyr	EDF	Reactors		22.11.68	24.11.68	Modification to perimeter: Decree of 10.12.85 *Journal officiel* of 18.12.85. Decree of 11.04.94 for final shutdown, *Journal officiel* of 16.04.94
48	SYNCHROTRON SATURNE (Saclay) 91191 Gif-sur-Yvette Cedex	CEA	Particle accelerator	17.02.67			Decree of 08.10.200 for final shutdown, *Journal officiel* of 15.10.02
49	LABORATOIRE DE HAUTE ACTIVITÉ (Saclay) 91191 Gif-sur-Yvette Cedex	CEA	Use of radioactive substances	08.01.68			Extension: Decree of 22.02.88 *Journal officiel* of 24.02.88
52	ATELIER D'URANIUM ENRICHI (ATUE) (Cadarache) 13115 Saint-Paul-lez-Durance	CEA	Fabrication of radioactive substances	08.01.68			
53	MAGASIN DE STOCKAGE D'URANIUM ENRICHI ET DE PLUTONIUM (Cadarache) 13115 Saint-Paul-lez-Durance	CEA	Deposit of radioactive substances	08.01.68			
54	LABORATOIRE DE PURIFICATION CHIMIQUE (Cadarache) 13115 Saint-Paul-lez-Durance	CEA	Transformation of radioactive substances	08.01.68			
57	LABORATOIRE DE CHIMIE DU PLUTONIUM (LCPu) 92265 Fontenay-aux-Roses Cedex	CEA	Use of radioactive substances	08.01.68			Final production shutdown: 01.07.95
59	LABORATOIRE D'ÉTUDES DE COMBUSTIBLES À BASE DE PLUTONIUM (RM2) 92265 Fontenay-aux-Roses Cedex	CEA	Use of radioactive substances	08.01.68			Shut down on 31.07.82
61	LABORATOIRE DE TRÈS HAUTE ACTIVITÉ (LAMA) 38041 Grenoble Cedex	CEA	Use of radioactive substances	08.01.68			
63	USINE DE FABRICATION D'ÉLÉMENTS COMBUSTIBLES 26104 Romans-sur-Isère	FBFC	Fabrication of radioactive substances	09.05.67			Modification: décret du 09.08.78 J.O. du 08.09.78

INB No.	Name and location of facility	Operator	Type of installation	Declaration date	Licensing date	Publication date in *J.O.*	Remarks
65	USINE DE FABRICATION DE COMBUSTIBLES NUCLÉAIRES 38113 Veurey-Voroize	SICN	Fabrication of radioactive substances	27.10.67			
68	INSTALLATION D'IONISATION DE DAGNEUX Z.I. Les Chartinières 01120 Dagneux	IONISOS	Use of radioactive substances		20.07.71	25.07.71	Increase of the maximum activity of the ionisation source: Decree of 15.06.78, J.O. du 27.06.78. New operator: Decree of 23.10.95 J.O. du 28.10.95
77	INSTALLATIONS D'IRRADIATION POSÉIDON -CAPRI (Saclay) 91191 Gif-sur-Yvette Cedex	CEA	Use of radioactive substances		07.08.72	15.08.72	
90	ATELIER DE PASTILLAGE 38113 Veurey-Voroize	SICN	Fabrication of radioactive substances		27.01.77	29.01.77	Modifications: Decree of 15.06.77, J.O. du 19.06.77. Decree of 14.10.86 J.O. du 17.10.86
93	USINE GEORGES BESSE DE SÉPARATION DES ISOTOPES DE L'URANIUM PAR DIFFUSION GAZEUSE (Eurodif) 26702 Pierrelatte Cedex	EURODIF PRODUCTION	Transformation of substances radioactives		08.09.77	10.09.77	Modification to perimeter: Decree of 22.06.85 J.O. du 30.06.85
98	UNITÉ DE FABRICATION DE COMBUSTIBLES NUCLÉAIRES 26104 Romans-sur-Isère	FBFC	Fabrication of radioactive substances		02.03.78	10.03.78	
99	MAGASIN INTERRÉGIONAL DE CHINON 37420 Avoine	EDF	Storage of new fuel		02.03.78	11.03.78	Modification: Decree of 04.06.98 J.O. du 06.06.98
102	MAGASIN INTERRÉGIONAL DU BUGEY 01980 Loyettes	EDF	Storage of new fuel		15.06.78	27.06.78	Modification: Decree of 04.06.98, J.O. du 06.06.98
105	USINE DE PRÉPARATION D'HEXAFLUORURE D'URANIUM (COMURHEX) 26130 Saint-Paul-Trois-Châteaux	COMURHEX	Transformation of substances radioactives				Classified as secret until 31.12.78
106	LABORATOIRE POUR L'UTILISATION DU RAYONNEMENT ÉLECTROMAGNÉTIQUE (LURE) 91405 Orsay Cedex	CNRS	Particle accelerator				New operator: Decree of 08.07.85 J.O. du 12.07.85. Modification: Decree of 02.07.92, J.O. du 08.07.92
113	GRAND ACCÉLÉRATEUR NATIONAL D'IONS LOURDS (GANIL) 14021 Caen Cedex	G.I.E GANIL	Particle accelerator		29.12.80	10.01.81	Modification : Decree of 06.06.01 J.O. du 13.06.01
121	IRRADIATEUR DE CADARACHE (IRCA) 13115 Saint-Paul-lez-Durance	CEA	Use of radioactive substances		16.12.81	18.12.81	
123	LABORATOIRE D'ÉTUDES ET DE FABRICATIONS EXPÉRIMENTALES DE COMBUSTIBLES NUCLÉAIRES (LEFCA) (Cadarache) 13115 Saint-Paul-lez-Durance	CEA	Fabrication of radioactive substances		23.12.81	26.12.81	
131	USINE DE FABRICATION DE COMBUSTIBLE NUCLÉAIRE 26701 Pierrelatte Cedex	FBFC	Fabrication of radioactive substances		07.09.82	09.09.82	New operator: Decree of 18.10.85 J.O. du 26.10.85. Decree of 22.05.00 for final shutdown and dismantling, J.O. du 25.05.00
133	CHINON A1D 37420 Avoine	EDF	Disposal or deposit of radioactive substances		11.10.82	16.10.82	Shutdown of old reactor on 16.04.73
134	MAGASIN D'URANIUM 13140 Miramas	AREVA	Storage of uranium-bearing products		16.11.83	19.11.83	
138	INSTALLATION D'ASSAINISSEMENT ET DE	SOCATRI	Plant		22.06.84	30.06.84	Modification: Decree of 29.11.93,

INB No.	Name and location of facility	Operator	Type of installation	Declaration date	Licensing date	Publication date in *J.O.*	Remarks
	RÉCUPÉRATION DE L'URANIUM (Tricastin) 26130 Saint-Paul-Trois-Châteaux						*Journal officiel* of 07.12.93
143	ATELIER DE MAINTENANCE NUCLÉAIRE (SOMANU) 59600 Maubeuge	SOMANU	Nuclear maintenance		18.10.85	22.10.85	
146	INSTALLATION D'IONISATION DE POUZAUGES Z.I. de Monlifant 85700 Pouzauges	IONISOS	Ionisation facility		30.01.89	31.01.89	New operator: Decree of 23.10.95 *Journal officiel* of 28.10.95
147	INSTALLATION D'IONISATION GAMMASTER - M.I.N. 712 13323 Marseille Cedex 14	GAMMA S-TER	Ionisation facility		30.01.89	31.01.89	
151	USINE DE FABRICATION DE COMBUSTIBLES NUCLÉAIRES (MELOX) BP 2 - 30200 Chusclan	AREVA	Fabrication of radioactive substances		21.05.90	22.05.90	Modification: Decree of 30.07.99 *Journal officiel* of 31.07.99
153	CHINON A2 D 37420 Avoine	EDF	Disposal or deposit of radioactive substances		07.02.91	13.02.91	Shutdown of old reactor on 14.06.85
154	INSTALLATION D'IONISATION DE SABLÉ-SUR-SARTHE Z.I. de l'Aubrée 72300 Sablé-sur-Sarthe	IONISOS	Ionisation facility		01.04.92	04.04.92	New operator: Decree of 23.10.95 *Journal officiel* of 28.10.95
155	INSTALLATION TU 5 BP 16 26701 Pierrelatte	AREVA	Transformation of substances radioactives		07.07.92	11.07.92	Modification: Decree of 15.09.94, *Journal officiel* of 24.09.94
156	CHICADE (Cadarache) BP 1 13108 Saint-Paul-lez-Durance Cedex	CEA	R&D Laboratory		29.03.93	30.03.93	
157	BASE CHAUDE OPÉRATIONNELLE DU TRICASTIN (BCOT) BP 127 84504 Bollène Cedex	EDF	Nuclear maintenance		29.11.93	07.12.93	
161	CHINONA3 D 37420 Avoine	EDF	Disposal or deposit of radioactive substances		27.08.96	31.08.96	Shutdown of old reactor on 17.03.93
162	MONTS D'ARRÉE EL4 D Brennilis 29218 Huelgoat	EDF	Disposal or deposit of radioactive substances		31.10.96	08.11.96	Shutdown of old reactor on 31.07.85. New operator: Decree of 19.09.00 *Journal officiel* of 26.09.00
163	CENTRALE NUCLÉAIRE DES ARDENNES CNA-D 08600 Givet	EDF	Disposal or deposit of radioactive substances		19.03.99	21.03.99	Shutdown of old reactor on 17.03.93
164	Cedra (Cadarache) 13113 St Paul lez Durance	CEA	Conditioning and storage of radioactive substances		04.10.04	05.10.04	

Table 28 : INBs generating radioactive waste

Apart from INBs in which radioactive waste may be stored or reprocessed, as mentioned in § L.1, radioactive waste is stored or reprocessed in the INBs shown in Table 27.

