FRANCE

Third 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

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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 third one 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 the radioactive materials covered by this Convention are quite diversified in nature and are controlled in France by different regulatory authorities (see Section E).

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 Nuclear Safety Authority (*Autorité de sûreté nucléaire* – ASN). Below that threshold and provided that the facility involved is subject to 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 the Prevention of Risks (Direction générale de la prévention des risques, DGPR), , the Directorate for Regional Action, Quality and Industrial Safety (*Direction de l'action régionale, de la qualité et de la sécurité industrielle* – DARQSI), the General Directorate for Energy and Climate (*Direction générale de l'énergie et du climat* – DGEC) 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 Atomic Energy Commission (*Commissariat à l'énergie atomique* – CEA) and the National Radioactive Waste Management Agency (*Agence nationale pour la gestion des déchets radioactifs* – Andra). The final draft was completed in September 2008 after consultation of all French parties concerned.

A.1.4 Structure of the report

For her third report, France drew from the experience acquired over the first two similar reports for the Joint Convention and the four reports for the Nuclear Safety Convention. It constitutes a self-supporting report, based on existing documentation, and reflects the viewpoints of the different regulatory authorities and operators. Hence, for each of the chapters in which the regulatory authority is not the only party to express its opinion, a three-step structure was adopted: a description by the regulatory authority of the regulations involved, followed by a presentation by the operators of the steps taken to comply with those regulations, and lastly, by 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 chapter bearing the corresponding text of the relevant article of the Joint Convention on a shaded background at the top of the chapter. After the Introduction (Section A), the various sections deal successively with the following topics in the specific order prescribed by the guidelines:

- 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, along with the list of 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 in Sections G and H, as recommended by the guidelines for drafting national reports.

A.1.5 Publication of the report

The Joint Convention comprises no obligation regarding the communication to the public of the report referred to in Article 32. 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 will be available in both English and French on ASN's Website (*www.asn.fr*) as soon as it is published.

A.2 Major developments since the last French report

A.2.1 Evolution of nuclear safety control

A.2.1.1 Law on Transparency and Security in the Nuclear Field

Since the last review meeting, a significant element occurred in France concerning the control of nuclear safety: the adoption of *Law No. 2006-686 of 13 June 2006 on Transparency and Security in the Nuclear Field,* hereinafter referred to as the "*TSN Act*" (*Loi relative à la transparence et à la sécurité en matière* *nucléaire – Loi TSN*). The Act applies to all INBs, whether they involve nuclear reactors, spent-fuel management facilities or radioactive-waste management facilities, and it provides a new legislative basis for controlling nuclear safety and radiation protection.

The act represents a significant advance concerning the following three aspects:

- it improves the transparency of nuclear safety and radiation protection by granting the public an access right to the information held by nuclear operators and officers responsible for radioactive substances in those fields;
- it upgrades the safety basis of nuclear facilities (nuclear power plants, fuel-cycle plants, nuclear-research establishments, storage facilities, disposal facilities) and of the transport of radioactive materials, and
- it transforms ASN into an administrative authority independent from the government, thus reinforcing its legitimacy.

The act contains also other provisions, such as the institution of a penalty system.

It was followed by several implementation decrees, including *Decree No. 2007-1557 of 2 November 2007 relating to INBs and the Transport of Radioactive Materials* and *Decree No. 2008-378 of 21 April 2008 instituting a Nuclear Policy Council.*

A.2.1.2 Abrogation of former texts

The *TSN Act* abrogated *Law No. 61-842 of 2 August 1961 relating to the Control of Atmospheric Pollution and Odours* (hereinafter referred to as the "*1961 Law*"). However, all licences and requirements relating to INBs and delivered pursuant to that law or to regulatory instruments taken for its implementation are still valid as licences and requirements under the new law but are modified in the conditions set by the law and its implementation instruments.

Decree No. 63-1228 of 11 December 1963 Concerning Nuclear Facilities and *Decree No. 95-540 of 4 May 1995 Relating to INB Discharges of Liquid and Gaseous Effluents and Water Intakes* were abrogated by *Decree No. 2007-1557*.

A.2.2 Evolution of the radioactive-waste management policy

Since the last review meeting, two major elements occurred regarding the French Management Policy for the Radioactive Materials and Waste, as follows:

- The *Planning Act No. 2006-739 of 28 June 2006 Concerning the Sustainable Management of Radioactive Materials and Waste,* hereinafter referred to as the *"2006 Planning Act",* was adopted after the 15 years of research launched by the *Law No. 91-1381 of 30 December 1991 Concerning Research on the Radioactive Waste Management* (hereinafter referred to as the "*1991 Law*"). The scope of the new planning act does not only cover all radioactive materials and waste, but sets research and development (R&D) orientations and objectives for management solutions in the case of radioactive waste categories lacking a suitable management system. The *2006 planning act* also prescribes specific communication tools with the public and the funding principles for investigations and radioactive-waste management. The Act was consolidated within the *Environmental Code* (Articles L542-1 to L542-14). The French overall management policy for radioactive materials and waste is presented in § B.1, and
- the first edition of the National Management Plan for Radioactive Materials and Waste (*Plan national de gestion des matières et des déchets radioactifs* – PNGMDR) was published in March 2007. The *2006 Planning Act* sets forth the implementation principle of the Plan and prescribes its major objectives and orientations. *Decree No. 2008-357 of 16 April 2008 Setting Forth the Provisions of the National Management Plan for Radioactive Materials and Waste* includes the corresponding provisions. The PNGMDR is presented in more detail in § B.1.3.

A.2.3 IAEA's Integrated Regulatory Review Service

An Integrated Regulatory Review Service Audit (IRRS) was requested by ASN and took place on 5-17 November 2006. One of its conclusions was ASN good standing in relation to the best international practices in control of nuclear safety and radiation protection. In their final report, experts pointed out the sound practices in use and formulated recommendations and suggestions. The final report was made public.

Following the audit, ASN prepared and implemented an action plan in order to ensure that its practices and organisation complied with existing international standards. A follow-up to the IRRS audit is scheduled in March 2009.

During the audit, experts also focused on verifying that the recommendations formulated after the Transport Safety Appraisal Service (TranSAS) audit had been taken into account (formalisation of practices and control of transport packagings not requiring the approval of the competent authority).

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

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:*
   - *i) spent fuel management policy;*
   - *ii) spent fuel management practices;*
   - *iii) radioactive waste management policy;*
   - *iv) radioactive waste management practices;*
   - *v) 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 implementations instruments, as follows: the *1991 Law* and the *2006 Planning Act*.

The policy is described in detail in the PNGMDR, which has been developed on the basis of the *National Inventory of Radioactive Waste and Recoverable Materials* (*Inventaire national des déchets radioactifs et des matières valorisables*). The purpose of the PNGMDR is to specify long-term management systems for radioactive waste and recoverable materials, to formulate improvement proposals for existing systems and to organise research and investigations on radioactive-waste management.

The policy relies on the following three principles:

- R&D;
- transparency and democratic dialogue, and
- adequate funding for radioactive-waste management and dismantling activities.

B.1.1 National Inventory of Radioactive Waste and Recoverable Materials

At the government's request in June 2000, the Chairman of Andra proposed to draw a national reference inventory, based on a broad notion of waste (integrating spent fuel with no further use) and including prospective assessments on "committed" waste in existing facilities with a view to providing an accountable and prospective overview and to securing a sound national reflection on the overall waste-management issue.

Andra published the first edition of the *National Inventory of Radioactive Waste and Recoverable Materials* in November 2004, and the second, in January 2006. The preparation of both inventories was supervised by a steering committee whose membership included representatives from the major waste producers, administrations, ASN and Andra. The inventory lists all waste identified as radioactive throughout France and provides corresponding balance sheets; it also includes balance sheets for all existing radioactive materials. In addition, the *National Inventory* comprises a prospective section with estimates of radioactive waste and materials to be produced until 2010 and 2020, as well as estimates of waste to be produced by facilities intended for dismantling after 2020.

Preparing the *National Inventory* is an integral part of the tasks entrusted by the government upon Andra every three years. The law prescribes that a State subsidy be attributed to the Agency in order to contribute to the funding of that public-interest mission.

The National Inventory may be consulted on Andra's Website (*www.andra.fr*).

B.1.2 Radioactive materials

The integration of certain types of radioactive materials, which are not considered as waste, was discussed within the relevant working group responsible for developing the PNGMDR.

Those materials consist mainly of depleted uranium resulting from isotopic-enrichment plants, spent-fuel elements unloaded from nuclear reactors, as well as fissile materials extracted from irradiated fuel (uranium and plutonium) after reprocessing.

Currently, part of those materials is recovered through various 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, and
- part of the reprocessed uranium (about one-third of the annual production) is re-enriched abroad and enters in the fabrication of various types of fuel used in two reactors of the Cruas Nuclear Power Plant (NPP). It should be noted that the future enrichment plant (GB II) should be designed to enrich reprocessed uranium. A more thorough recovery of reprocessed uranium could also be contemplated as mentioned in § B.2 and D.1.2.1.1.

In its report of 15 March 2005, the Parliamentary Office for the Assessment of Scientific and Technological Options (*Office parlementaire d'évaluation des choix scientifiques et technologiques* – OPECST) stated that the PNGMDR would be extended to recoverable materials in order to eliminate gaps in the management of radioactive waste. Consequently, the former National Management Plan for Radioactive Waste (PNGDR), now called the PNGMDR, is now consistent with Andra's *National Inventory for Radioactive Waste and Recoverable Materials*.

However, some members of the Working Group consider that those materials should be considered as waste and integrated as such in a limited management plan, dealing exclusively with those residues. They feel that the presentation of certain substances resulting from the operation of nuclear facilities as recoverable materials tend to influence future decisions regarding the energy policy towards the nuclear option.

In the end, the PNGMDR does not describe the status of recoverable materials, but takes into account their existence and recommends specific long-term management solutions in case they were not reused. On the other hand, the selected approach is designed to verify that those materials are stored under satisfactory safety and radiation-protection conditions. Their future must be reviewed periodically and especially at every update of the PNGMDR.

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

Beyond the above-mentioned principles, the PNGMDR constitutes the key element in the leadership of the French National Management Policy.

The first Plan was tabled before Parliament in March 2006 and was the result of the work undertaken by the Minister of Ecology and Sustainable Development, on 4 June 2003. It was carried out by a multidisciplinary working group placed under the aegis of ASN and the DGEMP, and consisted of representatives from the Administration, producers of nuclear and non-nuclear radioactive waste, Andra, the IRSN, representatives from environmental associations, as well as a member of the National Review Board (*Commission nationale d'évaluation* – CNE).

Based on the work achieved in the framework of the PNGMDR, the *2006 Planning Act* established its principle and *Decree No. 2008-357* specified the conditions of its implementation. The Plan is based on the knowledge of the different waste categories mentioned notably in the *National Inventory of Radioactive Waste and Recoverable Materials,* as developed and published by Andra in January 2006.

Moreover, the CNE is responsible for assessing the progress achieved every year concerning investigations and studies on the management of radioactive materials and waste.

B.1.3.1 Major guidelines of the PNGMDR

The PNGMDR guidelines are as follows:

- seeking to reduce the quantity and toxicity of radioactive waste, notably through the treatment of spent fuel, and the treatment and conditioning of radioactive waste;
- storing radioactive materials pending treatment and radioactive waste pending disposal in dedicated facilities, and
- after storage, disposing in a deep geological repository the ultimate radioactive waste that may not be disposed of for nuclear-safety or radiation-protection concerns in surface or shallow facilities.

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.);
- prevention or limitation of waste production and toxicity;
- responsibility of waste producers to eliminate their residues under safe conditions in order to protect human health and the environment;
- information and active implication of citizens;
- traceability of waste management (with regard to the radioactive character of the waste and during the management operations of that waste), as well as the definition of associated constraints;
- due consideration 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 each overall system and determination of associated controls; due consideration of those optimisation results in the regulatory framework of long-term waste-management systems, and
- quantifiable progress approach relating to methods and techniques.

B.1.3.2 PNGMDR objectives

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 each category of radioactive waste being produced;
- to take over historical radioactive waste;
- to take due account of public concerns about the future of radioactive waste;
- to ensure the consistency of the overall management mechanism for radioactive waste, whatever the radioactivity level or of the chemical or infectious toxicity involved, particularly in the case of waste categories with “mixed” risks;
- without prejudice to the primary responsibility of every waste producer, to optimise waste management at waste producers’ premises: nuclear industry, more conventional industries using notably naturally-occurring radioactive materials for their other properties, activities involving the use of radioelement sources, medical sector, soil and rubble originating from polluted sites, mining industry (especially uranium mines);

- to ensure consistency among practices relating to polluted sites and rehabilitation methods, and
- to analyse past long-term management solutions and to review the justification for an intervention if improvements are necessary in order to achieve a management method that would constantly improve in clarity, rigour and safety.

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 to master the topic, especially by determining long-term management venues and financing means for the management of radioactive-waste categories lacking a suitable solution.

B.1.3.3 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 by radioactivity or activated due to the nuclear activity;
- all waste resulting from activities involving the manipulation 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 upon necessarily the radioactive properties of the materials, and whose radioactive concentration is too high to be overlooked from a radiation-protection standpoint;
- all residues resulting from the treatment of uranium ore being disposed of in ICPEs, and
- all radioactive materials (see § B.1.2).

B.1.4 Management policy based on research and development

High-level and intermediate-level long-lived waste

For high-level and intermediate-level long-lived (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 commissioned industrially around 2040. Those investigations are conducted in parallel with those on fourth-generation reactor systems with a view to studying the possibility to reduce 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 for the repository-licence application to be reviewed in 2015 in the hope of commissioning the facility by 2025, subject to the favourable outcome of the review. The act sets out a minimum reversibility period of 100 years. That disposal option is described by the act as the reference solution to replace 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 investigations is to design such a repository and to rely on the experimental results achieved in the Meuse/Haute-Marne Underground Research Laboratory (MHM-URL) located at Bure. The Laboratory 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.

Contrary to disposal, storage is only a temporary solution, offering a provisional means for securing waste over a certain timescale currently under study (at the scale of a few decades), notably in the prospect of major scientific advances.

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 repository within a deep geological formation will be assessed throughout the different phases of its management, including its final closure that only a new act may authorise. A specific law prescribing 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 financed in accordance with the "polluter-pays" principle by a special tax on INBs producing HL waste. So far, research on partitioning and transmutation, funded by a CEA subsidy, have induced the expenses shown in Table 1:

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 1 : Total research expenses for deep geological disposal, storage and partitioning/transmutation with special focus on 2005, 2006 and 2007

B.1.5 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, 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 shall 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 1333-10 of the *Public Health Code* shall 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 any non-compliance on the part of operators.

Decree No. 2008-357 specifies the scope and nature of that information in order to complete the *National Inventory for Radioactive Materials and Waste* and to clarify the PNGMDR.

B.1.6 Funding of 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 for investigation purposes and for management itself.

The selected system in France for dismantling INBs and managing the resulting radioactive waste rests on the full financial liability of industrial stakeholders, as follows:

- INB operators must assess the charges for dismantling their facilities and for managing their spent fuel and radioactive waste; they must also establish conservative estimates and constitute specific assets allocated exclusively to those estimates in order to ensure that actual means exist at the end of the operating lifetime of a facility to finance the various operations involving its dismantling and the management of its radioactive waste.

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

  In addition, no asset allocated to those estimates shall be used for any other purpose of the operator and shall be claimed by any creditor (including in case of financial difficulties on the part of the operator), except for the State in the exercise of its functions to ensure that operators comply with their obligations relating to the dismantling of facilities and the management of radioactive waste. Those assets shall be the subject of a separate entry;
- provisions also exist for the State to exert its control and to benefit from regulation and sanction powers, including the seizure of funds. That control shall only be valid on the basis of the reports to be submitted every three years by operators in order to describe how they intend to implement that mechanism, and
- a second-level control authority, called the National Financial Assessment Committee (*Commission nationale d'évaluation financière*), was created under the aegis of Parliament.

B.2 Spent-fuel-management policy

Between 2003 and 2007, the annual nuclear production in France ranged from 418 TWh (2007 value) and 429 TWh (2005 value), thus entailing an average quantity of about 1,150 t of spent fuel per year.