L.2.2 - Other facilities generating radioactive waste

Apart from INB in which radioactive waste may be stored or reprocessed, as mentioned in § L.1, radioactive waste is stored or reprocessed in the INBs shown in Table 28.

INB No	Name and location of facility	Operator	Type of installation	Declaration date	Licensing date	Publication date in *J.O.*	Remarks
34	SOLID AND LIQUID WASTE TREATMENT PLANT 92265 Fontenay-aux-Roses Cedex	CEA	Radioactive substance transform. plant	27.05.64			
35	LIQUID WASTE MANAGEMENT ZONE	CEA	Radioactive	27.05.64			

INB No	Name and location of facility	Operator	Type of installation	Declaration date	Licensing date	Publication date in *J.O.*	Remarks
	(Saclay) 91191 Gif-sur-Yvette Cedex		substance transform. plant				
36	SOLID AND LIQUID WASTE TREATMENT PLANT 38041 Grenoble Cedex	CEA	Radioactive substance transform. plant	27.05.64			
37	SOLID AND LIQUID WASTE TREATMENT PLANT (Cadarache) 13115 Saint-Paul-lez-Durance	CEA	Radioactive substance transform. plant	27.05.64			
38	SOLID AND LIQUID WASTE TREATMENT PLANT STE2 (La Hague) 50107 Cherbourg	COGEMA	Radioactive substance transform. plant	27.05.64			Change of operator: Decree of 09.08.78 (*J.O.*, 19.08.78)
66	CSM 50448 Beaumont-Hague	Andra	Radioactive substance storage facility		19.06.69	22.06.69	Start of monitoring period: Decree of 10.01.03 (*J.O.*, 11.01.03)
73	SOLID RADWASTE INTERIM FACILITY 92265 Fontenay-aux-Roses Cedex	CEA	Radioactive substance interim storage or warehouse facility		14.06.71	22.06.71	
74	IRRADIATED GRAPHITE JACKET INTERIM STORAGE FACILITY (Saint-Laurent-des-Eaux) 41220 La Ferté-St-Cyr	EDF	Radioactive substance interim storage or warehouse facility		14.06.71	22.06.71	Change of operator: Decree of 28.06.84 (*J.O.*, 06.07.84)
118	STE3 SOLID AND LIQUID WASTE TREATMENT FACILITY La Hague 50107 Cherbourg	COGEMA	Radioactive substance transform. plant		12.05.81	16.05.81	Commissioning postponed: decree of 27.04.88 (*J.O.*, 03.05.88)
149	CSFMA Soulaines-Dhuys 10200 Bar-sur-Aube	Andra	Radioactive substance surface disposal facility		04.09.89	06.09.89	Change of operator: Decree of 24.03.95 (*J.O.*, 26.03.95)
160	CENTRACO Codolet 30200 Bagnols-sur-Cèze	SOCODEI	Radioactive waste and effluent treatment		27.08.96	31.08.96	

Table 29 : Other radioactive-waste storage or reprocessing facilities

L

L.3 - Nuclear facilities undergoing dismantling on 30 June 2011

L.3.1 - Decommissioned reactors or in the process of being decommissioned

Facility name and location	INB No.	Commissioning year	Final production shutdown year	Thermal power (MW)	Last regulatory actions	Current status
EL2 Saclay	(ex INB No. 13)	1952	1965	2.8	Cancelled from INB list	Sealed source
Chinon A1D (ex-Chinon A1)	133 (ex INB No. 5)	1963	1973	300	1982: Decree for the containment of Chinon A1 and creation of the Chinon A1D storage INB	Partly dismantled, modified into a storage INB for remaining waste on site (Museum)
CESAR Cadarache	(ex INB No. 26)	1964	1974	0.01	1978: Cancelled from INB list	Dismantled
ZOÉ Fontenay-aux-Roses	(ex INB No. 11)	1948	1975	0.25	1978 Cancelled from INB list and classified as IC	Contained (Museum)
PEGGY Cadarache	(ex INB No. 23)	1961	1975	0.001	1976: Cancelled from INB list	Dismantled
PEGASE Cadarache	22	1963	1975	35	1980: Decree to modify the reactor into a storage facility for radioactive substances (decree modified in 1989	Partly dismantled, new storage facility for radioactive substances
MINERVE Fontenay-aux-Roses	(ex INB No. 12)	1959	1976	0.0001	1977: Cancelled from INB list	Dismounted at Fontenay-aux-Roses and reassembled at Cadarache
EL 3Saclay	(ex INB No. 14)	1957	1979	18	1988: Cancelled from INB list and classified as IC	Partly dismantled, confinement of remaining sections
NEREIDE Fontenay-aux-Roses	(ex INB No. 10)	1960	1981	0.5	1987: Cancelled from INB list	Dismantled
TRITON Fontenay-aux-Roses	(ex INB No. 10)	1959	1982	6.5	1987: Cancelled from the INB list and classified as IC	Dismantled
RAPSODIE Cadarache	25	1967	1983	20, then 40		Dismantling under way
MARIUS Cadarache	(ex INB No. 27)	1960 à Marcoule, 1964 à Cadarache	1983	0.0004	1987: Cancelled from INB list	Dismantled
EL-4D (ex-EL4) Brennilis	162 (ex INB No. 28)	1966	1985	250	1996: Decree for dismantling and the creation of EL-4D storage INB	Dismantling under way
CHINON A2D (ex-Chinon A2)	153 (ex INB No. 6)	1965	1985	865	1991: Decree for partial dismantling of Chinon A2 NPP and creation of Chinon A2D storage INB	Partly dismantled, modified into a storage INB for remaining waste
MELUSINE Grenoble	19	1958	1988	8		Final shutdown
CHINON A3D (ex-Chinon A3)	161 (ex INB No. 7)	1966	1990	1360	1996: Decree for partial dismantling of Chinon A3 NPP and creation of the Chinon A3D storage INB	Partly dismantled, modified into a storage INB for remaining waste
SAINT-LAURENT-DES-EAUX A1	46	1969	1990	1662	1994: Decree for final shutdown	Final shutdown under way
CHOOZ AD (ex-Chooz A)	163 (ex INB Nos. A1, 2, 3)	1967	1991	1040	1999: Decree for partial dismantling of Chooz A NPP and creation of the Chooz AD Storage INB	Partly dismantled, , modified into a storage INB for remaining waste
SAINT-LAURENT A2	46	1971	1992	1801	1994: Decree for final shutdown	Final shutdown under way
BUGEY 1	45	1972	1994	1920	1996: Decree for final shutdown	Final shutdown under way

Facility name and location	INB No.	Commissioning year	Final production shutdown year	Thermal power (MW)	Last regulatory actions	Current status
HARMONIE Cadarache	41	1965	1996	0.001		Undergoing end of operation
SILOE Grenoble	21	1963	1997	35		Undergoing end of operation
RUS Strasbourg	44	1967	1997	0.1		Undergoing end of operation
SUPERPHENIX Creys-Malville	91	1985	1997	3000	1998: Decree for final shutdown	Undergoing final shutdown

Table 30 : Decommissioned reactors or in the process of being decommissioned

L.3.2 - Other decommissioned facilities or in the process of being decommissioned on 30 June 2011

Facility name and location	INB No.	Type of installation	Commissioning year	Final production shutdown	Last regulatoru actions	Current status
LE BOUCHET	(Ex-INB No. 30)	Ore processing	1953	1970	Removed from INB list	Dismantled
ATTILA Fontenay-aux-Roses	57	Reprocessing pilot in 1'INB cell	1966	1975		Dismantled
LCPu Fontenay-aux-Roses	57	Laboratory of plutonium chemistry	1966	1995		Dismantling under way
ELAN II B La Hague	47	Fabrication of caesium- 137 sources	1970	1973		Dismantling under way
AT1 La Hague	33	Reprocessing of fast fuel	1969	1979		Dismantling under way
GUEUGNON	(Ex-INB No. 31)	Ore processing		1980	Removed from INB list	Dismantled
BAT. 19 Fontenay-aux-Roses	(Ex- INB No. 58)	Plutonium metallurgy	1968	1984	1984: Removed from INB list	Dismantled
RM2 Fontenay-aux-Roses	59	Radiometallurgy	1968	1982		Dismantling under way
LCAC Grenoble	(Ex-NB No. 60)	Fuel analysis	1968	1984	1997 Removed from INB list	Dismantled
SATURNE Saclay	48	Accelerator	1958	1997	2002: Decree for final shutdown and dismantling of the facility	Stopped
SNCS Osmanville	(Ex-INB No. 152)	Ioniser	1990	1995	2002: Decree for final shutdown and dismantling of the facility	Dismantling under way
ATUE Cadarache	52	Uranium processing	1963	1997		Cleanup under way
ARAC Saclay	(Ex-INB No. 81)	Fabrication of fuel assemblies	1975	1995	1999: Removed from INB list	Cleaned up
ALS Saclay	43	Accelerator	1965	1996		Final cessation of operation under way
FBFC Pierrelatte	131	Fuel fabrication	1983	1998	2000: Decree for final shutdown and dismantling of the facility	Dismantling under way

Table 31 : Other decommissioned facilities or in the process of being decommissioned

L

L.4 - Complementation safety evaluations of nuclear installations in the light of Fukushima accident – List of concerned installations and sites

L.4.1 - Installations and sites identified as priority to be assessed in 2011

L.4.1.1 - Installations operated by Electricité de France – NPPs

1. Belleville NPP (INB 127 et 128)
2. Blayais NPP (INB 86 et 110)
3. Bugey NPP (INB 78 et 89)
4. Cattenom NPP (INB 124, 125, 126 et 137)
5. Chinon B NPP (INB 107 et 132)
6. Chooz B NPP (INB 139 et 144)
7. Civaux NPP (INB 158 et 159)
8. Cruas NPP (INB 111 et 112)
9. Dampierre NPP (INB 84 et 85)
10. Fessenheim NPP (INB 75)
11. Flamanville site, including Flamanville 3 reactor (INB 108, 109 et 167)
12. Golfech NPP (INB 135 et 142)
13. Gravelines NPP (INB 96, 97 et 122)
14. Nogent NPP (INB 129 et 130)
15. Paluel NPP (INB 103, 104, 114 et 115)
16. Penly NPP (INB 136 et 140)
17. Saint-Alban-Saint-Maurice NPP (INB 119 et 120)
18. Saint Laurent B NPP (INB 100)
19. Tricastin NPP (INB 87 et 88)

L.4.1.2 - Installations operated by the CEA

Cadarache site	• Jules Horowitz Reactor (INB 172) • Masurca (INB 39) • ATPu (INB 32)
Saclay site	• OSIRIS (INB 40)
Marcoule site	• Phénix (INB 71)

L.4.1.3 - Installations operated by AREVA

La Hague site AREVA NC	• UP3 (INB 116) • UP2 800 (INB 117) • UP2 400 (INB 33) • STE2 A (INB 38)	• HAO (INB 80) • Elan 2B (INB 47) • STE3 (INB 118) • Site support functions
Marcoule site	• MELOX SA : Melox facility (INB 151)	
Tricastin site EURODIF SA	• George Besse I facility (INB 93) • SET : George Besse II and RECII (INB 168) • AREVA NC : TU5 W facility (INB 155) • Comurhex – Tricastin facility (INB 105) • SOCATRI (INB 138) • Site support functions	
Romans site	• FBFC : FBFC facility (INB 98)	

L.4.1.4 - Installation operated by l'Institut Laue Langevin

Grenoble site	• High Flux Reactor (RHF) (INB 67)

L.4.2 - Installations and sites to be assessed in 2012

L.4.2.1 - Installations operared by the CEA

Cadarache site	• Rapsodie (INB 25) • MCMF (INB 53) • LECA (INB 55) • CHICADE (INB 148)	• Cabri (INB 24) • PEGASE (INB 22) • Storage facility (INB 56) • Site support functions
Saclay site	• Orphée (INB 101)	
Marcoule site	• Atalante (INB 156) • Site support functions	

L.4.2.2 - Installations operated by AREVA

Romans site	• FBFC – CERCA facility (INB 63)

L.4.2.3 - Installation operated by Cisbio International

Saclay site	• Cisbio facility (INB 29)

L.4.2.4 - EDF Installations being dismantled

Creys Malville site	• Superphénix including TNA (INB 91) • APEC (INB 141)
Bugey site	• Bugey 1 (INB 45)
Chinon site	• Chinon A1 (INB 133) • Chinon A2 (INB 153) • Chinon A3 (INB 161)
Saint-Laurent site	• Saint-Laurent A1 (INB 46) • Saint-Laurent A2 (INB 46)
Chooz site	• Chooz A (INB 163)
Brennilis site	• Monts d'Arrée - EL4-D (INB 162)

L.4.2.5 - ITER ORGANIZATION installations

Cadarache site	• ITER

L.4.3 - Other installations of lower priority to be assessed according to specific ASN requests, including by anticipated periodic safety reviews

L.4.3.1 - Installations operated by CEA

Cadarache site	• Phébus (INB 92) • EOLE (INB 42) • MINERVE (INB 95) • STAR (INB 55) • Magenta (INB 169) • CEDRA (INB 164)	• LPC (INB 54) • LEFCA (INB 123) • CASCAD (INB 22) • AGATE (INB 171) • STEDS Traitement (INB 37)
Saclay site	• ISIS (INB 40) • LECI (INB 50)	• LHA (INB 49) • ZGDS Storage facility (INB 72)

	• Poséidon (INB 77)	• ZGEL Liquid Effluent Management Zone (INB 35)
Grenoble site	• STED (INB 36) • STED (INB 79)	• LAMA (INB 61)
Fontenay-aux-Roses site	• INB Process (INB 165) • INB Support (INB 166)	

The following INB are not concerned by the complementary safety evaluations : ATUe (INB 52) located at Cadarache site, Ulysse (INB 18) located at Saclay site, Melusine (INB 19) and Siloé (INB 20) located on Grenoble site.

L.4.3.2 - Installations operated by IONISOS

- Dagneux site (INB 68)
- Pouzauges site (INB 146)
- Sablé sur Sarthe site (INB 154)

L.4.3.3 - Installations operated by ANDRA

- CSM (INB 66)
- CSFMA (INB 149)

L.4.3.4 - Installations operated by EDF

Tricastin site	• Tricastin operational hot unit (BCOT) (INB 157)
Chinon site	• Irradiated materials facility (AMI) (INB 94) • Chinon inter-regional warehouse (MIR) (INB 99)
Bugey site	• Bugey Inter-regional warehouse (MIR) (INB 102) • ICEDA (INB 173)
Saint- Laurent site	• Interim storage facility of irradiated graphite sleeves (INB 74)

L.4.3.5 - Installations operated by AREVA

Narbonne site	• Comurhex Malvési (ECRIN) (Licensing in progress)

L.4.3.6 - Other operators

SOCODEI	Marcoule site	• Centraco (INB 160)
SOMANU	Maubeuge site	• Nuclear maintenance facility (INB 143)
GIE GANIL	Caen site	• GANIL (INB 113)
ISOTRON		• GAMMASTER - Marseille (INB 147) • GAMMATEC – Chuslan (INB170)

The following INB are not concerned by the complementary safety evaluations : Strasbourg University reactor (INB 44) – University Louis Pasteur, the LURE (INB 106), SICN (INB65 et INB90).

.

L.5 - MAJOR LEGISLATIVE AND REGULATORY TEXTS

L.5.1 - Laws and regulations

Planning Act No. 2006-739 of 28 June 2006
on the Sustainable Management of Radioactive Materials and Waste.

Act No. 2006-686 of 13 June 2006
Concerning Transparency and Security in the Nuclear Field (*TSN Act*).

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
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
Concerning the INB Nomenclature.

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. 2007-721 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 Environmental Code *for Underground Laboratories Conducting Research Into the Radioactive Waste Management and Modifying* Decree No. 99-686 of 3 August 1999*.*

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 Environmental 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 Environmental 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.

Ministerial Order of 31 December 1999
on the General Technical Requirements to Prevent and Limit the Harmful Effects and External Hazards Resulting From the Operation of Basic Nuclear Facilities.

Interministerial Order of 26 November 1999
on the General Technical Requirements Concerning the Limits and Methods Relating to Intakes and Discharges Subject to Licensing, Made by Basic Nuclear Facilities.

Order 2001-270 of 28 March 2001
on the Transposition of EU Directives Concerning the Protection Against Ionising Radiation.

L.5.2 - Basic Safety Rules subject to the Convention

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 Reprocessing 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 Reprocessing 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 Reprocessing of Fuel Irradiated in Pressurised-waster 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 Reprocessing 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).
RFS-III.2.f	*Definition of Goals to Be Set in the Engineering and Work Phases for the Final Disposal of Radioactive Waste in Deep Geological Formations, in Order to Ensure Safety After the Operating Lifetime of the Repository* (1 June 1991).