Similarly to a number of other countries, France has opted to reprocess and recycle her spent fuel. The system comprises a spent-fuel reprocessing plant at La Hague and a MOX-fuel fabrication plant (MELOX at Marcoule). In addition, the French NPP fleet includes a total of 58 standardised reactors, 20 of which operate with recycled MOX fuel. Among eight other reactors with a design that could allow to use the same fuel after minor operational modifications, two have been authorised in 2007 to use MOX fuel.

France's decision to select the reprocessing-recycling option, as confirmed by the *2006 Planning Act,* was based primarily on energy and environmental considerations.

In order to avoid accumulated inventories of non-reusable separated plutonium, the fuel is reprocessed as uses for the extracted plutonium appear ("equal-flow" principle). Consequently, about 850 of the 1,150 t of fuel being unloaded from French reactors are reprocessed currently every year, and the plutonium is recycled in the form of about 100 t of MOX fuel. Spent fuel, including recycled spent fuel (MOX and REPU), is stored in cooling pools and is progressively reprocessed. Priority is given to the reprocessing of UO_2 spent fuel in order to optimise the quality of the recycled plutonium used in MOX-fuel fabrication.

Spent MOX-fuel assemblies, which have a higher plutonium content with a high energy potential, and REPU spent fuel assemblies, are currently stored pending their reprocessing in due time to use their plutonium content in future Generation-IV reactors. Hence, the ultimate development or not of new generations of reactors will be a determining factor in the storage time for that fuel, its disposal rate and its final outlet. Furthermore, specific campaigns for spent MOX-fuel reprocessing are performed at La Hague.

The *2006 Planning Act* has established a system to secure long-term financial liabilities (see § B.1.6), except for those that do not relate to the operational cycle. Consequently, as long as spent-fuel reprocessing does not rely on an operational technology, the waste producer must constitute assets in order to cover his future liabilities.

As a precaution, the *Planning Act* also requires that, no later than 31 December 2010, all owners of recoverable nuclear materials undertake studies on potential management systems, in case those materials may be considered as waste in the future (see § B.1.2).

All current spent-fuel management and treatment activities rely on the fact that spent fuel is considered as recoverable energy, and not as waste. They help to maintain open the option involving the recycling of recoverable materials and the potential reuse of spent fuel as an energy resource for future fuel types and for future reactors.

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 the nuclear reactors, spent-fuel assemblies are shipped 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 into fuel containing re-enriched separated uranium. That share is due to rise as a result of the significant price increase for natural uranium, which is gradually replaced by reprocessed uranium.

The industrial reprocessing-recycling process:

- ensures specific conditioning of HL waste by vitrification, guaranteeing its safe long-term containment in a compact volume (about 110 m^3/a), with the prospect of its disposal in a deep geological formation, in accordance with the provisions of the law;
- 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;
- ensures the long-term control of the quantities of spent fuel pending reprocessing, in relation to existing facilities and current storage capacities, and
- keeps open the option of using in the long run the potential energy resource contained in spent-fuel assemblies.

In 2007, operators reviewed the entire fuel cycle from the standpoint of facility safety and the associated transport, radiation protection and waste control, and presented a report to ASN.

Hence, EDF, in consultation with other industrial partners in the fuel cycle, keeps an up-to-date file on the compatibility between changes in properties of new or spent fuel and changes to fuel-cycle facilities and the impact of envisaged changes on them, with due account of the following:

- the quantities of stored radioactive materials produced by past fuel management practices, and particularly the storage of vitrified waste in existing facilities;
- current reactor-fuel management practices, which may require a review of the safety reference systems for fuel-cycle facilities, or even changes of these facilities;

- fuel assemblies in which the structural or rod-cladding materials are different from those taken into account in former safety studies of fuel-cycle facilities;
- the scenarios concerning new fuel-management methods and new products to be implemented over the next 10 years;
- management scenarios for unloaded spent fuel, and
- the consequences of those fuel-management methods and management scenarios not only until, but beyond 2017, for by-products and waste resulting from fuel fabrication and spent-fuel reprocessing (reprocessing possibilities and corresponding technologies, interim storage or ultimate disposal).

The file is updated as fuel status reports are issued. It is also examined and monitored by ASN.

B.3.2 Spent-fuel management by the CEA for its 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 UP2 800 Plant (AREVA NC). Some of the fuel is also intended for deep geological disposal.

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

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 – Heavy water	CASCAD pit	CASCAD ⇒ Deep geological disposal
OSIRIS oxides	PÉGASE	CARES ⇒ Deep geological disposal
OSIRIS silicides	PÉGASE	Processing
	OSIRIS	Processing
UAI	CABRI/SCARABEE	Processing
	SILOE, SILOETTE	
	ORPHÉE	
	ORPHÉE	
	ULYSSE	
Gas-cooled reactor – Heavy water	PÉGASE	CASCAD ⇒ Deep geological disposal
	INB 72 (dykes 106 and 126)	CASCAD ⇒ Deep geological disposal
Experimental fuel	INB 72, INB 22 – PEGASE, LAMA, LECI, LECA	CASCAD ⇒ Deep geological disposal

Table 2: Current technological solutions for CEA spent fuel

There are still interim storage facilities at Saclay and Marcoule where the fuel will be removed within the next 10 years. All fuel stored in the PÉGASE pool at Cadarache will be removed by 2010.

Current technological solutions are summarised in the Table 2: they include staggered processing at La Hague's UP2 800 Plant or storage in Cadarache's CASCAD or CARES facilities pending a deep geological repository.

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 L542 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 MELOX plant in Marcoule, where the capacity has been raised to 195 HMt (heavy metal t).

B.4 Criteria used in the definition and classification of radioactive waste

B.4.1 Definition of "radioactive waste"

The following notions were clarified by the *2006 Planning Act:*

- "a radioactive substance shall include any substance containing natural or artificial radionuclides, the activity or concentration of which legitimates a radiation-protection control";
- "radioactive waste shall include any radioactive substance for which no further use is considered or foreseen";
- "ultimate radioactive waste shall include any radioactive waste for which no further processing is possible under current technical and economic conditions, notably by extracting their recoverable fraction or by reducing their polluting or hazardous character", and
- "a radioactive material shall include any radioactive substance that is intended for further use, after treatment, if need be."

B.4.2 Classification of radioactive waste

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. Half-lives 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 ends, 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 lies between 10,000 and 100,000 Bq/g. 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 result mainly from the operation and dismantling of nuclear power plants, fuel-cycle facilities and research establishments, as well as, for a slight share, to activities relating to biological and academic studies. Most residues in that category are disposed of in a surface facility at the *Centre de la Manche* Disposal Facility (CSM) up to 1994 and 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-VC
LL-LL	Low-level long-lived	FA-VC
LIL-SL	Low-level and intermediate-level short-lived	FA/MA-VC
VLL	Very-low-level	TFA

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

Table 3: 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 (VLL)</td><td rowspan="4">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 some tritiated waste and some sealed sources</td><td>Dedicated shallow facility
under study</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 colspan="2">Systems under study pursuant to Article 3 of the 2006 Planning Act</td></tr>
</table>

Table 4: Status of long-term management solutions for each waste category

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 ICPEs; the waste survey, which must lead toa 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;

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 story of the operation and it is confirmed by radiological monitoring.

- for each type of waste (see definition, § B.4.2), the development of adapted and duly authorised 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 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 Universal clearance thresholds

In France, there are no universal and pre-established clearance thresholds below which it would be possible to consider a specific nuclear waste to be non-hazardous due to its radioactivity.

Indeed, after having weighted the advantages and disadvantages associated with those thresholds and taken into account a certain number of events that occurred in the country, ASN decided in the mid-1990s to implement a VLL-waste management policy involving dedicated systems for the waste generated by INBs.

However, clearance authorisations may be granted, but only on a case-by-case basis and upon a sufficient knowledge of the situation, of the origin of the waste and in a relation to a special licensed elimination system that ensures satisfactory traceability.

It is impossible to meet such objectives when dealing with consumer goods or construction products, since the *Public Health Code* does not allow it, even though, under certain conditions and at the cost of a heavy procedure, the Minister of Health may waive that rule. ASN does not intend to request the Minister to authorise the reuse of contaminated waste or of waste likely to be contaminated in consumer goods or construction products, or to provide a favourable opinion in support of such project.

In that regard, France is therefore more rigorous than the radiation-protection recommendations of international organisations on which is based the policy of several countries regarding VLL waste. That situation may generate a consistency problem, especially at the European scale. It is suggested that, instead of harmonising clearance thresholds, European countries tend rather to harmonise their objective of protecting the population by reinforcing clearance conditions for materials originating from nuclear facilities. Some provisions, such as facility zoning (identifying contaminated or activated areas, see above), the availability of suitable disposal facilities for radioactive waste with activity levels above clearance thresholds, the traceability of operations, as well as the reuse of slightly-contaminated materials in nuclear facilities submitted to radiological controls, might be contemplated and harmonised in the future.

The recycling of VLL materials within the nuclear industry does not raise the same type of issues with regard to the traceability and control of materials after recycling. That option could therefore be developed in order to save on raw materials. The processing of VLL materials in preparation for their recycling may take place in INBs, as in the case of steel cylinders produced from VLL metal scrap and designed to be used in radioactive-waste containers and in certain cases or conditons in a conventional facility. Three conventional facilities have been licensed to conduct such operations in France, but only one actually does so.

B.5.2.3 Waste with enhanced naturally-occurring radioactivity

Waste containing enhanced natural radioactivity results from industrial activities outside the nuclear sector. In those particular cases, the raw materials being used may contain concentrations of naturally-occurring radioelements (ores) and/or the process being implemented may concentrate naturally-occurring elements.

Since production residues may therefore include natural radioactivity in a concentrated form, the situation may raise some concerns with respect to radiation protection.

Two cases may occur:

- waste containing enhanced natural radioactivity to be eliminated in conventional technical burial facilities (*centre d'enfouissement technique* – CET):

  The *Order of 30 December 1992 Concerning the Disposal of Hazardous Waste* prohibits the elimination of radioactive waste in CET facilities. (That case involves any waste containing one or several radio-nuclides whose activity and concentration may not be overlooked from a radiation-protection standpoint.)

  Some waste containing enhanced natural radioactivity may be disposed of in CET facilities, provided that their impact be negligible. However, the waste must be characterised beforehand and the CET facility must have a radioactivity-detection procedure as an additional line of defence. Hence, the DPPR (at present superseded by DGPR) issued a circular on 25 July 2006, together with a guide for the disposal of such waste in CET facilities;

- waste in large quantities and with a high concentration of natural radioelements:

  Those residues originate normally from industries dealing with raw materials, such as:

  - uranium-mine tailings (approximately 50 million tonnes) that are managed in adjacent disposal facilities on site in accordance with a certain number of provisions. The list of sites and of their main characteristics, including their administrative situation and the existence or not of monitoring devices, appear in the national inventory of uranium-mine sites (MIMAUSA Programme) (see § B.6.3);
  - residues of raw materials used in the non-nuclear industry, for instance in the production of rare earths or the fabrication of zirconium. Those residues belong to the LL-LL system, which is currently under study, or pertain to VLL-waste disposal, if their characteristics are suitable, and
  - residues that were disposed of *in sit*u in the past without any intention of recovery.

The *Order of 25 May 2005 Concerning Professional Activities Involving Raw Materials Containing Naturally-occurring Radionuclides for Other Purposes Than Their Radioactive Properties,* issued by the Ministers for Labour, Health and the Environment, requires operators belonging to one of the professional categories using materials that are not used for their radioactive properties to carry out a radiological impact study (workers, population). The Order includes a revisable list of the professional categories concerned and specifies that the operator shall characterise his waste and identify the matching elimination systems.

The DPPR and ASN have launched a survey in order to seek the opinions of Regional Directorates for Industry, Research and the Environment (*Direction régionale de l'industrie de la recherche, et de l'environnement* – DRIRE), potentially concerned industrialists, Andra, associations and different administrative services, and to clarify the scope of regulations governing that type of activity.

In addition, a report on enhanced natural radioactivity, commissioned by ASN, was published in 2006. It details the different categories of activities involved and their geographical locations. It appears that if the specific activity of the waste is low, its volume amounts to significant quantities that are impossible to transfer to dedicated disposal facilities. Such is the case of residues resulting from the phosphate industry, most of which will need to be managed *in situ*.

The issue relating to the long-term institutional monitoring of disposal sites for ore tailings, notably in the case of uranium, must be examined in relation to the potential consequences of an unsuitable use in the future.

The *2006 Planning Act* requires that a status report on the long-term impact of mine-tailing disposal sites be carried out in 2008 and that a reinforced monitoring plan of those sites be implemented. Furthermore, the *Planning Act* requires that a status report on the short-term and long-term management solutions for residues containing enhanced natural radioactivity be prepared in 2009 and propose any new solutions, if appropriate. ASN is responsible for preparing that status report.

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 and prospects (disposal, extension, decommissioning, justification of the use of sealed sources) are mentioned in Section J. Managing sealed sources constitutes an integral part of the PNGMDR.

B.5.4 Other sources, ICPEs and mine tailings

The ICPE nomenclature includes several classification headings according to the conditioning of the radioactive substances being used, the uses to which they are put and the corresponding activity threshold of the substances involved. For each of those headings, classification thresholds are set in order to regulate the relevant facilities with the most significant impact.

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 authorised facilities, on the basis of an impact assessment taking into account of 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.

B.5.5 Stakeholders' responsibilities

Article L542-1 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 mean that he has ceased to be financially responsible 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. The quality of the conditioning must also be guaranteed. Compliance with that objective is 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 waste quantities. 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 residues show the advances achieved in the field over the last two decades.

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 L. 542-12 of the *Environmental Code,* Andra is responsible for all operations involved in the long-term management of radioactive waste, including:

- 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 2009;
- 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 Industry, 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, Andra is seeking to find an implementation site and is developing disposal concepts for low-level long-lived waste for which there is no management system so far, such as graphite waste (piles and sleeves resulting from old graphite-moderated gas-cooled [UNGG] reactors) and radium-bearing waste.For those residues, Andra is looking for a suitable geological site in the hope of commissioning the future disposal facility in 2019 (see § H.3.2.1).

These initiatives require the reinforcement of partnerships with the other actors in the field of research and technology, including the application of a scientific exchange policy.

Lastly, Andra is responsible for integrating its knowledge in its own projects in accordance with the contracts it 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 decisions. 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 controls directly Andra's overall organisation for the design and operation of disposal facilities, and for the acceptance of the producers' waste in its facilities. It also assesses the waste-management policy and practices throughout all 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 storages.

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 waste resulting from the operation of pressurised-water reactors (PWR) consists of VLL, low-level or IL-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 operations. 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 5 and 6 show the distribution of waste arising from the operation of EDF nuclear reactors in 2007. Data are expressed in volume of conditioned packages and intended for disposal at the CSFMA or at the CENTRACO facility. Most packages have been shipped, but some of them were still on site at the end of the year.

VLL waste disposed of at the CSTFA

2007 results *(58 PWRs)*	Disposal facility	Mass of disposed waste *(t)*	Activity *(TBq)*
Process waste	CSTFA	850	0.007
Technological waste	CSTFA	1,670	0.001
	Total	2,520	0.008

Table 5: Volume and activity of nuclear operational waste produced by EDF in 2007 and disposed of at the CSTFA

Note: Values given in § B.6.4 are the quantities shipped effectively to both disposal facilities in 2007.

LIL waste disposed of at the CSFMA

2007 results *(58 PWRs)*	Routes	Gross volume before conditioning *(m³)*	Volume of disposed packages at CSFMA *(m³)*	Activity *(TBq)*
Process waste	CSFMA/ CENTRACO	1,030	2,600	225
Technological waste	CSFMA/CENTRACO	7,000	1,920	25
	Total	8,030	4,520	250

Table 6: Volume and activity of nuclear operational waste produced by EDF in 2007 and disposed of at the CSFMA

Technological waste represents the main stream (85% of the total volume of gross waste) and is:

- after on-site compacting, shipped directly in 200-L metal drums to the CSFMA press for further compaction and then to final disposal after concrete encapsulation in 450-L metal drums. 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 to the CENTRACO Incineration Unit, while LL-contaminated scrap is sent to the melting unit of the same plant, as follows:
    - ashes, clinkers (incineration residues) are encapsulated in 450-L metal drums, then disposed of at the CSFMA, and
    - 200-L ingots (melting residues) are disposed of at the CSFMA, or at the CSTFA, if their activity level warrants it.