L.6 - STRUCTURE OF MAJOR NUCLEAR OPERATORS

L.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.

Functional divisions include:

- 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.

Operational divisions include:

- 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.

L.6.2 - CEA

The CEA is a public research organisation founded in 1945. It has now organised its operational resources on the basis of four operational sectors, each of which deals with one of its four core activities, as shown in the organisation chart shown in the figure below: the nuclear, technological research, fundamental research and defence sectors. Each sector has its own resources (general management, objective-setting division and its own operational resources) allowing it to develop, to plan and to control all its activities.

The CEA also has four functional sectors, including the Risk Control Sector, which is in charge of cross- actions in the areas of security, radiological protection and nuclear safety.

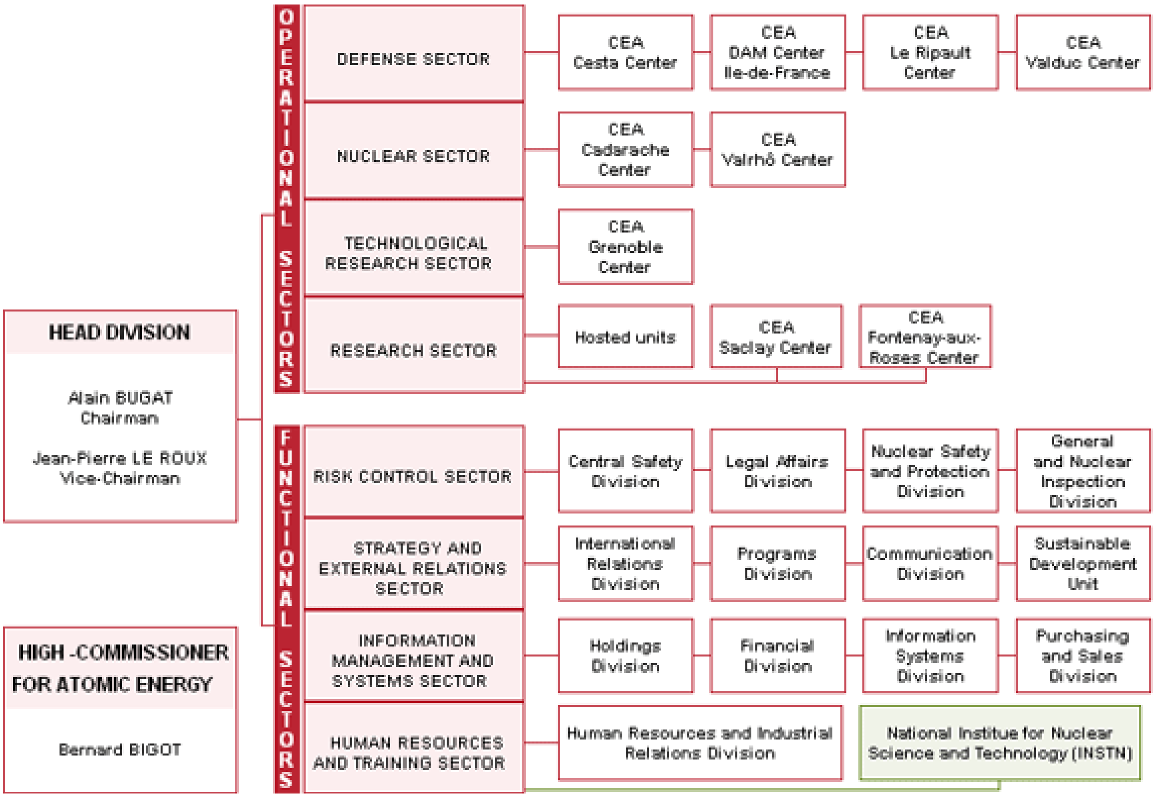

Figure 11 : CEA's organisation chart

L.6.3 - AREVA

Hence, 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_2.

AREVA's activities are reflected in the organisation chart shown in Figure 12.

The general nuclear-safety-inspection function pertains to the Corporate Safety, Security, Health and Environment Department (*Direction Corporate sûreté-sécurité-santé-environnement* – D3SE).

EXECUTIVE BOARD Luc Oursel: Chief Executive Officer			
EXCOM Executive Committee			
CORPORATE DEPARTMENTS			
Front-end Division	Reactors and Services Division	Back-end Division	Renewable Energies Division
Mining	Reactors	Treatment-Recycling	Offshore Wind Turbines
Chemistry	Equipment	Recovery	Bioenergetics Biomasse
Enrichment	Nuclear Services	Logistics	Concentrated Solar Power
	Nuclear Measurements	Cleanup	Hydrogen and Energy Storage
	Consulting and Information Systems		
Fuel	AREVA TA	Engineering	

Figure 12 : AREVA's organisation chart

L.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.

L.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 units and CENTRACO) and disposal (CSFMA and CSTFA). The Director of the DPN is the main contact with the ASN Director-General, particularly in the field of waste management in operating NPPs

L.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 quality of the packages they produce. They are required to implement the doctrine drawn up for the entire nuclear fleet and to use generic certifications, whenever available. They ensure that the certifications specific to their situation are consistent with existing national provisions. They rely essentially on the support of the Corporate Technical Support Unit (*Unité technique opérationnelle* – UTO).

L.6.4.1.2 - National engineering units

Since 2005, the UTO is the only national engineering unit supporting NPPs for operational waste-management issues. It is responsible for:

- support activities in the development of the doctrine regarding operating waste (internal guidelines, instructions, etc.);
- the methodological support (waste surveys, interim storage, regulations, disposal systems, etc.) necessary for the implementation of the doctrine;
- package certifications and their evolution, the incorporation of experience feedback, applications for new generic approvals;

- the development of a reference set of safety rules for radioactive waste, grouping technical notes for waste certifications, etc.;
- the technical support of DPN management in EDF's relations with ASN;
- management activities;
- contractual relations with suppliers of products (packagings, hulls, drums) and materials (dry loads), as well as with SOCODEI for Mercure mobile machines;
- the management of common conditioning resources (mobile units, etc.), and
- the leadership of the Co-ordination Group for the Disposal of Radioactive Waste Package, a transverse initiative with the DPI.

The Operational Engineering Unit (*Unité d'ingénierie d'exploitation* – UNIE), the second national unit of the DPN, 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.

L.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 cleanup of nuclear facilities.

The CIDEN includes 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.

L.6.4.3 - Nuclear Fuel Division

The Nuclear Fuel Division (*Division Combustible nucléaire* – DCN) draws up strategies concerning the back-end of the fuel cycle and notably the disposal of radioactive waste. It manages contracts for uranium supply and enrichment, the fabrication of UO_2 and MOX fuels, as well as spent-fuel transport, interim storage and reprocessing with AREVA. It also organises the quality monitoring of those activities under the terms of the *1984 Quality Order*.

More particularly, the DCN negotiates and manages the transport and disposal contracts for the operational waste generated by NPPs. To that end and based on the data supplied by NPPs and centralised by the DPN, it sends contractual delivery forecasts to the CSFMA and organises rail and road waste shipments in consultation with the DPN. The DCN is responsible for the economic and financial-management aspects of the agreements signed with ANDRA. It manages all radioactive-waste transport and disposal contracts signed with ANDRA.

L.7 - MEASUREMENTS TAKEN IN THE ENVIRONMENT

L.7.1 - Monitoring stations

L.7.1.1 - Radioactivity Telemetry Network

L.7.1.1.1 - Téléray (ambient gamma dose rate)

The IRSN's TÉLÉRAY network is dedicated to the continuous monitoring of ambient gamma radiation and is equipped with an alert function in case of abnormal increase in radioactivity. The probes of the network, which included 170 stations in 2011, are scattered throughout the country (metropolitan France and overseas *départements* and regions/overseas communities (*département et région d'outre-mer/collectivité d'outre-mer* – DROM-COM). Their major objective is to detect as quickly as possible any artificial increase in the ambient gamma-radiation level in order to protect and to inform the relevant populations.

A redeployment plan of the network is currently understudy in order to reinforce the coverage of the probes over the entire territory and between 10 and 30 km around nuclear sites, and hence to improve the sensitivity of the recording beacons.