CENTRACO's low-level-waste processing and conditioning plant, located in Codolet, near the Marcoule Site in the Gard *département,* and operated by SOCODEI (an EDF and AREVA subsidiary), specialises in the treatment of low-level and VLL waste, either by melting metal scrap or incinerating combustible or liquid waste.

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 surface disposal. 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 20 years, important progress has 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 m^3/TWh(e) in 1985 to just under 11 m^3/TWh(e) in 2007. The latter value corresponds to an average production of about 78 m^3 of packages intended for surface disposal per PWR unit.

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.

B.6.1.2 Management by the CEA 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 and 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, and
- implementing those actions under the best possible nuclear-safety, radiation-protection and technical-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 effluent is treated by evaporation. Concentrates are embedded in cement matrices for storage at the Aube disposal facility.

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.

In Saclay, in 2009, a new facility called STELLA, will replace the former facility and be used to treat effluents by evaporation. Concentrates will be embedded in cement 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 in Morvilliers.

Solid LIL-SL waste is either:

- incinerated at the CENTRACO facility;
- compacted at Cadarache, Saclay and Marcoule facilities, or
- transferred untreated to the CSFMA for conditioning purposes.

Most of the waste is compacted and then embedded or immobilised in cement.

Depending on their activity level, packages are either sent to the CSFMA or stored at Cadarache. For any non-acceptable radioactive waste at the CSTFA, CEA has storage facilities with a special capacity and design, especially in terms of safety, with regard to its expected production rate and to the scheduled availability of final disposal facilities to be implemented by Andra.

In the case of IL-LL waste, the CEA has been planning, since 1994, to replace its dedicated storage facility in Cadarache (INB No. 56), which was obsolete and nearing saturation, by the Radioactive Waste Conditioning and Storage Project (*Projet de conditionnement et d'entreposage de déchets radioactifs* – CEDRA), pending the implementation of a deep geological repository. The new INB No. 164 facility was commissioned in April 2006.

It should be noted that, since 2005, the CEA has taken over the management of the Marcoule storage facilities formerly run by COGEMA and especially the storage facility known as the Multipurpose Interim Storage Facility (*Entreposage intermédiaire polyvalent* – EIP) where packages of bitumised IL-LL waste from the operation of the UP1 Plant are currently stored.

Other waste categories produced by the CEA (specific waste) are also subject to analysis or actions with a view to ensuring their elimination.

They include the following:

- 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, currently being dismantled. After processing and stabilisation, the waste will be disposed at the CSFMA or at the CSTFA;
- 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. Conditioning solutions and specific disposal facilities are being examined, pursuant to the *2006 Planning Act;*
- radium-bearing waste temporarily stored at Saclay and Cadarache, mainly on behalf of Andra and Rhodia–Rare Earths, Andra is also studying a joint project involving the disposal of graphite waste, 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 of mercury by Andra (after physical and chemical stabilisation).

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

- a network of service facilities and a transportation fleet;
- a full range of waste packages consistent with the CEA's specifications for waste characteristics and Andra's waste-acceptance criteria in its final disposal facilities.

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

As a rule since the late 1980s, waste is systematically packaged immediately (or temporarily deferred until packaging facilities are built).

AREVA provides waste-management services to its electric utility customers. Nonetheless, a waste stream remains its property (predominantly historical waste, technological waste and dismantling waste resulting from old sites) and is addressed in this section.

All of AREVA's LIL-SL and VLL waste are currently disposed of in their matching operational systems. AREVA produces virtually no graphite waste. Its radium-bearing waste results from the production of zirconium sponges at the CÉZUS facility in Jarrie.

With regard to managing HL-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 less than 85,000 m^3.

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 has still 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 is returned to its owners as soon as technical and administrative conditions allow it. Hence, more than half the activity of the waste packaged under the Service Agreement-UP3 contracts – the main reason for the construction and initial operation of the modern La Hague Plant – have been shipped back to the customer's country of origin.

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

Lastly, it is worth noting that AREVA's waste volume and share in the national yield vary very little. Today, AREVA's HL waste consists mainly of historical waste, for which the volume stands still. The volume of IL-LL waste packages from AREVA, the CEA and EDF is well known and the forecasts have proven to be accurate. It should be mentioned that changes in the packaging methods for unpackaged waste, the operation pattern at La Hague, future commercial agreements and the volumes of dismantling 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 Treatment waste from radioactive effluents

Initially, the La Hague Site had two radioactive effluent-treatment plants (STE2 and STE3). Effluents are treated by co-precipitation and the resulting sludges were encapsulated in bitumen and poured into stainless-steel drums in the newer of the facilities (STE3). Those drums are stored on site. Production by those two plants has been virtually zero over the last decade, because most of the acid effluents are now evaporated in the various spent fuel-reprocessing workshops and the concentrates are encapsulated in vitrified packages. The relay has been taken by the retrieval and packaging of "historical" sludges, in particular those from the seven STE2 silos. Conditioning modalities are currently under study. Given the concentrated activity of the sludges and the presence of long-lived radionuclides, the bitumen drums produced at La Hague are not suitable for surface storage and are therefore considered in the sizing inventory of the deep geological repository. Discussions about waste shipments to foreign AREVA customers are under way between those customers and relevant authorities with a view to use bitumen drums or other packaging yet to be designed.

AREVA also has a workshop for mineralising organic effluents by pyrolysis at La Hague and producing 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 waste that is encapsulated in cement in the Resin Packaging Workshop (*Atelier de conditionnement des résines* – ACR).

B.6.1.3.3 Technological and structural solid waste

Solid technological waste is sorted out, compacted and encapsulated or immobilised in cement in the AD2 Workshop. Packages that meet Andra's technical specifications for surface disposal are sent to the CSFMA. Other packages are stored, pending a final disposal solution.

Since the end of 2001, the Hull-and-End Compacting Building (*Atelier de compactage des coques et embouts* – ACC) has been conditioning IL-LL waste into standard compacted-waste packages (CSD-C), which replace, with considerable volume reduction, the cemented packages previously produced by COGEMA. The process also allows for the packaging of certain categories of technological waste.

CDS-Cs are stored in the Compacted Package Storage Building (*Atelier d'entreposage des coques et embouts compactés* – ECC), which was commissioned in May 2002.

B.6.1.3.4 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.

The experience acquired has enabled bitumised waste to be 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 Industrial activities in the non-nuclear sector

Waste resulting from industrial activities in the non-nuclear sector originates from the following:

- the fabrication of radioactive sources (sealed or non-sealed) and their use, either past or current. There is only one manufacturer of sealed sources left in France. However, there is a very large number of users in both nuclear and non-nuclear industries (measurements, controls, molecule detection, industrial irradiation). The management of disused sealed sources is addressed in Section J, and
- non-nuclear industries dealing with chemistry, metallurgy or energy production and using raw mineral materials containing natural radioactivity, but not for their radioactive content.

B.6.2.2 Research activities (non-CEA establishments)

Radionuclides are used in many public or private establishments divided as follows by the PNGMDR:

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

The production of radioactive waste is small in comparison to the nuclear industry. However, the waste is very 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 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 together with those resulting from therapeutic activities. All waste with a shorter half-life than 100 days is managed *in situ* through radioactive decay. In the case of other radioactive waste, management options include incineration at CENTRACO (solid waste, liquid waste). Bulky tritiated and carbonated waste are disposed of at the CSFMA. Some solid waste is disposed of at the CSTFA.

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

Physics laboratories exist 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. The generated waste consists mainly of LIL-SL and VLL residues, which are disposed of at the CSFMA and CSTFA, respectively.

With regard to academic research, there is no national overview on the status of radioactive-waste management. However, the case of a medium-size university was taken into account, which encompasses strong specificities (labour turnover, different and 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.6.2.3 Management and elimination of radioactive effluents resulting from activities in biomedical research and nuclear medicine

Faced with the problem of therapeutic waste contaminated with radionuclides, which appeared with the development of nuclear medicine, public authorities launched a supervision and information process for both patients and physicians on the best applicable practices in the management of those residues. As a first step, Circular DGS/DHOS No. 2001/323 of 9 July 2001 issued by the General directorate for health (*Direction générale de la santé* – DGS) and the Directorate for Hospitalisation and Care Organisation (*Direction de l'hospitalisation et de l'organisation des soins* – DHOS) of the Ministry for Health provided recommendations in support of the management and elimination of radioactive waste and effluents in hospitals.

The collection and management of radioactive waste and effluents produced by research in biomedicine and nuclear medicine rest on the following four principles that must be incorporated in any management plan and have become compulsory since July 2003:

- sorting and conditioning waste as early upstream as possible in generating units, with due account of their nature, the radionuclides they contain, as well as their activities and half-lives. All waste originating from the use of radionuclides with radioactive shorter half-lives than 100 days is segregated from the others;

- storing effluents and waste with due account of preliminary sorting with a view to their local elimination (waste containing radionuclides with shorter half-lives than 100 days) or to their take-over by Andra (presence of radionuclides with longer half-lives than 100 days);
- carrying out a systematic radiological control of the waste and effluents before disposal;
- disposing of waste and effluents through suitable systems. All waste originating from the use of radionuclides with shorter half-lives than 100 days may be eliminated after decay through the system for household waste, provided that there are no infectious and chemical hazards involved. Otherwise, all waste resulting from therapeutic activities is directed towards one of the specialised systems. Aqueous liquid effluents containing radionuclides with shorter half-lives than 100 days may be directed after decay towards the public sewage collection network. The traceability of operations must be guaranteed.

Solid waste must be collected in dedicated receptacles designed to control radiological, infectious and chemical risks (specific conditionings). The waste is then stored pending its local elimination after radioactive decay or its take-over by Andra.

There are three major types of controlled discharges, based on their origins and their activities.

A decision by ASN, to be validated by the Ministers for Health and the Environment, will set forth the relevant technical rules for the elimination of waste and effluents contaminated or likely to be contaminated with radionuclides produced by non-INBs (see Article R. 1333-12 of the *Public Health Code*).

Between the end of 2004 and 2006, a working group led by ASN examined more specifically the integration of a double infectious and radioactive risk in the management of waste and effluents, as well as the experience feedback of the *Circular of 9 July 2001.*

In 2006, a draft text was distributed for comments to the professionals involved. Once comments were reviewed, a new draft was issued for comments in August 2007. The new draft integrates the major provisions of the *Circular of 9 July 2001* and sets forth new provisions relating to:

- the development and approval of management plans for effluents and waste;
- management conditions for waste and effluents through radioactive decay;
- the possibility to discharge effluents contaminated with carbon 14 or tritium;
- control conditions at facility outlets, and
- the implementation of a radiation-detection portal at the exit from the site.

The above-mentioned decision will be supported by an implementation guide describing the applicable sound practices for the management of effluents and waste.

B.6.3 Mine-tailing management

Waste from uranium-mining operations in France was addressed in a report issued on 9 June 1993 by the General Council of Civil Engineering (*Conseil général des ponts et chaussées*) at the request of the Minister for the Environment. The report, entitled « Déchets faiblement radioactifs – 1re partie : Stockage de résidus de traitement de minerai d'uranium » (*Low-level Waste – Part 1: Disposal of Uranium Ore Treatment Tailings*), begins as follows:

> *The uranium ore mined in France has a relatively low yield of only a few kilograms of uranium per tonne of ore. By the end of 1990, the output of the CEA and COGEMA mining operations totalled 52 million tonnes of extracted ore containing 76,000 t of uranium or an average yield of 0.15%.*
>
> *The lowest grade of extracted ore depends on the local mining conditions and, above all, on world uranium prices. At certain times when the price was high, relatively poor quality ore was extracted. However, the current low price of uranium has resulted in the shutdown of various mines in France.*

When mineralised layers are close to the surface, open-pit mining may be used; excavation is carried out using the bench process, down to a depth of 30 to 40 m, and sometimes even 100 m. The proportion of tailings increases with the depth of the open pit; on average, for every tonne of uranium ore, 9 t of tailings are produced, and in certain cases, up to 20 t. Those tailings must not be confused with the ore-treatment tailings: these tailings obviously contain a residual amount of uranium (generally less than 0.03%) and, other than the separation process, have undergone no physical (breaking, crushing, etc.) or chemical treatment.

Mining operation is carried out in accordance with the provisions of the *Mining Code*, which aim at safeguarding the interests of the public at large in accordance with Article 79 (occupational health and safety, public health and safety, essential characteristics of the environment, etc.) and at ensuring that operators use mining methods that maximise the final yield from the deposit, provided of course that the first aim is met.

Administrative supervision is the responsibility of the Prefect with the support of relevant DRIRE services.

Ore treatment and disposal of the resulting residues are subject to ICPE regulations. However, for historical reasons, some of those operations were authorised by decisions taken under the *Mining Code*.

However, the measures implemented so far do not provide a sufficiently clear picture of the actual context owing to a lack of investigation into the real impact of mining operations. It was in order to remedy the situation that the DARQSI, the regulatory authority responsible for mines, has been taking part in a study entrusted upon the IRSN by the DPPR, the regulatory authority responsible for ICPEs, since 2002. During the first phase, a study, called « Histoire et impact des mines d'uranium : Synthèse et archives » (*History and Impact of Uranium Mines: Summary and Archives* – MIMAUSA), provided a national inventory of uranium-mining sites, which was updated in November 2007 with a view to:

- building a summary of available data in order to provide a source of quality information on the radiological status of the environment around French mining sites;
- ensuring a permanent knowledge base pertaining on those sites, despite the fact that operation is discontinued;
- building a working tool for State agencies responsible for defining remediation and monitoring programmes, and
- improving the representativeness of the national radiological monitoring network in the environment.

During the second phase, specific studies designed to supplement available information through additional investigations will be carried out. The activity may lead to proposals for changes to the management and monitoring of the sites concerned.

Moreover, within the framework of the initiatives defined by the first PNGMDG pursuant to the *2006 Planning Act,* an R&D Programme was instituted with a view to providing in 2008 an appraisal of the long-term impact of disposal sites for uranium tailings and the implementation of strengthened radiological monitoring programme on those sites.

Concurrently, the Ministers for Ecology and Sustainable Development, Industry, Heath and Social Cohesion have decided to institute a pluralistic expert group (*groupe d'expertise pluraliste* – GEP) on Limousin Uranium Mines. The group is notably in charge of participating in the co-ordination of the IRSN critical analysis and of AREVA NC's decennial environmental assessment of uranium mines in the Haute-Vienne *département*. The group is primarily expected "to advise the government and operators on the management and monitoring of facilities", "to formulate recommendations aiming at reducing the impact of mining sites on the population and the environment" and "to propose a general long-term approach for managing such sites".

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; located in Morvilliers, it 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 the memory of those disposal facilities were to be lost. In those facilities, Andra reconditions part of the delivered waste, notably through compacting before emplacing permanently waste packages into disposal structures.

In 2007, deliveries to the CSFMA amounted approximately to the following values[2]:

- EDF 5,500 m^3;
- AREVA NC 2,400 m^3;
- CEA 4,500 m^3, and
- miscellaneous 380 m^3.

That distribution takes into account the transfer of responsibilities to the CEA of the overall activities of the Marcoule Site in early 2005 (see § B.6.1.2.2).

At the CSTFA, deliveries were distributed as follows:

- EDF 5,600 m^3;
- AREVA NC 7,800 m^3;
- CEA 11,600 m^3, and
- miscellaneous 1,200 m^3.

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 and describes the take-over conditions of residues for which Andra has various elimination or disposal systems at the CSFMA. Residues are first collected, 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 system, Andra is investigating various storage systems. It calls upon CEA facilities for orphan sealed sources and radium-bearing lightning conductors. On 10 June 2003, Andra obtained in the form of a modification to the *SOCATRI Decree* a licence to use some of the company's 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.

2. It is impossible to provide reliable figures of disposed of volumes, due to compacting and reconditioning operations.

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 its 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 comes from military or secret facilities. ASN also double-checks their quality after Andra. ASN and 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) also conduct joint inspections.

Any transfer of nuclear materials or waste between civilian and military facilities must be duly authorised 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 § L, Figure 6.

D.1 Spent-fuel management facilities

D.1.1 Spent-fuel generating facilities

Most spent fuel is produced in France by 58 PWRs, with power ranging from 900 to 1,450 MWe. Commissioned between 1977 and 1999, they are distributed over 19 EDF sites. The fuel used in those reactors is either based on uranium oxide 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) 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 authorised 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 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 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 2006, the accumulated quantity of URT recycled or shipped back by AREVA to its customers amounted to 7,480 t compared to 21,750 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.