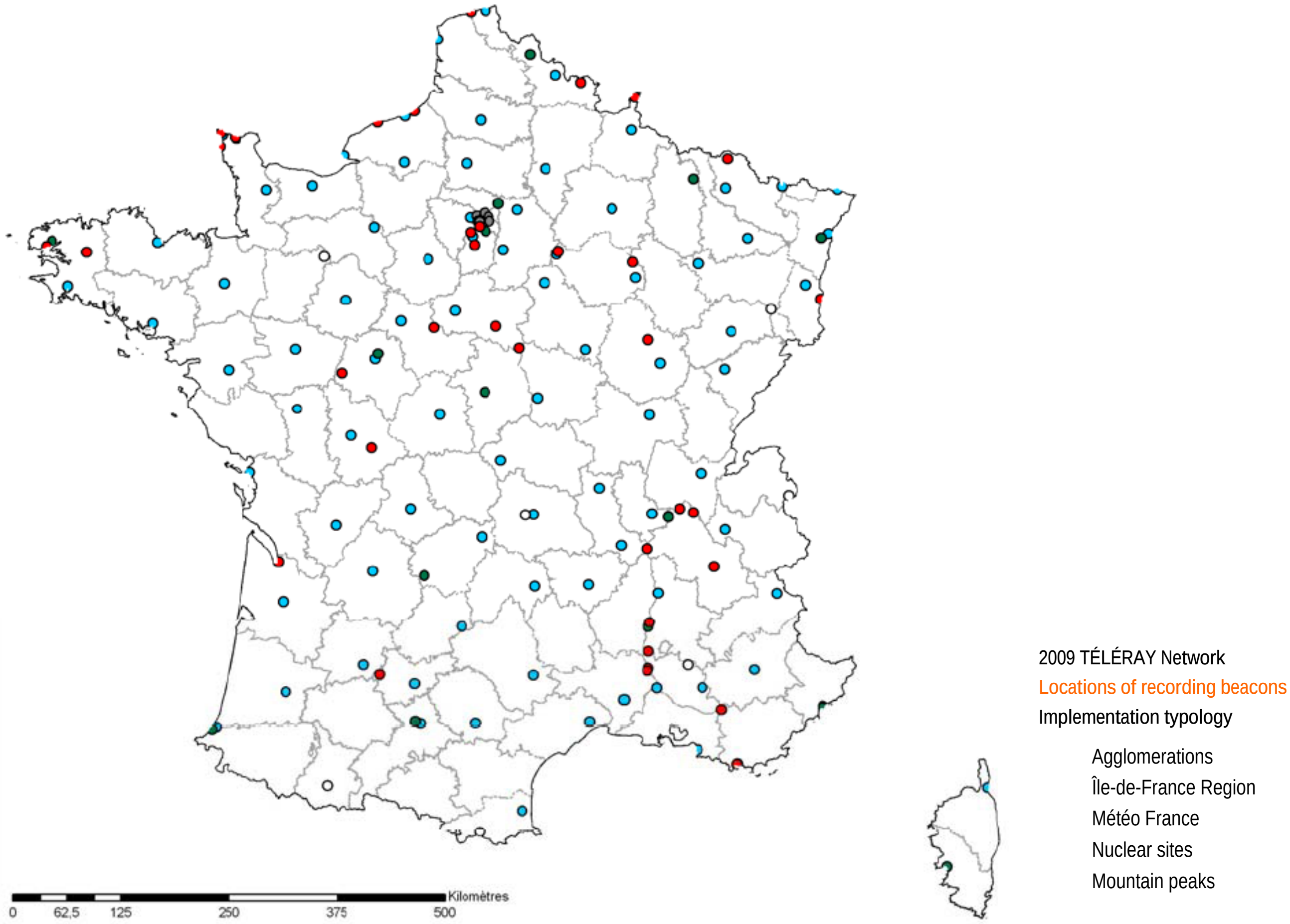

Figure 13 : Monitoring stations installed in France

Figure 14 : Monitoring stations installed in France

L.7.1.1.2 - Hydrotéléray network (radioactivity of major rivers)

The Hydrotéléray network is an automated network dedicated to the continuous monitoring of the radioactivity of the major rivers downstream from all nuclear finicalities 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 detect any significant abnormal increase in radioactivity in major rivers flowing in the sea. In 2009, the network provided 30,000 gamma-spectrometry measurements.

L.7.1.2 - Measurement and reference stations

Radioactivity monitoring concerns the atmosphere, water, soil, plant life and the food chain. Besides the reference stations spread throughout the country and located far from nuclear sites, measurement stations are also located close to nuclear sites, industrial sites or urban centres, on major rivers and along the seacoast. Their locations are shown below.

L.7.1.3 - Monitoring of the atmospheric compartment

L.7.1.3.1 - 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 thermoluminescent dosimeters (DTL Network), which is integrated over periods of six months. Approximately 900 DTLs are scattered throughout the country (metropolitan France and DOM-TOM), with a reinforced density close to nuclear sites.

L.7.1.3.2 - 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 "ground-level" air (*air au niveau du sol* – AS) stations at a rate of 7 to 10 m^3/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, and
- a total of eight very-high-rate (*très grand debit* – TGD) stations at a rate of 300 to 700 m^3/h are scattered throughout the country. The gamma-spectrometry aerosol recordings are collected over a period of 10 days and measure radionuclide traces in the order of 10^{-7} Bq/m^3.

L.7.1.3.3 - Rainwaters

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 prevaling winds at locations where water is collected on a weekly basis.

Environment	Sample	Analysis
Atmosphere	Téléray recorder (continuous) Integrating dosimeter (semi-yearly)	Ambient γ radiation
Aerosols	Filter (daily)	Total β (daily), γ spectrometry (monthly)
Rainwaters	Collector 0.2 m^2 (monthly)	Total β, γ spectrometry

Table 32: Measures taken for atmospheric monitoring

L.7.1.4 - Monitoring of the water compartment

L.7.1.4.1 - Continental streams

In addition to the Hydrotéléray continuous telemetry network, rivers (whether sea-bound or not) are monitored by a system of about 30 semi-automated hydrocollectors, located immediately downstream from the nuclear facilities. It is complemented by sampling points downstream from certain nuclear facilities. A series of five stations are implemented far away from any facility either downstream or upstream (on the Loire River at Les-Ponts-de-Cé, on the Seine River at Croissy and at Porcheville, on the Rhône at Génissiat and at Vallabrègues) and complete the water-stream monitoring system.

L.7.1.4.2 - 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 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 eight stations. On the Atlantic Ocean and on the Mediterranean Sea, seawaters are monitored in six and four points, respectively.

Coastal monitoring is oriented more towards bioindicators that concentrate pollutants and account for the status of the environment better that certain direct measurements in seawater.

Environment	Sample	Analysis
Rainwaters	Nuclear sites: weekly Others: monthly	Total β, ^{3}H (monthly) + γ spectrometry, ^{90}Sr (others)
Drinking water	Monthly to annual	Total β, total K + α, ^{226}Ra, U (mines) + γ spectrometry, ^{3}H, ^{90}Sr (Rhône Valley)
Mains water	For health approval	Total α, total β, K, ^{3}H, ^{90}Sr, ^{222}Rn, ^{226}Ra, U
Mineral waters	For health approval	Total β, K, ^{3}H, ^{90}Sr, ^{222}Rn, ^{226}Ra, U, Th
River water	Rivers: continuous + quarterly Mines: monthly	Total α, total β, K, ^{3}H, γ spectrometry + ^{131}I Total α, total β, K, ^{226}Ra, U (monthly)
River water	Rivers: continuous + quarterly Mines: monthly	Total α, total β, K, ^{3}H, γ spectrometry + ^{131}I Total α, total β, K, ^{226}Ra, U (monthly)
Seawater	Nuclear sites: continuous Coasts: monthly	Total β, K, ^{3}H, γ spectrometry (monthly) K, ^{3}H, γ spectrometry (semi-yearly)
Wastewater	Achères (Paris): continuous	Total β, K, ^{125}I, ^{131}I (weekly)

Table 33 : Measures taken for water-monitoring

L

L.7.1.5 - Food-chain monitoring

The radiological status of the zones that not influenced by the discharges from nuclear facilities is based on very-low-level measurements, which are made during studies or specific radiological recordings.

In addition, a regular watch of foodstuffs is made at the département level at least once a year. Since 2009, 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) in order to strengthen the monitoring of a geographic zone, if need be.

L.7.1.5.1 - Agricultural productions

The radiological watch covers two main: milk and cereals.

Milk either originates from farms located close to nuclear facilities (29 nuclear sites) or from typical co-operatives or dairy centres for cow-milk production at the scale of the *département* (90 departmental co-operatives). It is monitored every month if it comes from farms that are located to nuclear facilities and at least every year for other locations.

Since 2010, wheat is monitored in 210 silos scattered throughout the country. Samples are then grouped in 21 regional mixtures. That monitoring completes the other monitoring carried out close to the major nuclear facilities.

Item	Samples	Analysis
Milk	Co-operatives: twice a year Others: monthly	γ spectrometry β (Sr + lanthanides), γ spectrometry
Wheat	Departmental silos (annual) Nuclear sites (annual)	γ spectrometry, total β, Ca, K, ^{90}Sr, ^{226}Ra, U γ spectrometry
Fish	National market (weekly) Two types (flat and round)	γ spectrometry + total α, total β, K, Ca, ^{90}Sr (annual)
Honey	Five sites, including two nuclear (annual)	γ spectrometry
Bovine thyroid	Two slaughterhouses (weekly)	γ spectrometry, ^{131}I
Food and drink	Consumed in three canteens for seven days (monthly)	Total β, Ca, K, ^{90}Sr, U, γ spectrometry ^{226}Ra (annual)

Table 34 : Measures taken for food-chain monitoring

L.7.1.5.2 - Monitoring of marine fauna and flora

Flora and fauna monitoring primarily concerns aquatic species along the coastline, but also terrestrial flora around reference stations and a nuclear site. It involves about 300 samples and 1,700 measurements every year, as shown in Table 34.

Item	Sample	Analysis
French seashores	— Molluscs (annual) — Crustacea (annual) — Algae (annual) — Marine plants (annual)	Total α, total β, K, ^{90}Sr, *γ spectrometry* Total α, total β, K, ^{90}Sr, *γ spectrometry,* ^{210}Po, U, ^{238}Pu, ^{241}Am Total α, total β, K, ^{90}Sr, *γ spectrometry,* ^{210}Po, U, ^{238}Pu, ^{241}Am Total α, total β, K, ^{90}Sr, *γ spectrometry,* ^{210}Po, U, ^{238}Pu, ^{241}Am, U, Th
Seine Bay	— Molluscs (annual) — Crustacea (annual) — Fish (annual)	α global, β global, Ca, K, ^{90}Sr, Th, γ spectrometry idem + ^{210}Po, U, ^{238}Pu, ^{226}Ra idem
English Channel and North Sea	Fish (annual)	Total α, total β, Ca, K, ^{90}Sr, γ spectrometry

Table 35: Measures taken for fauna and flora monitoring

L.7.1.6 - Regional radiological findings

One of the evolving areas of the radiological-monitoring strategy for the environment of the relevant territory concerns the implementation of consigned regional radiological reports with a view to creating on a territory of several *départements* an updated reference system of radioactivity levels especially in local characteristic productions of the region.

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), waters and the atmospheric environment (aerosols and gases).

The first report was made in the Val de Loire area, where the study took place between 2008 and 2010. The main agricultural productions understudy covered, wine, asparagus, cucumbers and meat. For the aquatic environment, fish and water milfoil were selected in the area, whether influenced or not by the discharges of NPPs.

The consigned reports concerning the Rhône Valley and South-Western France were committed in 2009 and should be completed by 2012.

L.7.1.7 - 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 INBs 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 in Table 35.

Monitored environment	Regulatory samplings and checks to be performed by the operator
Air at ground level	Four stations for continuous sampling of atmospheric dust on a fixed filter with daily measurement of total α and total β One continuous sample under the prevailing wind with weekly measurement of atmospheric ^{3}H
Rainwaters	One station under the prevailing wind (monthly collector) Measurements: total β and tritium on monthly mix
Ambient γ radiation	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)
Plants	Two grass-sampling points (monthly check) with measurements: total β, γ spectrometry (+ ^{14}C and C, quarterly) Main agricultural crops (annual check) with measurements: total β, γ spectrometry
Milk	Two sampling points (monthly check) with annual measurements: β (^{40}K excluded), K (+^{14}C,)
Environment receiving liquid discharges	Samples at mid-discharge into the river or after dilution in cooling water (case of coastal NPPs), with measurement of total β, K and ^{3}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 β, K and ^{3}H Annual samples of sediments, aquatic fauna and flora with measurement of total β, γ spectrometry
Groundwaters	Five sampling points (monthly check) with measurement of total β, K and ^{3}H
Soils	Regulatory samplings and checks to be performed by the operator

Table 36 : Regulatory environmental monitoring at NPPs

L.7.1.8 - Regulatory environmental monitoring of CEA or AREVA facilities

The principles behind regulatory environmental monitoring in the area surrounding a laboratory or plant are summed in Table 36.

Monitored environment	Regulatory inspections and sampling imposed on the operator
Air at ground level	Four continuous sampling stations for sampling dust particles in the air, with fixed filters and daily measurements of overall β-emitting and α-emitting radionuclides One continuous sampling station providing weekly measurements of ^{3}H in the air
Rainwaters	Two continuous sampling stations, one of which is exposed to the prevailing winds, with weekly measurements of overall β-emitting radionuclides and tritium
Gamma-emitting background radiation	Four beacons recording measurements on a continuous basis 10 integrator dosimeters at the site boundaries (monthly readings)
Plants	Four grass-sampling points (monthly monitoring)

L

Monitored environment	Regulatory inspections and sampling imposed on the operator
	Major farms in the area (annual monitoring) with measurements: overall β, γ spectrometry (+^{3}H and ^{14}C, at regular intervals)
Milk	One sampling point (monthly monitoring) Measurements taken: overall β, γ spectrometry (+^{3}H and ^{14}C, at regular intervals)
Soil	One annual sample Annual measurements: ^{14}C and γ spectrometry
Environment receiving liquid discharges	At the least, weekly sampling of water in the receiving environment, measuring overall α, overall β, potassium and tritium Annual sampling of sediment and aquatic flora and fauna using γ spectrometry
Groundwaters	Five sampling points (monthly monitoring) measuring overall α, overall β. potassium and tritium

Table 37 : Regulatory environmental monitoring at CEA or AREVA facilities

L.7.2 - Measurements in the environment and around nuclear sites

L.7.2.1 - Gaseous discharges from nuclear sites

Gaseous discharges from the major INBs 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.

L.7.2.1.1 - Limits and values of gaseous discharges from EDF sites according to the original licence of 2006

In the original licences established on the basis of the 1974 specifications for nuclear-power reactors, gaseous discharges are divided into two different categories, as shown in Table 37.

Site	Rare gases		Tritium		Carbon 14		Iodine		Others	
	Limit	2010 discharges	Limit	2010 discharges	Limit	2010 discharges	Limit	2010 discharges	Limit	2010 discharges
	(TBq)	*(TBq)*	*(TBq)*	*(TBq)*	*(TBq)*	*(TBq)*	*(GBq)*	*(GBq)*	*(GBq)*	*(GBq)*
Le Bugey	2590*	0.656	2590*	0.475	/	0.36	111**	0.055	111**[8]	0.00296
Chooz	25	1.08	5	0.911	1.4	0.241	0.8	0.0197	0.1	0.00415
Civaux	25	2.14	5	1.537	1.4	0.110	0.8	0.09	0.1	0.002
Creys-Malville	/	$0.42.10^{-4}$	100	1.2	/	/	/	/	0.1	$1.6.10^{-3}$
Dampierre-en-Burly	2220*	2.41	2220*	1.1	/	/	74**	0.046	74**	0.0068
Fessenheim	1480*	0.119	1480*	0.663	/	/	111**	0.00682	111**	0.00167
Penly	45	0.458	8	2.080	1.4	0.462	0.8	0.0218	0.8	0.00311

Table 38: Limits and discharge values of gaseous discharges in 2010 from EDF sites in the initial licences of 2006

** This is a common limit for rare gases and tritium*

*** This is a common limit for iodine and other gases*

L.7.2.1.2 - Limits and values of gaseous discharges from EDF sites according to the licence renewed in 2006

In the new licences established on the basis of the 1995 specifications when renewed for NPP sites, gaseous discharges are now divided into five different categories, including carbon-14, which is also measured, as shown in Table 38.

Site	Rare gases		Tritium		Carbon 14		Iodine		Others	
	Limit	2010 discharges	Limit	2010 discharges	Limit	2010 discharges	Limit	2010 discharges	Limit	2010 discharges
	(TBq)	*(TBq)*	*(TBq)*	*(TBq)*	*(TBq)*	*(TBq)*	*(GBq)*	*(GBq)*	*(GBq)*	*(GBq)*
Belleville-sur-Loire	45	0.632	5	2.51	1.4	0.523	0.8	0.0206	0.8	0.0105
Le Blayais	72	1.11	8	1.020	2.2	0.55	1.6	0.060	1.6	0.084
Cattenom	90	1.6	10	5.6	2.8	0.6	1.6	0.09	1.6	0.009
Chinon	72	1.01	8	1.780	2.2	0.512	1.6	0.0279	1.6	0.00289
Cruas-Meysse	72	3.5	8	0.912	2.2	0.56	1.6	0.09	1.6	0.016
Flamanville	45 (25 since 1/10/10)	0.508	5 (8 since 1/10/10)	0.501	1.4	0.309	0.8	0.0336	0.8 (0.1 since 1/10/10)	0.00378
Golfech	45	0.339	8	1.42	1.4	0.385	0.8	0.185	0.8	0.078
Gravelines	108	2.14	12	3.34	3.3	1.16	2.4	0.04	2.4	0.016
Nogent-sur-Seine	45	0.998	8	1.38	1.4	0.119	0.8	0.062	0.8	0.004
Paluel	90	1.09	10	2.11	2.8	0.785	1.6	0.0373	1.6	0.0123
Saint-Alban – Saint-Maurice	45	1.2	5	2.1	1.4	0.33	0.8	0.028	0.8	0.005
Saint-Laurent-des-Eaux	36	0.276	4	0.433	1.1	0.278	0.8	0.00874	0.8	0.00194
Le Tricastin	72	4.98	8	1.960	2.2	0.612	1.6	0.202	1.6	0.004

Table 39: Limits and values of gaseous discharges in 2010 from EDF sites according to licences renewed in 2006

L.7.2.1.3 - Limits and values of gaseous discharges from AREVA's La Hague Site in 2010

The current licence (Order of 8 January 2007) subdivided the previous discharge categories and reduced authorised limits, as shown in Table 39.