The 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.

On 31 December 2007, the total current storage capacity CSD-Vs amounted to 12,420 packages, but the EV/SE building extension planned for 2012 will provide an additional capacity for 4,212 packages.

D.1.2.1.3 Storage of HL-LL waste on the La Hague Site

CSD-V packages are stored at three facilities: the two R7 and T7 production facilities, with appropriate halls, and the more compact E-EV-SE facility, which should be further extended by 2011-12.

There is currently room for about 3,000 containers, but that figure is expected to rise to 10,000 containers, depending on the extension decision.

A total of 4,164 CSD-V packages have been shipped back to foreign customers (i.e., rate above 75%).

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

Table 7: Storage capacity for HL-LL waste on the La Hague Site

D.1.2.1.4 IL-LL waste

In the IL-LL waste category, most current packages consist of CSD-Cs made of compacted structural waste. However, most inventories already produced and stored originate from the older generations of plants similar to Marcoule, which was in operation from the 1960s to the 1980s. Those residues are collected and conditioned (mostly by compacting, bitumisation and cementation) before being stored in pools and silos for the time being.

- CSD-Cs

  The current capacity of the ECC is 20,000 packages and should hold all of packages to be produced over the next 20 years, with due account of the plant's schedule. Moreover, the facility may be extended by up to six additional halls.

- Bitumised-waste drums

  Today, the production of bitumen drums at La Hague has almost disappeared, following the introduction of an improved effluent management system (*nouvelle gestion des effluents* – NGE), which involves the concentration and vitrification of radioactive effluents.

  The existing capacity accommodates the storage of all previously produced bitumised drums.

- Concrete waste packages

  The production of asbestos-cement containers (*conteneur amiante-ciment* – CAC) stopped in 1994. They currently number 753 packages, only 306 of which constitute IL-LL waste.

  The production of reinforced fibre-concrete containers (*colis cimenté en béton fibre* – CBFC-2) began in 1994, replacing CACs. Production will significantly slow down with the progressive inclusion of technological waste streams in the ACC Compacting Workshop, commissioned in 2002.

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, 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 at Cadarache, which should remain in service until 2010.

Given the limits in terms of capacity and evacuation of thermal power of the CASCAD Facility, at Cadarache, the CEA plans to commission a new Spent-fuel Storage Facility at Marcoule (*Entreposage de combustibles usés de Marcoule* – ÉCUME) in 2008 in order to hold fuel categories unsuitable for storage at CASCAD (see § B.3.2).

D.2 Inventory of spent fuel held in storage

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.

At the end of 2007, the total mass of stored spent fuel in France amounted to:

- 8,800 t at La Hague;
- 3,923 t at EDF NPPs, and
- 120 t at CEA facilities.

At the same date, the pools at La Hague contained fuel from the following foreign nuclear power reactors:

- Belgium (SCK/CEN): 440 kg;
- France: 8,835 t;
- Germany: 63 kg;
- Italy: 6.2 t;
- Research Testing Reactor (RTR): 1,995 kg, 140 kg of which are from the Australian Nuclear Science and Technology Organisation (ANSTO), and
- Switzerland: 5.3 t.

D.3 Radioactive-waste management facilities

By their very nature, all spent-fuel management facilities listed in § L.1 also have to manage radioactive waste. 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

All operating INBs produce radioactive waste. Spent-fuel management facilities are listed in § L.1 and other waste-generating INBs (shut-down reactors, laboratories, plants and storage buildings) are 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

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

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

The radioactive pollution of those sites is generally caused by past industrial activities. Waste from the 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 completion of ongoing studies.

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 2006 (available on Andra's Website: *www.andra.fr*). It has been developed as an addition to 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*).

If the responsible party is defaulting, the cleanup of polluted sites is ensured up through Andra's public-interest mission in accordance with Article L. 542-12 of the *Environmental Code.*

In such cases, Andra co-ordinates the cleanup of polluted sites, either under the authorisation of the prefects responsible for those sites or at the request of the site owners themselves. In any case, the health objectives of the cleanup process are defined by ASN and the site is 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 disposal facilities

D.3.3.1 Centre de la Manche *Disposal Facility*

The CSM, managed by Andra, was commissioned in 1969. It is located in Digulleville, in the Cotentin Peninsula (Normandy), in the immediate vicinity of the La Hague Spent-fuel Reprocessing Plant. It has accommodated slightly over 527,000 m^3 of waste packages until it shut down on 30 June 1994.

The general design principle was to separate, to collect and to control all waters likely to have been in contact with packages. The structures consist of concrete slabs on which the packages are either stacked directly or stored in concrete bunkers built on those slabs. The structures were loaded in open air and rainwaters were collected from the slabs and directed to the nearby AREVA NC Plant through a piping network running through underground galleries.

The repository occupies a site of about 15 ha and was covered in 1997 by a bitumen membrane within an assembly of draining or impermeable layers designed to prevent water seepages. The cover layer is planted with grass.

In January 2003, the CSM entered officially into its post-closure monitoring phase for a maximum period of 300 years, although very active 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, and
  - atmospheric-contamination checks, and
- following up the radiological and chemical impact of the facility.

In 2007, the impact of the CSM was estimated at less than 10^{-4} µSv for sea discharges and at 0.64 µSv for discharges in the nearest stream. The impact assessment of the CSM is subject to 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 requires 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 monitoring plan. Further updates of the report will be required 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.

D.3.3.2 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, the other barriers consisting of the structures and the geological formation. The waste must be 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 may have come into contact with waste. A specific system was created in order to collect 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 is 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, which consist 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 an area of 95 ha, 30 of which constitute the actual disposal area.

Disposal structures consist of cells measuring 25 m square by 8 m in height, in which packages are emplaced. Their bottom slab is made of reinforced concrete, sealed by a polymer membrane and includes a hole to collect any seepage water. Waste-loading operations are protected against rainwaters. Metal packages are concreted in the structure, whereas concrete packages are stabilised in the structure with gravel. Once the structure is full and the packages have been immobilised, a closing slab is poured over the top, pending the installation of the final cover.

On 31 December 2007:

- the total volume of disposed waste amounted to approximately to 208,000 m^3, and
- 92 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.

Compliance with radiation-protection criteria is mandatory. The *Public Health Code* (Book III, Title III, Chapter III) requires that the impact of nuclear activities (except medical uses) on the public must 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 if 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-licensing *Decree of 4 September 1989,* as follows:

- tritium 4,000 TBq;
- cobalt-60 400,000 TBq;
- strontium-90 40,000 TBq;
- caesium-137 200,000 TBq;
- nickel-63 40,000 TBq, and
- alpha emitters 750 TBq (assumption after 300 years).

Other limits were set forth in the facility's technical specifications. For instance, the 1999 revision prescribes relevant radiological capacities for chlorine-36, niobium-94, technetium-99, silver-108m and iodine-129.

Over and above the 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.

In 2006, the CSFMA's safety programme was re-examined in the context of a review of the overall safety of the facility, including the opinion of the Standing Expert Group on Waste in June 2006.

Following the public inquiry, the licensing decree for the creation of the facility was amended on 10 August 2006 in order to introduce an explicit reference to facility discharges, the limits of which are formalised within 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 cutting operations. Hence, 21 PWR covers have already been disposed of, including six in 2007.

In January 2006, Andra was authorised to dispose of sealed sources provided that their half-life is shorter than that of caesium-137. The licence prescribes admissible activity limits for each radionuclide involved. In that framework, the Agency is also investigating the feasibility of disposing of HL cobalt-60 sources with regard to thermal effects on the constituting materials of the disposal facility.

D.3.3.3 VLL Waste Disposal Facility (CSTFA)

Andra's disposal facility for VLL waste (CSTFA) has a capacity of 650,000 m^3. It covers a 45-ha area in Morvilliers, Aube *département*, a few kilometres away from the CSFMA, and was opened in August 2003. At the end of 2007, it had received over 89,000 m^3 of waste intended for disposal. Given the total radiological activity it will contain, the facility is not covered by INB regulations, but by ICPE regulations.

With due account of the activity level of the waste, 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 their impermeability. Once full, each cell is backfilled with sand and covered with another membrane and a layer of clay. An inspection shaft is used to check the cell and especially to detect any water infiltration.

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 flow, with due account of current dismantling operations.

Waste-acceptance criteria at the CSTFA

Waste-acceptance criteria at the CSTFA are based on a radiological waste-disposal impact index (*indice radiologique d'acceptation du stockage* – IRAS). The value of that indicator must not exceed 1 for any whole waste batch received and 10 for any single waste package.

In practice, that specific-activity limit for VLL waste depends on the classification of the contaminating radionuclide in one of the following four radiotoxicity classes:

- Class 0: category of radionuclides for which the average specific activity is 1 Bq/g per waste batch received or a maximum specific activity of 10 Bq/g per single waste package received;
- Class 1: category of radionuclides for which the average specific activity is 10 Bq/g per waste batch received or a maximum specific activity of 100 Bq/g per single waste package received;
- Class 2: category of radionuclides for which the average specific activity is 100 Bq/g per waste batch received or a maximum specific activity of 1,000 Bq/g per single waste package received, and
- Class 3: category of radionuclides for which the average specific activity is 1,000 Bq/g per waste batch received or a maximum specific activity of 10,000 Bq/g per single waste package received.

In order to determine the acceptability of any waste batch, the IRAS is determined as follows:

$$IRAS = \Sigma\ (Am_i / 10^{class\ i})$$

where: Am_i is the specific activity of radionuclide *i* (in becquerels per gram) in the waste mass concerned, and

class i is the class number of radionuclide *i* concerned (0, 1, 2 or 3).

In order to be accepted, the waste must not exceed an IRAS of 1 per batch. Any single waste package included in that batch may have an IRAS of 10 or less, provided that the average index for the whole batch does not exceed 1.

The following table provides the corresponding classes for major radionuclides:

RN_i	^{3}H	^{14}C	^{60}Co	^{63}Ni	^{90}Sr	^{137}Cs	^{232}U to ^{238}U	^{236}Pu to ^{240}Pu, ^{241}Am, ^{242}Pu, ^{244}Pu
Class	3	3	1	3	3	1	2	1

Table 8: Waste-acceptance criteria at the CSTFA

D.3.4 Mine-tailing disposal facilities

All mine tailings generated by the uranium-mining industry, which is no longer active in France today, are currently disposed of in 18 facilities 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, plus sodium chlorate as an 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.4 Radioactive Waste Inventory

D.4.1 Annual production of radioactive waste

The annual production of waste, according to the classification defined in § B.4.2, and its origin, is summarised in Table 9.

Type of waste	Volume *(m^3)*	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 9: Annual production of nuclear waste

The shares of IL-LL and HL waste shown in the table include all waste conditioned through the reprocessing of 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: All data mentioned in this paragraph are taken from the *2006 National Inventory* and date back to the end of 2004. Updated data at the end of 2007 will appear in the *2009 National Inventory* to be published in the second half of 2009.

D.4.2.1 Waste volume from spent-fuel reprocessing (French share)

Figures for processed volumes of IL-SL, IL-LL and HL waste include only the French share of the total waste generated by that activity. The overall volume of radioactive waste present in interim storage facilities at the end of 2004 may be broken down into the following international categories:

- IL-SL (including tritiated waste) 2,095 m^3;
- IL-LL 45,518 m^3, and
- HL (vitrified waste) 1,851 m^3,

IL-LL waste is currently stored at La Hague (Basse-Normandie Region), Marcoule (Languedoc-Roussillon Region) and Cadarache (Provence-Alpes-Côte d’Azur Region).

D.4.2.2 Other waste held in storage facilities (end 2004)

- 35,876 m^3 of radium-bearing waste;
- 72,178 m^3 of graphite waste containing radioactivity, 60,930 of which are still in the cores of gas-graphite reactors (GGR) and, as such, are not considered as waste;

  Note: The difference in value with the last report is due to the change in the conditioning ratio taken from the *National Inventory* following various Andra studies. Andra is investigating the disposal of other graphite waste in accordance with the *2006 Planning Act*. Those residues are also included in a specific LL-LL waste category (as mentioned in the *2006 National Inventory*);
- 144,498 m^3 of VLL waste;
- about 98,700 m^3 of LIL-SL waste stored in France, including IL-SL waste resulting from reprocessing;
- 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 dedicated and regulated areas (VLL-waste areas) in which those residues are stored pending their evacuation;
- 140,000 disused radioactive sources, and
- 50 million tonnes of mine tailings, constituting a specific VLL-waste category, which is managed separately, as shown in Table 10.

Region	Site	Quantity (*millions of tonnes*)
Limousin	Bellezane	1.556
	Montmassacrot	0.737
	Brugeaud	12.566
	Lavaugrasse	7.489
	Bernardan (Jouac)	1.852
	La Ribière	0.197
	Compreignac (Margnac + Peny)	0.004
Pays de Loire	Écarpière	11.350
	Commanderie	0.250
Rhône-Alpes	Bois-Noirs	1.300
Bourgogne	Gueugnon	0.226
	Bauzot	0.016
Auvergne	Rophin	0.030
	Saint-Pierre-du-Cantal	0.605
Languedoc	Lodève	5.388
Roussillon	Le Cellier	5.944
Midi-Pyrénées	Bertholène	0.476
Alsace	Teufelsloch	0.004
Total		~50

Table 10: Inventory of uranium mines and mine tailings (in millions of tonnes)

D.4.3 Waste intended for final disposal

At the end of 2007, the total volume of disposed VLL, LL and IL-SL waste amounted to about 833,900 m^3, as broken down in Table 11.

	Volume (m^3)
Immersion of 14,300 t (1967 and 1969)	9,900
CSM	527,000
CSFMA (LIL waste)	208,000
CSTFA (VLL waste)	89,000

Table 11: Total volumes of VLL, LL and IL-SL waste at the end of 2007

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

D.5 Dismantled nuclear facilities

At the end of 2007, more than 30 facilities were being dismantled or had already been dismantled, as follows:

- nine shutdown nuclear-power reactors;
- eight experimental reactors;
- two accelerators;
- nine disused laboratories or plants;
- three shut-down 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 regulatory framework for nuclear activities

Guaranteeing the safety of 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 very diversified in nature and are controlled by various regulatory structures.

Above a specific threshold set by *Decree No. 2007-830 of 11 May 2007 Concerning the INB nomenclature,* any nuclear facility is called an INB and is 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 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 121.

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. To that category belong facilities using radioactive materials for industrial or medical purposes; they are disseminated throughout the country and amount to approximately 800 in total.

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 *1961 Law* was abrogated by the *TSN Act.* However, all INB licences and requirements taken pursuant to the *1961 Law* or to its accruing regulatory instruments are still recognised as valid by the *TSN Act*. Licences and requirements are modified by the conditions set thereof and by the accruing instruments.

Decree No. 63-1228 and *Decree No. 95-540* were abrogated by *Decree No. 2007-1582*.

The *EURATOM Treaty* is one of the treaties of the European Union (UE). UE 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.

E.1.1.1 TSN Act

The legislative basis supporting the safety of INBs in France is the *TSN Act*, which revamps in depth the legal framework applicable to nuclear activities and their control. The Act created ASN as an independent administrative authority and included several improvements regarding transparency. Among other things, it takes into account the lessons learnt from the review of foreign legislations.

Basic principles

The law 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 maintains 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 is also in charge of emergency preparedness for civilians.

On the other hand, ASN is responsible for controlling local nuclear activities in INBs, small-scale nuclear facilities (industrial facilities, research laboratories and medical establishments using ionising radiation) and in the transport of radioactive substances.

ASN must be consulted about the drafting of governmental decrees and orders of a regulatory nature and may clarify those statutory instruments by technical decisions. It takes individual decisions concerning nuclear activities (e.g., licences for commissioning INBs, using transport packagings for radioactive substances or using radioactive sources); it also sets forth individual requirements. It carries out inspections and may impose penalties, including the licence suspension. It organises a permanent watch on radiation-protection issues (e.g., environmental monitoring and occupational exposures). It assists the government in case of emergency.

Lastly, ASN is responsible for contributing to public information about nuclear safety and radiation protection.

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 was already guaranteed by the *Environmental Code*. The *TSN Act* extends the scope of that right by granting the public a right of access to information held by INB operators, transport companies and holders of radioactive substances. Such a major innovation distinguishes between nuclear activities and other industrial activities, which are not subject to such a transparency requirement.

In addition, the *TSN Act* prescribes that INB operators shall prepare a yearly 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.

The Act reinforces CLIs by granting them a legal 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*) (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 framework according to which new INB procedures will apply; it encompasses the full lifetime cycle of INBs: from the creation and commissioning licences up to final shutdown and dismantling (or, in the case of a disposal facility, 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 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 Regulatory framework for ICPEs and mines

ICPE Regulations are taken pursuant to the *Environmental Code*, notably in 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 nationally. 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 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, 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 an 1810 decree.

Those legal instruments provide in general terms the criteria for deciding whether a facility may be hazardous or inconvenient either for the comfort either 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 authorisation or declaration regarding activities and 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 technical support organisations (ICPE Inspectorate and DRIREs).

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 authorised thresholds, the operator must file a declaration with the relevant prefect and comply with general prescriptions; the facility may be inspected. Beyond the authorised threshold, a prior authorisation 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 license in the form of a prefectoral order containing requirements.

While the requirements for facilities subject to declaration are standardised, requirements imposed on licensed installations 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 for violations.

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 authorised 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 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.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 chapter 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 transposition of *EURATOM Directives 96/29 and 97/43* and is presented with the corresponding regulations in § F.4.

E.2.2 Regulatory framework for the safety of INBs

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 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 a 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 authorisations 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 Site-selection procedures for INBs

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.

That review is organised by ASN to examine the socio-economic and safety aspects of the project. 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 L121-1 *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 Design, construction and safety assessment of INBs

E.2.2.3.1 Safety assessment

E.2.2.3.1.1 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 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.

ASN normally asks 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.

E.2.2.3.1.2 Safety review and assessment of INB creation-licence applications

In any licence application to create an INB, the applicant must provide a preliminary safety report. The modalities for the safety review and assessment of the facility are described in § E.2.2.3.2.

E.2.2.3.1.3 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.

E.2.2.3.1.4 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

E.2.2.3.2.1 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.

E.2.2.3.2.2 Consultation of the public and of local 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.

E.2.2.3.2.3 Consultation of technical organisations

The preliminary safety report supporting the creation-licence application must be transmitted to ASN for review by one of its Advisory expert groups (*Groupes permanents d'experts* – 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 authorising 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. The applicant is required to submit his comments within two months.

After having consulted the applicant, the Ministers in charge of nuclear safety must finalise the draft decree and forward it to the CCINB for comments (see § E.3.3.2.1) together with the case submitted to the public inquiry.

The CCINB is required to provide its opinion within two months after receiving the request. The Ministers in charge of nuclear energy must request ASN's opinion on the decree draft, as possibly amended, authorising or denying the creation of the facility, in order to take into account the CCNIB's opinion.

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

E.2.2.3.2.4 Creation-licence decree

Any INB creation licence is 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 specifies the term of the licence and the commissioning delay of the facility. It also imposes the availability of essential means for protecting public security, health and hygiene or nature and the environment.

E.2.2.3.2.5 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 includes any required licence for the discharge of liquid and gaseous effluent and for water intake, 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 licence the facility to be commissioned.

The licensing decision must be mentioned in the *Bulletin officiel de l'ASN*. ASN must also notify the operator as well as inform the Ministers for nuclear safety and the Prefect concerned. It may also inform the CLI.

Before the evolution or completion of the commissioning-licence procedure, ASN may authorise a partial commissioning 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 decision is published in its *Bulletin officiel*.

E.2.2.4.2 End of commissioning of the facility

ASN's decision to authorise commissioning prescribes 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-licence 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;
- 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 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 that operators must declare within 24 h to ASN. They are systematically classified according to the INES scale and inputted in a special database by ASN. A similar system exists also 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 dismantling licences

E.2.2.4.5.1 Legislative and regulatory framework for final shutdown and dismantling

Any technical measures applicable to facilities to be shut down definitively and dismantled must be consistent with general safety and radiation-protection regulations. Those measures concern notably professional external and internal 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 in order to dismantle it, 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 an 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.

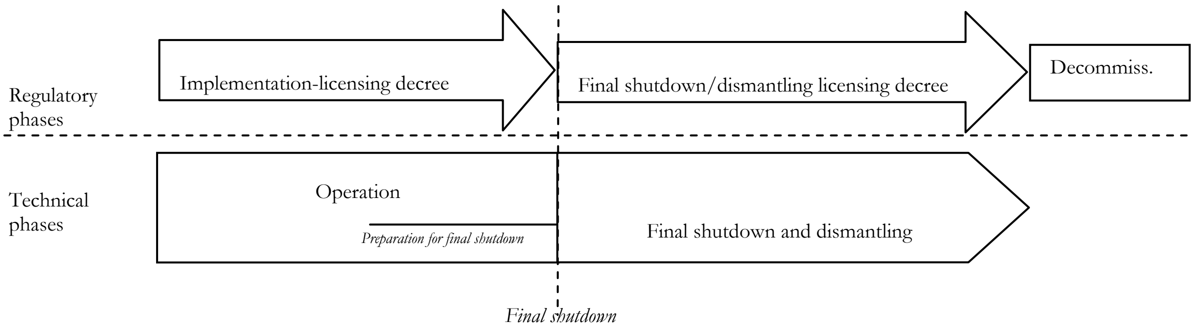

Figure 1 : INB life phases

Decree No. 2007-1582, 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 public.

E.2.2.4.5.2 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 licence application 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 radioactive-waste disposal facility is involved.

1. Generic 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 is 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.

2. Radioactive-waste management 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, and
- 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 dismantling.

E.2.2.4.5.3 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 materials, the elimination of fluids or any decontamination and cleanup action may be carried out in accordance with the creation-licence 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.

E.2.2.4.5.4 Decommissioning of facilities and implementation of public easements

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 likely facility constructions to remain.

In other 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 authorisation 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.

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.2.2.6.3).

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 decisions 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 decisions, 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 a RFS, as long as he is able to prove that the alternate method he proposes ensures that 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.

There are currently about 40 RFSes and other technical rules published by ASN. All RFSes 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 a nuclear operator assume his full responsibilities and complies 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 the final dismantling. ASN examines the steps taken with regard to safety, control, the limitation of occupational doses received in facilities and 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 environmental nuisances and risks generated by the operation of INBs are guaranteed by:

- *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 Licensed 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.*

More generally, the ASN 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 licensed 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 time periods. 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

In general, 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 NPP, 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 on 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 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 operators' 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 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 700 inspections in INBs and on shipments of radioactive substances.

In 2007, ASN conducted 675 inspections in INBs, 161 of which were unannounced and 82 dealt with the transport of radioactive materials. The distribution of those inspections per INB category is shown in Figures 2 and 3. In 2007, for instance, 14 inspections were carried out at operators managing radioactive waste and 10% of inspections dealt with effluents and environmental monitoring.

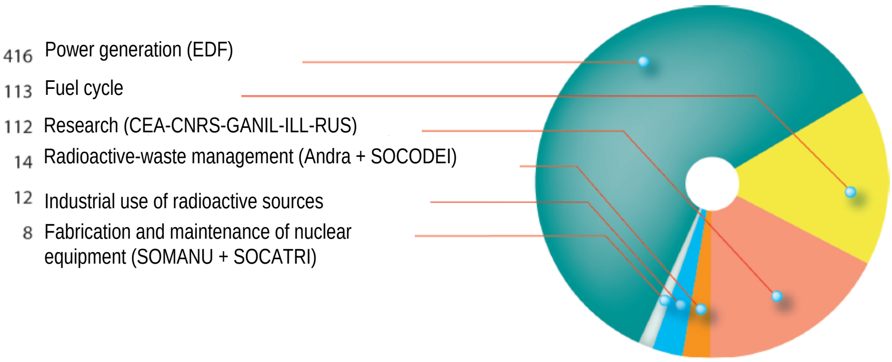

Figure 2 : Distribution of inspections per type of operator in 2007

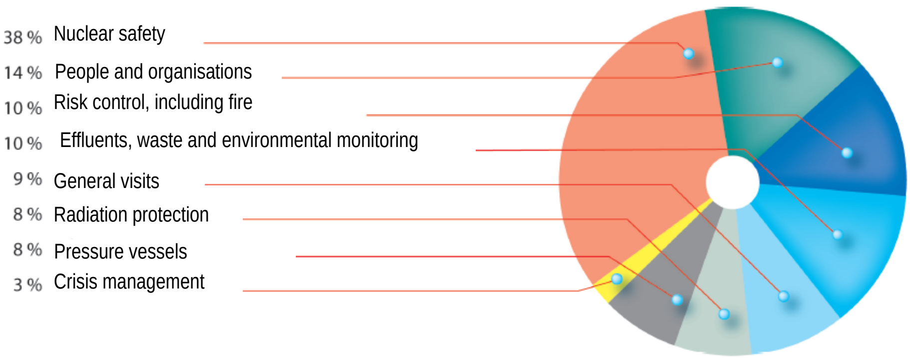

Figure 3 : Distribution of INB inspections per priority topic in 2007

E.2.2.7.2 Technical review of documents provided by operators

The operator is required to provide ASN with the relevant information in order to ensure the efficiency of its control. The content and quality of that information must enable inspections to be targeted and the technical demonstrations presented by the operator to be analysed. They must also help identify and follow up any significant event during the operation of any INB.

E.2.2.7.2.1 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, to prevent its recurrence and to ensure the diffusion of the relevant experience feedback among operators.

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 par 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.

E.2.2.7.2.2 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.

E.2.2.7.2.3 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 and DRIREs is to check the thoroughness of the case and the quality of the demonstration.

Whenever it deems it necessary, ASN calls upon its technical support organisations, primarily the IRSN, for advice. Safety assessment requires the co-operation of many specialists and effective co-ordination in order to identify key safety-related aspects. 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.

ASN's approach when requesting advice from a technical support organisation and, as the case may be, from a GPE, is described in § E.3.1.4. For major issues, ASN requests the opinion of the competent GPE to which the IRSN presents its analyses; for other secondary 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 77 of the *Mining Code*.

Those regulations apply to the actual mining work 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 to take to protect the interests referred to in 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 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 is 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 licence suspension. A programme of inspections is set yearly. The inspection frequency depends on the hazard potential of the facility concerned.

Mines are also inspected by DRIRE 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 shall ensure compliance with and specific radiation-protection requirements to which are subject the activities and persons referred to in Article L1333-1 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 licensing 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 management and in their regulation.*

E.3.1 Nuclear Safety Authority (ASN)

E.3.1.1 Organisation

Under the leadership of a five-member Commission, ASN consists of central services, as well as territorial representatives and divisions, all placed under the authority of the Director-General, assisted by three Deputy Directors-General, one adviser and one principal private secretary.

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 2007-09 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 decisions. All opinions and decisions are published on ASN's Website (*www.asn.fr*).

ASN must be consulted on a certain number of issues, such as the following:

- any draft of regulatory decrees or ministerial orders relating to nuclear security;
- any project involving the creation, final shutdown and dismantling of INBs (or the post-closure monitoring phase, in the case of disposal facilities), and
- any decree draft modifying the *Public Health Code* and the *Labour Code* with regard to nuclear security.

It may also be consulted at the request of the government or Parliament on other document drafts or on specific issues.

The *TSN Act* enumerates the different categories of either regulatory or individual decisions to be taken by ASN, such as the following:

- technical regulatory decisions 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.

The Ministers in charge of nuclear safety or radiation protection must validate some of those decisions.

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 the Commissioner may delegate part of its powers to its President and the President may delegate his signing authority to agents within ASN services.

In 2007, the ASN Commission met 54 times; it issued 42 opinions and took 87 decisions.

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 seven 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 regional DRIRE involved assumes the responsibility of representative and therefore assists ASN in the fulfilment of its mission in accordance with the *Decree of 21 September 2007 Relating to the Delegation of the Signing Authority to the Nuclear Safety and Radiation Protection Official for Defence Activities and Facilities* and a secondment agreement signed with the Ministry of Economy, Finance and Employment on 28 November 2007. 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 through the following means :

- field inspections and controls with regard to nuclear safety, radiation protection, environmental protection around INBs, pressure vessels and the *Labour Code* for nuclear power plants;
- the review of incidents and accidents occurring in their region, and
- the control of unit outages in NPPs of their region.

Divisions review most of the following licence applications submitted to ASN by the officers responsible for nuclear activities located on their territory (INB operators, industrial users of ionising radiation, researchers, physicians, etc., relating to the following:

- the creation, operation, major or minor modification or shutdown of INBs, and
- the licensing of activities involving the use of ionising radiation.

Certain major decisions are reviewed by ASN’s central services with the support of the relevant divisions.

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.

Lastly, territorial representatives act as ASN’s spokespersons in the region. With the support of the divisions, they contribute to ASN’s public-information mission. Moreover, they take part in CLI meetings, they also maintain 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 ASN's human and financial resources

E.3.1.2.1 Resources

E.3.1.2.1.1 Human resources

On 31 December 2007, ASN's effective amounted to 426 employees, divided as follows:

- 322 permanent or contract agents, and
- 104 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 40 years and seven months, whereas 62% of the staff was less than 45 years old. Such 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 12.

Central services	Territorial divisions	Total
206	220	426

Table 12: Distribution of ASN staff

Among ASN 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.

E.3.1.2.1.2 Financial resources

Since 2000, all staff and operating resources for the fulfilment of ASN's mandate are drawn from the general State budget.

ASN's budget is posted under Action No. 3 (Nuclear Safety and Radiation Protection Control) of Programme No. 181 (Risk and Pollution Control) within the *Ecology and Sustainable Development* Mission.

In 2007, ASN's full-cost budget amounted to 54 million euros, including 32.4 million euros for personnel expenses. ASN also benefits from the services provided by the Ministry of Economy, Finance and Employment and the DRIRE network in the framework of specific agreements. ASN's territorial divisions are accommodated within DRIRE offices.

In addition, pursuant to the *TSN Act,* ASN relies on the IRSN's technical know-how, as supported, if need be, by relevant research. Article 16 of the Act specifies that the government must consult ASN on the corresponding share of the State subsidy allocated to the IRSN. That share amounting to 72 million euros in 2007 is posted in Programme No. 189 "Research on Risk and Pollution" within the "Research and Higher Education" Mission.

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 2007 amounts to 365.8 million euros and is deposited in the State's general budget.

In order to accelerate INB dismantling, Article 77 of the *2005 Amending Finance Act No. 2005-1720 of 30 December 2005* instituted a 50% reduced rate on that tax for permanently shut-down facilities or undergoing dismantling. The tax ceases to be payable as soon as the facility is officially decommissioned.

The tax generated an outcome of 213 million euros in 2003, 346 million euros in 2004, 347 million euros in 2005 and 358.7 million euros in 2006.

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.

In 2007, those taxes generated 132 million euros.

E.3.1.2.2 Human-resource management

E.3.1.2.2.1 Training of agents

"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 2007, ASN agents spent 2,787 days in technical training distributed over 60 different courses.

E.3.1.2.2.2 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 Commission met twice in 2007 and proposed to certify 14 INB inspectors. On 31 December 2007, 44 ASN nuclear-safety inspectors are senior inspectors certified; they represent approximately 25% of the entire team of nuclear-safety inspectors.

E.3.1.2.2.3 Internal quality management

In order to guarantee and to enhance the quality and efficiency of its actions, ASN keeps developing and implementing a quality-management system based on the following:

- action plans laying out ASN's objectives and annual priorities, which are adjusted during the year through exchanges among the various entities (discussions, periodical meetings, internal memos, etc.);
- gradually-structured corporate notes and procedures grouped to constitute a corporate manual, specifying ASN's in-house rules to fulfil each of its tasks;
- internal audits, inspections by the General Mining Council (*Conseil général des mines* – CGM), as well as context, activity and performance indicators designed to monitor and to improve the quality and effectiveness of ASN's actions, and

- listening to stakeholders' expectations (public, elected officials, associations, media, unions, industrialists) in accordance with regulatory procedures (public inquiries) or in the framework of informal settings (qualitative opinion research, hearings, internal consultations, etc.).

E.3.1.3 ASN's technical supports

In preparing its decisions, ASN relies on 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 crated 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.

Safety analyses of INBs, 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.