Site	Tritium		Alpha emitters		Radioiodine		Rare gases	
	Limit	2010 discharges	Limit	2010 discharges	Limit	2010 discharges	Limit	2010 discharges
	(TBq/a)	*(TBq)*	*(GBq/a)*	*(GBq)*	*(TBq/a)*	*(TBq)*	*(GBq/a)*	*(GBq)*
La Hague	150	56.8	0.01	0.0019	0.02	0.0050	470 000	226 000

Site	Carbon 14		Other artificial beta and gamma emitters	
	Limit	2010 discharges	Limit	2010 discharges
	TBq/a	TBq	TBq/a	TBq
La Hague	28	16	1	0.114

Table 40 : Limits and values of gaseous discharges from AREVA's La Hague Site in 2010

L

L.7.2.1.4 - Limits and values of gaseous discharges from CEA sites in 2010

Current licences cover two or four gas categories depending on the site, as shown in Table 40.

Site	Tritium		Noble gases		Other artificial beta and gamma emitters	
	Limit	2010 Discharges	Limit	2010 Discharges	Limit	2010 Discharges
	TBq/a	TBq	GBq/an	GBq	MBq/an	MBq
Grenoble	0.75	0.000831	100	0	63	0.0061
Saclay	81.6	11	85 100	19 300	258	8.3

	Noble gases and tritium		Halogens and aerosols	
	Limit	2010 Discharge	Limit	2010 Discharge
	(TBq/a)	*(TBq)*	*(GBq/a)*	*(GBq)*
Cadarache	555	< 33.8	18.5	< 0.0093
Fontenay aux Roses	20	< detection limit	10	0.008

Table 41 : Limits and values of gaseous discharges from CEA sites in 2010

L.7.2.2 - Liquid discharges from nuclear sites

Liquid discharges from major INBs are presented in the following tables with their corresponding limits per category of radioactive product specified in current licences.

L.7.2.2.1 - Limits and values of liquid discharges from EDF sites in initial licences

In all licences based on 1974 specifications for nuclear-power reactors, liquid discharges are divided into two categories as shown in Table 41.

Sites	Tritium		Iodine		Miscellaneous	
	Limit	2010 discharges	Limit	2010 discharges	Limit	2010 discharges
	(TBq)	*(TBq)*	*(GBq)*	*(GBq)*	*(GBq)*	*(GBq)*
Le Bugey	185	37.2	2035*	0.0155	2035*	1.19
Chooz	90	63.6	0.1	0.11	5	0.658
Civaux	80	62.33	0.1	0.006	5	0.117
Creys-Malville	15	$0.266.10^{-3}$	/	/	30	$9.33.10^{-3}$
Dampierre-en-Burly	111	31	1480*	0.032	1480*	0.9
Fessenheim	74	30.9	925*	0.005	925*[9]	0.051
Penly	80	64.8	0.1	0.00473	25	0.151

Table 42: Limits and values of liquid discharges in 2010 from EDF sites according to the initial licences of 2006

[9] ** This is a common limit for Iodine and miscellaneous*

L.7.2.2.2 - Limits and values of liquid discharges from EDF sites in renewed licences in 2006

In all renewed licences based on 1995 specifications for nuclear-power reactors, liquid discharges are divided into four different categories, including carbon 14, as shown in Table 42.

Site	Tritium		Carbon 14		Iodines		Miscellaneous	
	Limit	2010 discharges	Limit	2010 discharges	Limit	2010 discharges	Limit	2010 discharges
	(TBq)	*(TBq)*	*(GBq)*	*(GBq)*	*(GBq)*	*(GBq)*	*(GBq)*	*(GBq)*
Belleville-sur-Loire	60	59.1	400	14.2	0.1	0.0145	25	0.295
Le Blayais	80	46.3	600	37	0.6	0.012	60	0.53
Cattenom	140	118	380	16	0.2	0.02	50	0.9
Chinon	80	45.3	600	19	0.6	0.0142	60	0.46
Cruas-Meysse	80	54.5	600	58.5	0.6	0.044	60	1.83
Flamanville	60 (80 since 1/10/10	47	400 (190 since 1/10/10)	22.2	0.1	0.0118	25 (10 since 1/10/10)	0.48
Golfech	80	60.1	190	22.9	0.1	< 0.0083	25	0.162
Gravelines	120	74.1	900	35	0.9	0.02	90	2
Nogent-sur-Seine	90	71.5	190	42.6	0.1	0.018	25	0.318
Paluel	120	88.6	800	33.5	0.2	0.0334	50	0.918
Saint-Alban – Saint-Maurice	60	57.2	400	13	0.1	0.011	25	0.45
Saint-Laurent-des-Eaux	40	22.3	300	23.3	0.3	0.01	30	0.2
Le Tricastin	90	57,3	260	37,6	0.6	0.0031	60	0.895

Table 43 : Limits and values of liquid discharges in 2010 from EDF sites according to licences renewed in 2006

L.7.2.2.3 - Limits and values of liquid discharges from AREVA's La Hague Site in 2010

The current licence (Order of 8 January 2007) subdivides the previous discharge categories and reduces authorised limits, as shown in Table 43.

Tritium		Alpha emitters		Strontium 90		Caesium 137		Caesium 134	
Limit	2010 discharges	Limit	2010 discharges	Limit	2010 discharges	Limit	2010 discharges	Limit	2010 discharge s
(TBq/a)	*(TBq)*	*(TBq/a)*	*(TBq)*	*(TBq/a)*	*(TBq)*	*(TBq/a)*	*(TBq)*	*(TBq/a)*	*(TBq)*
18 500	9950	0.14	0.026	11	0.13	8	1.08	0.5	0.075

Carbon 14		Ruthenium 106		Cobalt 60		Radioiodines		Other beta and gamma emitters	
Limit	2010 discharges	Limit	2010 discharges	Limit	2010 discharges	Limit	2010 discharges	Limit	2010 discharges
(TBq/a)	*(TBq)*	*(TBq/a)*	*(TBq)*	*(TBq/a)*	*(TBq)*	*(TBq/a)*	*(TBq)*	*(TBq/a)*	*(TBq)*
42	7.34	15	1.03	1.4	0.07	2.6	1.38	60	2.64

Table 44: Limits and values of liquid discharges from AREVA's La Hague Site in 2010

L.7.2.2.4 - Limits and values of liquid discharges from CEA sites in 2010

Current licences concern four sites and cover three categories of liquid discharges, as shown in Table 44.

Those results confirm ASN's policy to downgrade discharge licences by adapting them more strictly to the operating requirements of the facilities.

Site	Tritium		Alpha emitters		Miscellaneous	
	Limit	Discharge	Limit	Discharge	Limit	Discharge
	(TBq)	*(TBq)*	*(GBq)*	*(GBq)*	*(GBq)*	*(GBq)*
Cadarache	1	0.053	0.13	0.00027	1.5	0.326
Fontenay-aux-Roses	0.2	0.000005	1	0.001	40	0.006
Grenoble	0.097	0.00068	0.022	0.0001	0.22	0.0076
Saclay	0.246	0.0147	0.01	0.044	0.54	0.024

Table 45 : Limits and values of liquid discharges from CEA sites in 2010

L.8 - BIBLIOGRAPHY

L.8.1 - Documents

1. *Joint Convention on the Safety of Spent Fuel Management and the Safety of Radioactive Waste Management (JC), September 1997,* IAEA, INFCIRC 596, 24 December 1997.
   See: www.iaea.org/Publications/Documents/Infcircs/1997/infcirc546.pdf

2. *Joint Convention on the Safety of Spent Fuel Management and the Safety of Radioactive Waste Management: Guidelines Regarding the Review Process, INFCIRC/603/Rev.3, 24 July 2006.*
   See: https://www.iaea.org/Publications/Documents/Infcircs/2006/infcirc603r3.pdf

3. *Code de la santé publique* [*Public Health Code*], *Journal officiel de la République française*[10], French version only.
   See: www.legifrance.gouv.fr/affichCode.do?cidTexte=LEGITEXT000006072665&dateTexte=20080713

4. *Code de l'environnement* [*Environmental Code*], *Journal officiel de la République française*, French version:
   See: www.legifrance.gouv.fr/affichCode.do?cidTexte=LEGITEXT000006074220&dateTexte=20080713 .

5. *Sûreté nucléaire en France: Législation et réglementation,* Recueil No. 1606, Les Éditions du *Journal officiel,* 4e édition, May 1999, French version only.