With regard to facilities subject to the *Joint Convention,* for example, the IRSN provided ASN in 2007 with the following:

- 115 opinions concerning minor modifications to facilities or incidents;
- seven opinions for the GPE on major changes or new facilities, and
- 140 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 its budget is dedicated to providing an overview of human radon exposures in homes.

ASN is pursuing its co-operative efforts with:

- the *Association Robin des Bois*, with a view to studying phosphogypsum and ash dumps from coal-fired thermal power stations;
- the Owners' Association of Pressure Vessels and Electric Equipment (*Association des propriétaires d'appareils à vapeur et électriques* – APAVE), with a view to developing a sound doctrine on the evolution of industrial codes of the American Society of Mechanical Engineers (ASME) and to preventing criticality risk at the CEA, and

- the Economy Centre of Paris-Nord University (*Centre d'économie de l'Université Paris-Nord* – CEPN) for the health aspects of the Co-operation for Rehabilitation Project (*Projet de coopération pour la réhabilitation* – CORE).

E.3.1.4 Advisory expert groups

ASN also relies on the opinions and recommendations from various expert groups, as follows:

- GPEs;
- the Standing Nuclear Section of the Central Committee for Pressure Vessels (*Commission centrale des appareils à pression*), which is not involved within the scope of the *Joint Convention*), and
- the High Council for Public Health (*Haut Conseil de la santé publique* – HCSP) .

In accordance with the Rules of Procedure, the President of ASN decided on 9 March 2007 to set up four GPEs in order to assist the Director-General of ASN. Their purpose will be to analyse technical issues relating to the safety, creation, commissioning, operation and shutdown of nuclear facilities and of their annexes, as well as to the transport of radioactive materials.

GPEs are consulted by the Director-General of ASN on nuclear-safety and radiation-protection issues and on any other matter within their jurisdiction. More specifically, they review the preliminary, provisional and final safety reports of each INB. They also have access to reports containing IRSN's analytical results and they issue opinions along with a number of recommendations.

Each GPE may call upon any recognised person for his specific skills and interview any operator representatives. The participation of foreign experts also helps to diversify approaches to problems and to enhance benefits from international experience feedback.

Lastly, ASN and the IRSN are currently studying relevant modalities for disseminating efficiently the opinions of the different GPEs.

E.3.1.5 Decentralised services: Regional and District Directorates for Health and Social Affairs

DRASSes and Departmental Directorates for Health and Social Affairs (Direction *départementale des affaires sociales et de la santé* – DDASS) assume their role with in a given geographic zone (département or administrative region).

Each DRASS and DDASS participates in radiation-protection controls both in the environment and in life quarters, through the following:

- radiological monitoring of drinking water, and
- radon monitoring in establishments receiving members of the public and in homes.

Each DRASS and DDASS also partake in the preparation and management of radiological emergency preparedness, notably through the following actions:

- assisting the Prefect in case of incident or accident;
- contributing to the development of the emergency plans established by the Prefect;
- constituting inventories of iodine tablets and distributing them, and
- participating in periodical crisis drills.

However, DRASSes and DDASSes are no longer expected to participate in licensing procedures or in statements on radiation protection relating to activities in nuclear medicine, or to collect samples in the environment. Their role regarding the radiation protection of patients is yet to be clarified.

E.3.2 ICPE and mine inspection

ICPEs and mines are inspected by the staff from delegated services, such as the DRIRE, veterinary services and the Interdepartmental Technical ICPE Inspection Service (*Service technique d'inspection des installations classées* – STIIC). All inspectors (engineers, technicians, veterinarians) are sworn State officers. In each region, the DRIRE Director is responsible for organising inspections under the responsibility of the relevant Prefects.

The ICPE Inspectorate is responsible for ensuring that operators (industrialists, craftsmen, farmers, communities) comply with applicable regulations and assume fully their responsibilities. Inspectors review licensing applications, carry out inspection visits and perform various checks on at ICPEs. In the event of a 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 DRIREs. Inspections are performed by DRIRE engineers specialising in mining industries.

E.3.3 Other actors involved in safety and radiation-protection control

E.3.3.1 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.

In 1990, Parliament asked the OPECST to examine how the safety and security control of nuclear facilities was supervised. That mandate has been renewed every year ever since.

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 nuclear 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 for 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.

E.3.3.2 Advisory bodies

E.3.3.2.1 INB Advisory Committee (CCINB)

Ministers in charge of nuclear safety must consult the CCINB, instituted by *Decree No. 2007-1557,* regarding any licence to create, to modify or to shut down permanently an INB, and for any special provisions applicable to each of those facilities.

Pending the constitution of the CCINB, the Interministerial Commission for INBs (*Commission interministérielle sur les installations nucléaires de base* – CIINB), whose membership was renewed by the Prime Minister on 6 September 2006, acts in lieu of the new commission.

In 2007, the CIINB, which must meet at least once a year according to its Statutes, held four meetings during which 11 text drafts were reviewed.

E.3.3.2.2 French Higher Council for Public Health (HCSP)

During the first quarter of 2007, the HCSP, instituted pursuant to *Law No. 2004-806 of 9 August 2004 Concerning the Public Health Policy,* superseded the CSHPF.

The High Council consists of four specialised committees comprising qualified persons in the fields of health safety, chronic diseases and disabilities, health protection and determinants, assessment, strategy and prospects. It also comprises an Expert Board consisting of 10 qualified persons and other *ex officio* members, including the President of ASN.

If need be, certain opinions and recommendations established by the GPEs on radiation protection (see § E.3.1.4) may be submitted to the HCSP.

E.3.3.2.3 High Committee on Transparency and Information on Nuclear Security

The *TSN Act* provided for the creation of a High Committee on 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 34 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. It replaces the Senior Council for Nuclear Safety and Information (*Conseil supérieur de la sûreté et de l'information nucléaires* – CSSIN), which had been created in 1973 for similar purposes.

The High Committee met for the first time on 18 June 2008.

E.3.3.2.4 Laboratory Accreditation Commission

Environmental radioactivity measurements must be 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. The *Order of 12 September 2005,* abrogating the *Order of 5 January 2004,* appointed various persons to the Laboratory Accreditation Committee for Environmental Radioactivity Measurements (*Commission d'agrément des laboratoires de* *mesures de la radioactivité de l'environnement*). A new ASN decision concerning the appointment of commissioners will be required as soon as the decision relating to the laboratory-accreditation modalities for measuring environmental radioactivity is approved. The validation of ASN's *Decision 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.3.3.3 Health and safety agencies

E.3.3.3.1 French Health Watch Institute (InVS)

The Health Monitoring Institute (*Institut de veille sanitaire* – InVS), which reports to the Minister for Health, is responsible for the following tasks:

- monitoring and observing public health on an ongoing basis, collecting health-risk data and detecting any event likely to alter public health, and
- alerting public authorities, and especially the three health and safety agencies presented below in case of any threat to public health or of any emergency situation, and recommending appropriate steps.

E.3.3.3.2 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.3.3.3.3 French Food Safety Agency (AFSSA)

The role of the French Food Safety Agency (*Agence française de sécurité sanitaire des aliments* – AFSSA), which reports to the Ministers for Agriculture, Consumer Affairs and Health, is to contribute to ensuring the safety of foodstuff throughout the cycle, from the production of raw materials to consumer distribution. It assesses the potential health and nutritional risks in any foodstuff intended for human consumption. With regard to ionising radiation, the AFSSA's mandate is to issue opinions on the radiological quality of the food and water intended for human consumption, particularly in accident or post-accident situations.

E.3.3.3.4 French Environmental and Occupational Health and Safety Agency (AFSSET)

The role of the French Environmental and Occupational Health and Safety Agency (*Agence française de sécurité sanitaire de l'environnement et du travail* – AFSSET), which reports to the Ministers for the Environment and Health, is not only to promote health and safety in the environment and in the workspace, but also to assess environmental and occupational health hazards. Its task is also to provide public authorities with the relevant knowledge as well as the scientific and technical backup required for drafting and implementing legislative and regulatory provisions within its jurisdiction.

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* (*installation nucléaire de base – INB*), 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.

As in the case of any other type of waste, the producer of radioactive waste remains responsible for it until its final elimination in duly dedicated and licensed facilities. Although he sends his waste to be treated or stored in a facility run by another company, he always remains responsible for his waste.

However, the operator of the facility in which the waste is stored and/or processed is 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 INBs, the respective roles and responsibilities of ASN and of the operator are identical to those presented in § F.1.1.

As for the respective responsibilities of the waste producer and when the radioactive waste is taken over by Andra, it should be noted that the waste producer remains responsible for his 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).

The only exceptions involve historical waste, such as 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. Those residues represent small volumes compared to the total production of radioactive waste in France.

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 assume risk control on the concerned sites. That may notably be 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. As mentioned in § D.3.1.4, Andra is not only in charge for collecting, transporting and taking over radioactive waste, but also for 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 shall benefit from a State subsidy in support of the Agency's public-interest missions. In order to achieve that goal, Andra created within its own structure a National Assistance Commission on Radioactive Issues (*Commission nationale des aides dans le domaine radioactif* – CNAR). 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.

Target contracts are signed between the State and operators, such as EDF, AREVA, the CEA and Andra.

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 detailed in *Decree No. 92-1391 of 30 December 1992* (consolidated in Articles R542-1 *sqq.* of the *Environmental Code*), 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, four personalities representing economic activities with an interest for the Agency's operations, three qualified personalities and seven staff representatives;
- a chief executive officer appointed by decree;
- a government commissioner, who is the Director-General for Energy and Raw Materials;
- a financial committee, 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 research tax – In accordance with Article L542-12-1 of the *Environmental Code,* Andra manages an internal research fund designed to finance studies and investigations on storage and on the deep geological disposal 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 *Planning 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[3] (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 nuclear diffuse waste or the rehabilitation of sites contaminated with radioactive substances in cases of default of the liable entity. Indeed, in accordance with Article L542-12-1 of the *Environmental Code,* "the Agency shall 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 L542-12".

Lastly, Article 16 of the *2006 Planning Act* (Article L542-12-2 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 shall 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.

In 2007, the turnover for the financial year amounted to 134.5 million euros. The operation of the CSFMA, CSTFA and CSM disposal facilities and of corresponding activities represented a turnover in the order of 53 million euros.

F.2.2.1.2 Andra's human resources

At the beginning of 2008, Andra's staff amounted to 370 agents, 65% of which were engineers and managers. Seventy-five 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 facilities' safety rules. In that regard, the Agency intends to maintain and to develop

3. Due to their nature, commercial contracts are subject to conventional commercial risks; consequently, they may generate benefits or involve intrinsic risk.

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 Safety, Quality and Environmental Division consisting of 40 agents whose duties involve also quality and environmental-management activities.

With a staff of about 50 employees, the Scientific 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.

With an effective of about 45 employees, the 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 Safety, Quality and Environmental Division.

The Underground Research Laboratory Division has a team of about 60 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's and ILL's 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 defence sectors. The CEA's organisation chart is shown in § L.5.2. In 2007, the CEA's resources for civilian nuclear programmes amounted to 2,060.9 million euros, 44.5% of which were funded through public resources (a subsidy of 917.5 million euros including a cancellation of 60 million euros equivalent to the bonus dividends paid by AREVA), with the remaining 55.5% funded via equity capital (including 713.5 million euros of third-party receipts).

Since 2002, cleanup and dismantling operations in the CEA's civilian sites have been funded via a specific fund set up in 2001 and supplied by the income of *CEA Industrie* and by the contributions made by industrialists 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 2007 amounted to approximately 191 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.

In 2007, the ILL's financial resources were worth 76 million euros and were funded equally by the three major associate members, except for 19% by the other member States (Austria, the Czech Republic, the Russian Federation, Spain and Switzerland). At the end of 2007, provisions for dismantling operations amounted to 142 million euros.

F.2.2.2.2 Human resources

At the end of 2007, the CEA had close to 11,140 employees working for civilian programmes, 56% of which were managerial staff and 44% non-managerial out of a total workforce of some 15,600 employees including the Defence Pole. Employees involved in civilian programmes work on five 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 staff (engineers): safety engineers, engineers and experts in support units and safety skills centres and engineers in safety-control units.

At the end of 2007, the ILL had 475 employees (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 2007 are shown in Table 13.

In 2007, AREVA posted a turnover of 11,923 million euros, while its consolidated net income amounted to 743 million euros.

At the end of 2007, the group consisted of 65,583 employees, 60.5% of which worked in the nuclear sector.

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 refers to basic training and to experience; they also identify any need for further training and qualification as well as 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	Interest *(%)*
CEA	78.96
French State	5.19
Bearers of certificates of investment	4.03
Deposit and Consignment Office (*Caisse des dépôts et consignations*)	3.59
ERAP	3.21
EDF	2.42
Calyon	0.89
Framépargne	0.69
Total	1.02

Table 13: Distribution of AREVA shareholders

Pursuant to Article 7 of the *1984 Quality Order,* ASN must check the consistency between human resources and safety requirements during regular monitoring visits.

F.2.2.3.2 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 the removal costs for historical waste. Provisions set up by AREVA on 31 December 2007 totalled 4,775.8 million euros at present value and covered the liabilities of the 21 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; MELOX SA at Marcoule; EURODIF and SOCATRI; SOMANU at Maubeuge, and CERCA and FBFC at Romans.

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

On 31 December 2007, the realisable value of that liability coverage was estimated at 5,098 million euros.

At that date, the group had already completed a robust and prudent 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 had 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 2007, corresponding provisions totalled 299 million euros at present value.

F.2.2.4 EDF's human and financial resources

F.2.2.4.1 Human resources

Approximately 19,000 employees work in EDF's Nuclear Power Generation Division (compared to about 20,000 in 2003), divided into three groups: operating staff (around 5%), supervisory staff (around 68%) and managerial staff (around 27%). EDF's organisational chart is shown in § L.5.4.

In addition to those 19,000 members of staff who are directly involved in the operation of EDF's 58 nuclear reactors, EDF also dedicates human resources to the development, operation and decommissioning of nuclear reactors:

- about 2,000 engineers and technicians at the Nuclear Engineering Division (*Division ingénierie nucléaire* – DIN);
- close to 150 engineers and technicians at the Nuclear Fuel Division (*Division combustible nucléaire* – DCN), and
- more than 600 engineers and technicians at 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. The 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.

More than 300 employees work exclusively in the field of nuclear safety (safety engineers at NPPs, as well as safety specialists and experts in central services, engineering groups and inspection units).

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 2007, EDF's net electric output in France amounted to 469 TWh, including 418 of nuclear origin.

In 2006, the EDF Group posted consolidated revenues of 58.9 billion euros, a net Group share income of 5.6 billion euros and a gross operating surplus of 15.2 billion euros.

The provisions created by EDF at the end of 2006 amounted to about 14.6 billion euros for the back-end of the nuclear fuel cycle (management of spent fuel and nuclear waste) and to about 12.3 billion euros for dismantling NPPS and last cores.

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 when time comes. 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.

Moreover, in order to secure the financing of its long-term nuclear commitments, EDF has created over the last years an asset mix for the exclusive coverage of the allocated provisions for NPP deconstruction and to the back-end of the fuel cycle. In 2006,the gradual-constitution process of that portfolio was accelerated and the *2006 Planning Act* introduced new compulsory measures requiring operators to implement a dedicated asset plan within five years. On 31 December 2006, the total value of the portfolio amounted to 6.3 billion euros.

In the light of all the 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 ASN analysis

As mentioned at the beginning of this chapter, it is by checking that the operator fulfils all his requirements that ASN ensures his financial ability to operate his facility under safe conditions.

Concerning the financing review for dismantling and radioactive-waste management activities, ASN considers that:

- in accordance with Article 20 of the *2006 Planning Act* (see § B.1.6), the DGEMP, which has been designated as the competent authority, received from every operator a report estimating his dismantling and waste-management costs, within one year after the adoption of the law, and
- in application of Article 12 of *Decree No.2007-243 of 23 February 2007 Concerning the Financing Security of Nuclear Charges,* the DGEMP requested ASN's opinion on the soundness of the strategies proposed by the operators from a nuclear-safety standpoint (dismantling operations and schedule, spent-fuel and radioactive-waste management) as well as ASN's comments, if any, on any insufficiency that might have reduced the cost estimates.

In its *Opinion No. 2007-AV-037 of 20 November 2007,* ASN pointed out the following items:

- the initial analysis constitutes a first exercise, which is satisfactory as a whole, with due account of the short timescale of three months that operators had between the publication of the decree and the submission date of the reports. Several sections of those reports will need to be completed in order to comply with the provisions of *Decree No.2007-243* and the *Order of 21 March 2007 Concerning the Financing Security of Nuclear Charges,* and

- reports help to describe more precisely the strategies proposed by the operator, whether on the provisional lifetime of his facilities, the expected date of their dismantling or their final rehabilitated state. ASN is therefore satisfied that operators have opted for a strategy calling for immediate dismantling, but wishes for a prompt reconsideration of the final rehabilitated state of certain AREVA and CEA facilities where some buildings remain in place, especially since the presence of VLL waste raises technical problems.

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 “Seveso-type” ICPEs (chemical industries, paper mills, flammable-gas or liquid depots, etc.), as well as for certain types of facilities, in order to cover the rehabilitation costs once operation has stopped.

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; 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 using 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 the facilities during operation and decommissioning. The ICPE Inspectorate simply checks that the operator is taking all relevant steps. 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 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.

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. Although the computerised inventory was created many decades ago, it has undergone many technical improvements and is able to manage thousands of sealed sources and trace 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 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 prescribe 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 the following:

- “for quality-related activities carried out by suppliers, the operator shall ensure that contracts include the notification to those suppliers of the applicable steps for the enforcement of [the] order;
- the operator 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
- the operator shall constitute and update a file summarising the planned steps and means for enforcing [the] Order; more particularly, the operator shall 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 shall 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, 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 Assurance Policy and Programme

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 shall be responsible for the long-term management of radioactive waste and contribute to the national radioactive-waste management policy. Its missions are detailed further in § B.5.6.

Andra's quality policy is based on a set of requirements common to all Agency's roles and sites, such as consistency in the Agency's approaches, thoroughness and simplicity in order to enhance the clarity of Andra's actions, as well information sharing, dialogue and explanations.

Consequently, Andra has set up a quality and environment system fulfilling all requirements of ISO-9001 (quality) and ISO-14001 (environment) standards, as well as all provisions of the *1984 Quality Order* applicable to INBs (CSFMA, and CSM, and study of new facilities). In 2001, the Agency was certified consistent with ISO-9001 and ISO-14001 standards. Through its continued efforts, monitored by internal audits and yearly external audits. Andra maintains both certifications of compliance with those standards and their further evolution. Both certifications were renewed in 2007.

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 contract with the State.

The CEA's key quality actions are focused on project management, process identification, interface management, the availability of up-to-date and accessible guides, together with suitable training. The CEA is generalising the implementation of quality-management systems, and most divisions have launched initiatives with regard to ISO-9001 and ISO-14001 certification or ISO-17025 laboratory-accreditation.

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 9001:2000 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 are aiming to obtain the OHSAS-18001 certification of the Occupational Health and Safety Assessment Series by the end of 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-9001:2000 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.

The CEA's service providers are supervised thanks to the quality systems set up at the Purchasing and Sales Division and at site units. An internal Committee for the Certification of Radioactive Cleanup Companies (*Commission interne d'acceptation des entreprises d'assainissement radioactive* – CAEAR) assesses those service suppliers via audits referring to a baseline guide to common requirements and carried out by qualified auditors. The Committee issues certificates for a renewable three-year term.

Since its inception, the ILL has implemented quality procedures in the areas of design, construction and operation. The ILL applies the *1984 Quality Order.* The *Quality Organisation Manual (Manuel d'organisation de la qualité – MOQ),* first drawn up in 1984, has been revised twice, and numerous quality-assurance memos *(Notes d'assurance qualité – NAQ)* and procedures have been added.

The ILL's ambition is to achieve the highest possible research standards, with a constant concern to protect human beings and the environment. As part of a continuous improvement initiative, the ILL is actively involved in analysing process-induced risks and in project management.

Protecting the environment, developing a safety culture and managing availability are the priorities set forth in the Multi-annual Financial Estimates.

F.3.2.3 AREVA's Quality Assurance Policy and Programme

The senior management of the AREVA Group is committed to a policy of environmental excellence and sustainable development. That commitment is a comprehensive response to the company's various concerns, such as quality, nuclear safety, occupational safety, environmental impact, financial performance and social welfare.

The commitment is an extension of the other initiatives undertaken in those various fields since the company's inception with the aim of satisfying all its customers and partners and ensuring the sustainability of the company. It is inscribed in the provisions of a charter with the follow objectives:

- constantly improving the Group's understanding of the environment and of the environmental impact of AREVA's operations;
- anticipating regulatory changes by setting discharge and emission targets that are always lower than regulatory limits;
- implementing the best suitable human resources and tools for managing the environment and preventing risks in accordance with the specific needs of each site;
- designing facilities and processes in order to optimise consumption on a continuous basis, to reduce discharges, waste and harmful effects, and to promote the recycling of the generated materials and energy;
- developing environmental-analysis and monitoring practices in order to identify all impacts and to rank them so that those with the greatest risk to the environment and human health are dealt with as a priority;
- encouraging all AREVA employees to seek environmental excellence an to be aware of the need to protect the environment as a matter of routine through responsible working practices and behaviours;
- involving all customers, partners, subcontractors and suppliers of the Group in that initiative by reinforcing the hazard-prevention and environmental-protection aspects of their contractual and commercial relations;
- providing unrestricted access to precise, clear and complete information concerning AREVA's activities, their impact on the environment and the means used to monitor and reduce such impact;
- discussing with all stakeholders on environmental issues in order to compare experiences, to understand the expectations of the public and of the group's customers, and to identify fresh areas for progress, and
- assessing the economic and social aspects of the Group's environmental performance.

In the field of quality, AREVA 's first *Quality Assurance Manual* was published in 1978, two years after the company was created. It was complemented over the years and resulted in the ISO-9000 certification being granted to all sites involved in treatment-recycling operations. The certification is re-assessed periodically.

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. Furthermore, with a view to total quality and continuous improvement, incorporating the model of the European Foundation for Quality Management (EFQM) System began in the mid-90s and has been continuing since then.

Along the same lines, but in a more specific area (which nonetheless falls within the sustainable-development category), an environment-related initiative was instituted and resulted in the ISO-14001 certification of all sites involved in treatment-recycling operations.

Lastly, the La Hague discharge and environmental-analysis laboratories are accredited by the French Accreditation Committee (*Comité français d'accréditation* – COFRAC) as consistent with the requirements of the *NF EN 45001 Standard Relating to Calibration and Testing*. That means the regular calibration of all radiation detectors using secondary reference meters connectable to primary reference meters and cross-comparison exercises with other laboratories, including national and international laboratories (to be conducted independently from the regulatory cross-comparisons with the IRSN).

Among other specific actions within the sustainable-development initiative should be mentioned the gradual implementation of improvement indicators combining the concerns of quality, safety and the environment, as well as efforts towards greater transparency. With respect to the latter, the creation of a website dedicated to the La Hague facility is worth mentioning, together with the site's broad outreach efforts to welcome visitors, AREVA's participation in the La Hague Special and Standing Information Committee (*Commission spéciale et permanente de La Hague*), the work performed by the Nord-Cotentin Radioecological Group (*Groupe radioécologique Nord-Cotentin* – GRN), the publication of brochures, etc.

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, as necessary; in accordance with a continuing-progress dynamics;
- to promote the confidence of stakeholders in the quality system, by stimulating their involvement in its implementation and improvement, and
- to provide a quality system consistent with the French regulatory requirements, international quality recommendations and to effective practices and methods highlighted through experience feedback.

Design, construction and operation are the keys to the sound operation of NPPs. The quality management policy covers primarily safety-related activities and relies on the following guiding principles:

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:

- an 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 each 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 each 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, mostly 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.

Human and technical resources, along with methods and procedures, must be adapted to the required quality level and their soundness must be controlled periodically.

In order to guarantee the quality of contracted services, EDF monitors the activities it entrusts upon its contractors. Customer-supplier contracts specify the respective responsibilities of each party, as well as any applicable requirements and commitments regarding quality and expected results. In an effort to reinforce the partnership quality with contractors, an improvement programme is running between 2006 and 2010, with a view, notably, to contributing to the renewal of their skills and to facilitating intervention conditions.

Guaranteeing EDF's quality through adapted checks

The quality of an activity depends primarily on the persons conducting it. Control processes ensure that quality through self-checks, controls by other qualified persons and verification actions. That system contributes to the defence in depth.

Confirming EDF's quality through traceability

The attainment of quality is confirmed by documents produced at all stages of the activity, from the preliminary analysis to the final report. Preserving those documents ensures the traceability of every operation, particularly with respect to safety.

Anticipating, preventing and progressing at EDF

In order to prevent defects and to improve results, EDF uses an experience-feedback approach (cf. ISO 14001) is 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 computer 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 the EURATOM accounting rules for nuclear materials.

For nuclear waste, site inventories and computer databases (a computer application called “DRA”) ensure the traceability of output, interim-storage facilities and shipments of nuclear waste packages to disposal facilities, directly or after processing (incineration, fusion).

F.3.3 ASN analysis

Experience feedback from incidents or accidents occurring in INBs and the various inspection reports help ASN assess the implementation of the *1984 Quality Order* by analysing actual malfunctions. 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 1999.

Operators subcontract most of their INB-maintenance operations, thus involving about 40,000 people every year. While that industrial policy remains the strategic choice of the operators concerned, ASN verifies that they comply with the provisions of the *1984 Quality Order* with regard to the safety of their facilities by setting in place a quality process, especially for subcontractor supervision. In that respect, subcontractor supervision has been one of ASN’s recurring inspection topics.

Overall, nuclear industry has proven to be a pioneer for quality assurance in France, pursuant to the *1984 Quality Order* requiring that relevant steps be taken. Since then, new widespread quality references have been applied in the industry, notably via the ISO-9000 and ISO-14000 standards. Nevertheless, the requirements of the *1984 Quality Order* seem to remain valid and, in certain areas, are even more rigorous than international standards, particularly with respect to the supervision of contractors by operators.

On the whole, ASN recognises that major nuclear operators meet quality-assurance requirements.

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.

As in the case of all special industrial waste, any radioactive waste produced by ICPEs must be subject to specific precautions during collection and storage (appropriate packaging and labelling), shipment (compliance with regulations for the transport of dangerous goods) and treatment (exclusively in a licensed ICPE). For all those operations, authorities must be kept informed. A follow-up checklist must be issued and each intermediate operator must keep a copy. The treatment facility must return the last page to the producer within one month in order to confirm that he has effectively taken possession of the waste.

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 producer must send a waste sample to the operator of the recipient facility in order to obtain his approval prior to shipment.

Key data mentioned on the form include the following:

- the identity of the waste producer;
- the characteristics, quantities and destination of the waste;
- the transport and elimination means of the waste, and
- the identity of all firms concerned by the various operations mentioned above.

F.3.5 Specific case of radioactive sources

Specific licensing conditions for the fabrication, possession, distribution and use of sealed radionuclide sources, which have been consolidated in the current regulations, provide for suitable steps to trace back their movements.

The responsibility for traceability (acquisition, transfer, import, export) lies with the IRSN, which must promptly notify ASN in case of anomaly. Management is facilitated by the use of dedicated software, the design and operation of which anticipated the implementation of quality assurance.

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 compliance with requirements and the status report of sealed sources, when reviewing renewal applications, in cases of termination of activity and during spot-checks or inspections.

F.4 Radiation protection during the 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 completely 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 provide further clarifications and simplifications to the experience-feedback base on controls.

In accordance with the *TSN Act,* it is ASN's responsibility to licence the commissioning of any INB and to set relevant design, implementation and operation requirements in application of the related decrees. In that context, ASN prescribes special requirements for water intake as well as for liquid and gaseous discharges by radioactive and non-radioactive facilities.

F.4.1.1.1 Public Health Code

Radiation-protection principles

The new 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 cm^2), 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

The new provisions of 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,* thus keeping abreast the French legislation with *Directive No. 90/641 Regarding the Operational Protection of Outside Workers Exposed to the Risk of Ionising Radiation During Their Intervention in a Controlled Zone.*

The link with the three radiation-protection principles mentioned in the *Public Health Code* is set in the *Labour Code*. The rules concerning worker protection are described in *Decree No. 2003-296 of 31 March 2003 Concerning the Protection of Workers Against Ionising Radiation,* amended by *Decree No. 2007-1570 of 5 November 2007 Concerning the Protection of Workers Against Ionising Radiation and Amending the Regulatory Provisions of the* Labour 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

New articles R. 231-71 to R. 231-116 of the *Labour Code*, as introduced by *Decree No. 2003-296,* create a single radiation-protection regime for all internal and external workers 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 organisation of work (Article R. 231-75) 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. 231-76) 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 professional exposure, and
- the dose limit for pregnant women (Article R. 231-77) 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 setting up those new provisions.

Radiation-protection zoning

New 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
- if required, whole-body dose rates.

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.

As mentioned in § B.5.2.2, any intentional inclusion of natural or artificial radionuclides in the list of consumer goods and construction products is prohibited (Article R. 1333-2 of the *Public Health Code*). 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 materials or waste from a nuclear activity is also in principle prohibited, if they are contaminated or likely to have been contaminated by radionuclides as a result of that activity.

The effective annual dose limit (Article R. 1333-8) received by a member of the public as a result of nuclear activities is set at 1 mSv; maximum admissible dose equivalents for the crystalline lens and for the skin are set at 15 and 50 mSv/a (average value for any cubic centimetre of skin), respectively. The calculation method for effective and equivalent-dose rates and the methods to be used for estimating the dosimetric impact on a population are prescribed by the *Order of 1 September 2003.*

The institution of a national network for collecting radioactivity measurements in the environment is under way (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 requested by territorial communities and associations. Results will be accessible to the public. The management of the network has been entrusted to the IRSN, while its orientations have been set by ASN in accordance with the *Order of 27 June 2005 Concerning the Institution of a National Network for Collecting Radioactivity Measurements in the Environment and Setting the Laboratory Certification Procedures.*

In order to ensure the sound quality of the measurements, all network laboratories must comply with certain certification criteria, which include notably intercomparison tests. The list of certified organisations may be consulted on ASN's Website (*www.asn.fr*).

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 (Article R. 333-12 of the *Public Health Code*), is described in § B.6.2.3.

Although authorised by *EURATOM Directive 96/29,* French regulations do not include the notion of a clearance threshold (i.e., the generic radioactivity level below which any effluent and waste from a nuclear activity may be disposed of without monitoring). 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*. That section was updated in 2007 in order to take into account the experience acquired by ASN since 2002 and of the new prerogatives ASN was granted by the *TSN Act*.

Since then, most licences have been issued by ASN and declarations have been submitted to ASN's territorial divisions.

All medical, industrial and research applications are concerned by those provisions, especially with regard to the fabrication, holding, distribution, including import and export, as well as the use of radionuclides or products or devices containing some.

The licensing system applies without distinction not only to all companies or establishment holding radionuclides on their premises, but also to those marketing them without holding them directly. That provision is consistent with *EURATOM Directive 96/29*, which includes import and export explicitly. From a health and safety standpoint, that obligation is necessary 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 L1333-4 of the *Public Health Code,* licences concerning industries covered by the *Mining Code.* INBs and ICPEs also act as radiation-protection licences. However, that exception does not concern the use of ionising radiation for medical purposes or biomedical research. The ICPE nomenclature concerning certain facilities containing radioactive substances was modified by *Decree No. 2006-1454 of 24 November 2006 Amending the ICPE Nomenclature.* According to the new decree, all establishments, such as health institutions, that are not industrial and commercial in nature, are no longer part of the nomenclature, and the ICPE classification is only compulsory if the facility using radioactive sources is licensed as such under a different heading of the nomenclature.

Procedures for submitting licence applications or declarations, as specified in the *Order of 14 May 2004,* will need to be updated through an ASN decision in order to introduce the content of the supporting documents supporting the licence application or the declaration, as well as the content of the licences.

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*. They were established on the basis of the rules enacted by the Interministerial Commission on Artificial Radioelements (*Commission interministérielle des radioéléments artificiels* – CIREA). Their control has now been transferred to ASN agents. However, the CIREA's competency with regard to the bookkeeping of the inventory of radioactive sources was passed on to the IRSN (Article L 1333-9).