6. *La Sûreté nucléaire et la radioprotection en France en 2007 : Rapport annuel de l'ASN,* March 2008, English summary.
   See: www.asn.fr/sections/rubriquesprincipales/publications/rapport-annuel-asn/surete-nucleaire

7. *Inventaire national des déchets radioactifs et des matières valorisables,* 2006, French version only. See: www.andra.fr/interne.php3?id_article=552&id_rubrique=156

8. Nuclear Safety Convention: Fourth National Report (*Convention sur la sûreté nucléaire: Quatrième rapport national sur la mise en œuvre par la France des obligations de la* Convention), September 2007, Unofficial English version.
   See: www.asn.fr/sections/rubriquesprincipales/international/textes-internationaux/conventions/rapports/df

L.8.2 - Websites

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:

Légifrance: www.legifrance.fr

ASN: www.asn.fr

ANDRA: www.andra.fr

CEA: www.cea.fr

AREVA: www.areva.fr

EDF: www.edf.fr

MEDDTL (including DGEC and MSNR) : www.developpement-durable.gouv.fr/

IAEA: www.iaea.org

[10] *A large number of legislative and regulatory texts may be consulted on the following Website: www.legifrance.fr*

L

L.9 - List of main abbreviations

AGATE	*Atelier de gestion avancée et de traitement des effluents* – Advanced Effluent Management and Treatment Workshop
ANDRA	*Agence nationale pour la gestion des déchets radioactifs* – French National Radioactive Waste Management Agency
AREVA	Corporate holding company
ASN	*Autorité de sûreté nucléaire* – Nuclear Safety Authority
CEA	*Commissariat à l'énergie atomique* – French Atomic Energy Commission
CEDRA	*Conditionnement et entreposage de déchets radioactifs* – Radioactive Waste Conditioning and Storage Project
CENTRACO	*Centre de traitement et de conditionnement de déchets de faible activité* – Low-level Waste Processing and Conditioning Facility
CICNR	*Comité interministériel aux crises nucléaires ou radiologique* - Interministerial Committee for Nuclear and Radiological Emergencies
CIDEN	*Centre d'ingénierie de la déconstruction et de l'environnement* – Technical Centre for Deconstruction and the Environment
CIINB	*Commission interministérielle des installations nucléaires de base* – Interministerial Committee for Basic Nuclear Facilities
CMN	*centre de médecine nucléaire* – nuclear medicine centre
CNE	*Commission nationale d'évaluation* – National Review Board
CODERST	*Conseil départemental de l'environnement et des risques sanitaires et technologiques* – Departmental Council on the Environment and Health and Technological Risks
COFRAC	*Comité français d'accréditation* – French Accreditation Committee
COGEMA	*Compagnie générale des matières nucléaires*
CSFMA	*Centre de stockage de l'Aube pour déchets de faible et moyenne activité – Centre de l'Aube* Disposal Facility for LIL Waste)
CSM	*Centre de stockage de la Manche – Centre de la Manche* Disposal Facility
CSTFA	*Centre de stockage de l'Aube pour déchets de très faible activité – Centre de Morvilliers* Disposal Facility for VLL Waste
DARQSI	*Direction de l'action régionale, de la qualité et de la sécurité industrielle* – Directorate of Regional Action, Quality and Industrial Security
DDSC	*Direction de la Défense et de la sécurité civiles* - Directorate for Civil Security and Defence
DGEC	*Direction générale de* l'énergie *et du climat* – General Directorate for Energy and climate
DGEMP	*Direction générale de l'énergie et des matières premières* – General Directorate for Energy and Raw Materials
DGS	*Direction générale de la santé* – General directorate for Health
DGSNR	*Direction générale de la sûreté nucléaire et de la radioprotection* – General Directorate for Nuclear Safety and Radiation Protection
DHOS	*Direction de l'hospitalisation et de l'organisation des soins* – Directorate for Hospitalisation and Care Organisation
DPN	*Division production nucléaire d'EDF* – EDF Nuclear Production Division
DGPR	*Direction générale de la prévention des risques* - Risk Control Branch

DPPR	*Direction de la prévention de la pollution et des risques* – Pollution Control and Risk Branch
DRASS	*Direction régionale des affaires sociales et de la santé* – Regional Directorates for Health and Social Affairs
DRIRE	*Direction régionale de l'industrie, la recherche et l'environnement* (Regional Directorate for Industry, Research and the Environment)
DSNR	*Division de la sûreté nucléaire et de la radioprotection au sein des DRIRE* – Nuclear Safety and Radiation Protection Division within DRIREs
ECC	*Atelier d'entreposage des coques et embouts compactés* – Compacted Waste Storage Building
EDF	*Électricité de France*
EIP	*Entreposage intermédiaire polyvalent* – Multipurpose Interim Storage Facility
ENISS	European Nuclear Installations Safety Standards
EPIC	*Etablissement public à caractère industriel et commercial* – public industrial and commercial establishment
EPRI	Electric Power Research Institute
EU	European Union
FORATOM	European Atomic Forum
GCR	Gas-cooled reactor
GGR	Graphite-moderated gas-cooled reactor
GPE	*Groupe permanent d'experts* – Expert Advisory Group
GPD	*Groupe permanent pour les déchets* – Expert Advisory Group on Waste
HFD	Haut fonctionnaire de défense – High Civil Servant for Defence
HL	High-level (waste)
HL-LL	High-level long-lived (waste)
HWR	Heavy-water reactor
IAEA	International Atomic Energy Agency
ICEDA	*Installation de conditionnement et d'entreposage des déchets d'activation* – Conditioning and storage facility for activation waste
ICPE	*Installation classée pour la protection de l'environnement* – classified facility on environmental-protection grounds
ICRP	International Commission on Radiation Protection
IL	Intermediate-level
ILL	*Institut Laue-Langevin* – Laue-Langevin Institute
IL-LL	intermediate-level long-lived
INB	*Installation nucléaire de base* – basic nuclear facility)
INBE	*Installation nucléaire de base et d'entreposage* – basic nuclear and storage facility
INBS	*Installation nucléaire de base secrète [défense]* – secret basic nuclear facility [defence]
INES	International Nuclear Event Scale
INPO	Institute of Nuclear Power Operations
IPSN	*Institut de protection et de sûreté nucléaire* – Institute for Nuclear Protection and Safety
IRSN	*Institut de radioprotection et de sûreté nucléaire* – Institute for Radiological Protection and Nuclear Safety
LIL	Low- and intermediate-level (waste)

LIL-SL	Low-level *or* long-lived (waste)
LL-LL	Low-level long-lived (waste)
LL-SL	Low-level short-lived (waste)
LWR	Light-water reactor
MEDDTL	*Ministère de l'écologie, du développement durable, des transports et du logement* – Ministry of Ecology, Sustainable Development, Transport and Housing
MEEDDM	*Ministère de l'Écologie, de l'Énergie, du Développement durable et de la Mer* – Ministry of Ecology, Energy, Sustainable Development and the SEA (until November 2010)
MEIE	*Ministère de l'Économie, des Finances et de l'Industrie* – Ministry of Economy, Finance and Industry (also responsible for Energy)
MHM	Meuse/Haute-Marne Underground Research Laboratory
MOX	Fuel made of mixed uranium and plutonium oxides
NPP	Nuclear power plant
OECD/NEA	OECD Nuclear Energy Agency of the Organisation for Economic Co-operation and Development
OPECST	*Office parlementaire d'évaluation des choix scientifiques et techniques* – Parliamentary Office for the Assessment of Scientific and Technological Options
OSART	Operational Safety Review Team
PNGMDR	*Plan national de gestion des matières et des déchets radioactifs* – Plan for Radioactive Materials and Waste
PPI	*Plan particulier d'intervention* – Off-site Emergency Plan
PUI	*Plan d'urgence interne* – On-site Emergency Plan
PWR	Pressurised-water reactor
RFS	*Règle fondamentale de sûreté* – Basic Safety Rule
RGE	*Règles générales d'exploitation* – General Operational Rules
SGDN	*Secrétariat général de la défense nationale* - General Secretariat for National Defence
SICN	*Société industrielle de combustible nucléaire*
SL	Short-lived (waste)
SOCODEI	*Société pour le conditionnement des déchets et effluents industriels* – Conditioning Company for Industrial Waste and Effluents
STE	*Spécifications techniques d'exploitation* – technical operational specifications
TranSAS	Transport Safety Appraisal Service
VLL	Very-low-level (waste)
TSN Act	*Act of 13 June 2006 on Transparency and Security in the Nuclear Field* – Loi du 13 juin 2006 sur la transparence et la sécurité dans le domaine nucléaire
UOx	Uranium-based oxides
WANO	World Association of Nuclear Operators
WENRA	Western European Nuclear Regulators' Association

6, Place du Colonel Bourgoin – 75572 PARIS CEDEX 12 – France - Tel : +33.1.40.19.86.00 – Fax +33.1.40.19.86.69