Those general rules include the following:

- it is forbidden to alienate or acquire any source without being duly unauthorised to do so;
- 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 recording that a declaration is necessary to organise the follow-up of the sources and any 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 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, except in case of derogation for radioactive decay on site, and
- the supplier is required to collect without any condition 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.

The calculation procedures for the financial guarantees to be supported by source suppliers should be integrated soon in the *Public Health Code*. The national price list per source family, as well as implementation and payment procedures of those guarantees, will need to be set by an order of the Ministers for Health and Finance, after consultation with ASN, the IRSN and Andra.

F.4.1.3 Radiation protection in INBs

INBs perform nuclear activities (see § F.4.1.1.1) that are specifically regulated and monitored owing to the significant risk exposure to ionising radiation. More particularly, the conduct of such activities requires a radiation-protection licence beforehand, through procedures described in *Decree No. 63-1228,* as modified, and *Decree No. 95-540.* The terms of those procedures are prescribed by the *TSN Act* and *Decree No. 2007-1557.* In the framework of those procedures, the INB operator must provide the necessary evidence to demonstrate compliance with general radiation-protection principles and all specific rules in that field.

Lastly, regulations require that emergency plans be drawn up (on-site and off-site emergency plans produced by the operator and the Prefect, respectively) detailing the structures and resources intended to control accident situations, to limit their consequences and to take appropriate steps for protecting people against their impact (see § F. 5.2.4).

F.4.1.4 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 radioactive or not.

In that respect, INBs are subject to the provisions of the *TSN Act* and of *Decree No. 2007-1557* (see § A.2.1.2) abrogating *Decree No. 95-540.*

The *TSN Act* modifies notably 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. Consequently, the operator is now required to submit a single application covering all aspects in the form of a creation-licence (or dismantling-licence) application. The content of the application and the matching procedure are detailed in *Decree No. 2007-1557.* 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 decision is subject to the validation of the Ministers in charge of nuclear safety.

The first discharge limits had been prescribed on the basis of an impact lower than existing 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 will complete that approach by requiring INB operators to establish yearly forecasts of their planned discharges. Those forecasts, which will be obviously lower than regulatory limits, are designed to encourage operators to manage their discharges according to the finest technical forecasting method possible.

In addition, in accordance with Article 37 of the *EURATOM Treaty*, France provides the European Commission 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.4.2 Radiation-protection steps taken by INB operators

F.4.2.1 Radiation protection and effluent limitation at Andra

Radiation protection and minimisation of effluents are key areas of Andra's environmental policy.

F.4.2.1.1 Radiation protection objectives

Andra considers that for the public, the dosimetric impact of the disposal facilities running under normal operation must be at as low a level as reasonably achievable and must not exceed a fraction of the regulation 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 should 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 sediment, 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 results of the operational dosimetry recorded on the facility personnel in 2007 were below the 1-µSv detection threshold of recording devices. At the CSFMA, the maximal dose rate recorded in 2007 was 1.447 mSv.

Andra also completed the radiological monitoring of the disposal facilities by checking the physico-chemical quality of the water and by 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. The result was a very significant reduction in the volume of waters collected at the base of the disposal structures (by a factor of 100 between 1991 and 1997); those waters are treated by AREVA at La Hague Plant.

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 to authorise radioactive and chemical discharges. The application covered surface waters (rainwaters collected over the bituminous membrane) and their discharge in rivers, as well as the water collected 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.

With regard to the CSFMA and with due account of the VLL activity involved with the effluents, the *Circular of 19 July 1991* issued by the then radiation-protection regulatory body, called the Central Service for Protection Against Ionising Radiation (*Service central de protection contre les rayonnements ionisants* – SCPRI) prescribed the following specific activity requirements for all waters leaving the facility's stormwater tank: 0.0008 Bq/L for alpha activity, 0.8 Bq/L for beta activity and 400 Bq/L for tritium. From the time operations began until the end of 2004, the maximum recorded values amounted to 24% (primarily due to cumulative measurement thresholds), 3% and 0.3% of those limits, respectively.

Changes to the regulatory context, particularly the publication of the *Decree of 4 May 1995* taken in application of the *Water Law of 3 January 1992* and the publication of the *Order of 26 November 1999* defining general requirements for effluent discharges and/or water intake, led Andra to submit on 17 March 2004 a licence application to authorise liquid and gaseous discharges and a request to modify the creation-licence decree of the disposal facility. Once public inquiries were held at the end of 2004 and the administrative process was completed, the creation licence was modified on 10 August 2006 by *Decree No. 2006-1006* and the discharge licence was issued by the *Order of 21 August 2006*.

	Gas discharges (*GBq/a*) *(conditioning workshops)*	Liquid discharges (*GBq/a*)
Tritium	50	5
Carbon-14	5	0.12
Iodines	$2 \cdot 10^{-2}$	–
Other beta-gamma emitters	$2 \cdot 10^{-4}$	0.1
Alpha emitters	$2 \cdot 10^{-5}$	$4 \cdot 10^{-4}$

Table 14: Discharge limits prescribed by the Order of 21 August 2006 for the CSFMA

Applications for radioactive discharges are in line with the principle to reduce thresholds in relation to the values authorised originally by the SCPRI.

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.

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

F.4.2.2.1 Occupational radiation protection

The management programme for occupational external and internal exposures of CEA workers is applied when design 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. To minimise such exposures, protection measures are implemented: biological protection systems, dynamic containment, together with static systems establish 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 2007 (compared with 0.8 mSv in 2002).

In 2007, 7,259 CEA employees were monitored, and 95% of them did not receive any dose. 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.

F.4.2.2.2 Public exposure

The design of biological-protection systems at installations 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 measures, dose rates are measured in real-time and on a continuous basis using detectors located at measuring stations positioned around CEA sites. Recorded measures 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 general regulations and to specific regulations of each site (interministerial order), in which are defined the authorised discharges limits (annual and monthly limits, maximum concentration discharged into the environment), waste-discharge conditions and the required environmental monitoring procedures. Even before the first discharge licences were issued in 1979, the CEA has 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 discharge and water intake on CEA sites have been revised regularly with due account of recent changes in the regulatory framework. That implies a reduction in authorised discharges on sites (as in the case of the Grenoble Site, pursuant to the *Order of 25 May 2004*), together with the publication of licensing orders for every new facility.

Control of liquid discharges includes the activity of alpha-emitting radionuclides, beta- and gamma-emitting radionuclides and tritium activity. For at least the last 12 years and on all sites, discharges of radioactive effluents have consistently been lower than the limits prescribed by ministerial orders. At the end of 2007, discharged liquid effluents containing beta/gamma-emitters and tritium accounted for less than 21 % and 6 %, respectively, of the limits of current discharges licences, whereas discharged effluent containing alpha-emitters which are over-estimated in light of the sensitivity limits of the measuring methods used, were in the order of 15 %, at most, of authorised limits.

Monitoring air emissions includes monitoring aerosols, halogens, tritium and other gases. The analysis of the results for the last 12 years shows, as in the case of liquid discharges, a significant reduction in the discharged quantity. The results for 2007 show that tritium releases reached a maximum 4% of licensed releases, whereas halogen releases did not exceed 1 % and aerosol releases stood at less than 1%. Releases of other gases, which are overestimated given the sensitivity limits of the measuring methods used, came to less than 30% of the annual regulatory limit.

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 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 makes it possible to detect 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, above all, taken in the air (aerosols); in the water from the surface drainage network, as well as upstream and downstream from the site; in the 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 effluent, 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 sediment 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 that are available on various media: ASN Website (*www.asn.fr*), Minitel network (*36.14 MAGNUC*) or CEA booklets (*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

F.4.2.3.1.1 Occupational exposure

Control of 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 of at La Hague was only 0.098 mSv in 2006 (for both AREVA or subcontractor employees); while the collective dose amounted to 0.505 man.Sv.

Those results were 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 the 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 of 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 remotely, without any breach in containment and with full biological protection (use of mobile equipment-removal enclosures).

F.4.2.3.1.2 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 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.

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, the processing facilities may only be authorised 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 by-product 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 either into the atmosphere or 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 is never halted. Most of the products fed into the acid and base evaporators come out in the form of distillates, which are virtually free of contamination, directed towards "V" effluents and discharged as such. The residual concentrate contains all existing radioactivity and, thus, becomes a 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 also 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, which no longer requires 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 employs no unusual reagents, which also eliminates another part of the effluent stream.

Some analyses of residual plutonium solutions had 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.

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 the 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 Nord-Cotentin Radioecological Group which, at the request of the government, 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 marking from the plant discharges was insignificant when compared with natural radioactivity and the fallout from Chernobyl and atmospheric testing of nuclear weapons, levels which were already very low.

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 the 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 reduce further the doses of exposed individuals, EDF launched the ALARA-1 policy in 1992, thus leading to significant improvements, with collective dose falling from 2.4 man.sieverts/a per reactor in 1992 to 1.08 man-sieverts in 2000, 1.02 man.sieverts in 2001 and 0.69 man.sievert in 2006. 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 overall optimisation principle. In that context, the collective dose per reactor decreased further to 0.63 man.sievert in 2007. 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 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, shared by all nuclear sites and corporate engineering groups, and currently 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 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 completed, 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 the 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 four 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 the 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 (regulatory annual limits, additional or total maximum concentrations of the receiving environment);
- discharge conditions, and
- the modalities 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 very significant reduction in liquid effluent discharges, excluding tritium, which were originally the predominant contributor to the environmental and health impact (dose).

The substantial reduction in liquid discharges excluding tritium, which has been observed for a number of years, 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 of 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 on roads.

The scientific tracking-and-analysis function includes identifying and forecasting changes: follow-up of integrated parameters, radioecological studies (decennial and annual reviews, specific studies, hydroecological 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 Environmental Measurements, all environmental laboratories at EDF NPPs embarked on a process of gaining approval for the network, via accreditation to the ISO-17025 standard.

In addition, radioecological monitoring is carried out on an annual basis at all operating nuclear sites. It is part of a monitoring programme defined in a framework agreement with the IRSN.

Furthermore, a decennial review, similar to the baseline measurements performed when commissioning the first unit at a site, is also carried out. All sites have now conducted their first decennial review. Second decennial reviews began at Fessenheim in 1998, followed by Cruas in 2004, Saint-Alban and Paluel in 2005, and Flamanville in 2006.

At the end of 2006, 12 of 19 NPPs had carried out their second decennial review.

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 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.*

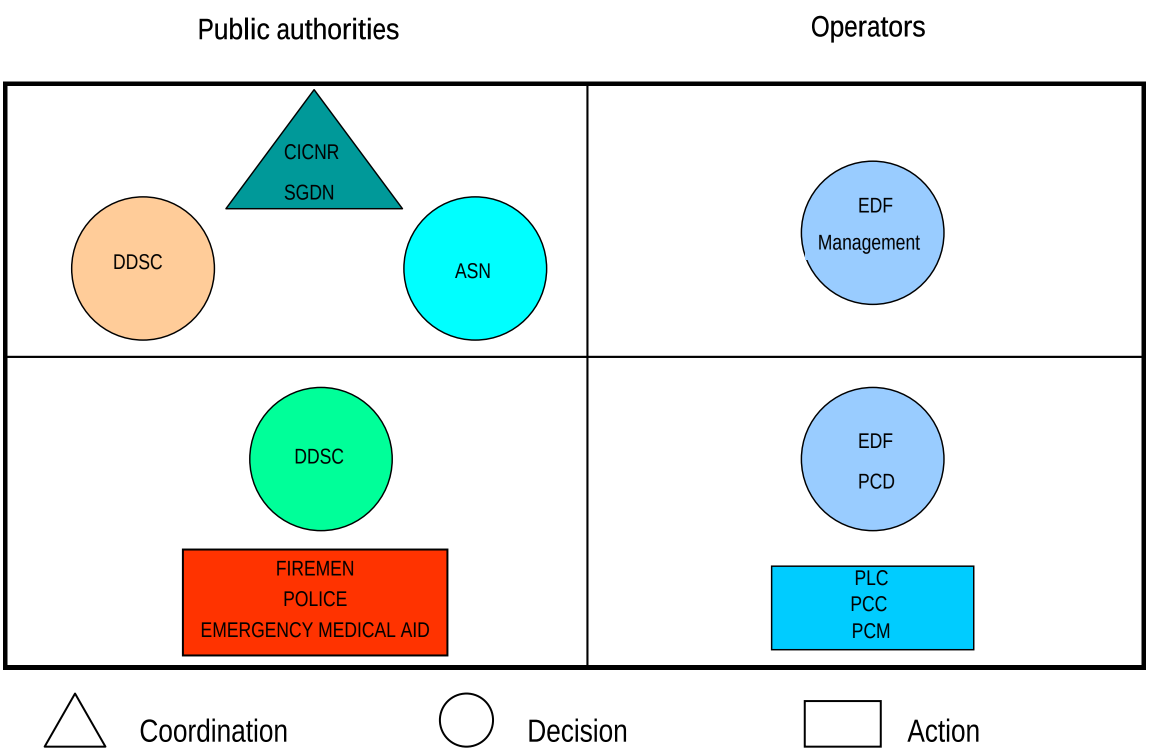

Figure 4 : Typical diagram of crisis organisation for a nuclear reactor operated by EDF

CICNR : *Comité interministériel aux crises nucléaires ou radiologique* - Interministerial Committee for Nuclear and Radiological Emergencies

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

DDSC : *Direction de la Défense et de la sécurité civiles* - Directorate for Civil Security and Defence

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 to assess source terms (i.e., the quantities of radioactive materials being discharged), to calculate their dispersal into the environment and lastly, to evaluate their radiological impact.

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 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, ASN, with the support of the IRSN, has 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, 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 task force designed not only to assist the Prefect in his decisions and communication actions, but also to ensure the relevancy of any actions taken by the operator directly on site, and
- an IRSN representative managing the measurement cell within the central operational station in order to co-ordinate field radioactivity recordings. The specific measurement structure was described in an interministerial directive, which was updated in 2005.

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 the site, triggering the on-site emergency plan;
- off the site, mobilising accident experts from national emergency response teams, in order to help site managers, and
- informing public authorities that may, depending on the gravity of the situation, trigger the off-site emergency plan.

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 On-Site Emergency Plan, 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 On-site Emergency Plan is analysed by the IRSN and submitted to the relevant Advisory Committee of experts for its opinion.

ASN ensures the sound enforcement of On-site Emergency Plans, 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 Off-site Emergency Plan. 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 off-site and on-site emergency plans.

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, 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 relevant Ministries and stakeholders, ASN drafted the Interministerial Circular DGSNR/DHOS/DDSC No. 2005/1390 of 23 December 2005 issued by the General Directorate for Nuclear Safety and Radiation Protection (*Direction générale de la sûreté nucléaire et de la radioprotection* – DGSNR), the DHOS and the Directorate for National Defence and Emergency Preparedness (*Direction de la défense et de la sécurité civile* – DDSC). The circular specifies the following items:

- the context of the response;
- the responsibilities of each actor;
- 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 General remarks

Since many INBs were built in France between 1950 and 1990, a large number 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 30 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 2007. In that context, the safety and radiation protection of dismantling operations have gradually become major topics for ASN.

At the international level, the following three main strategies have been developed by the IAEA:

- *deferred dismantling:* the sections of a facilities containing radioactive substances are maintained or placed under safe containment conditions over several decades before dismantling operations start, with the understanding that the conventional sections of the facility may be dismantled as soon as the facility closes;
- *safe containment:* the sections of the facility containing radioactive substances are placed within a reinforced containment structure ("cocoon") during the required time for radioactivity to reach a sufficiently low level for site clearance, with the understanding that the conventional sections of the facility may be dismantled as soon as the facility closes, and
- *immediate dismantling*: dismantling operations start as soon as operations stop without any waiting period.

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. For the time being, all major French operators have committed themselves to the immediate-dismantling strategy for the current facilities intended for dismantling.

According to the *TSN Act,* the operator must establish the main dismantling principles for the facility concerned in his licence application to create an INB, and Implementing the *Decree No. 2007-1557* prescribes that the supporting documentation of the licence application must include a dismantling plan describing the methodological principles and the scheduled steps for the dismantling of the facility, as well as for the rehabilitation and subsequent monitoring of the site.

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 relevant provisions for those overall charges and allocate sufficient assets to cover exclusively those provisions. In order to ensure compliance with those requirements, specific controls are prescribed by the law (see § B.1.6).

The regulatory aspects of final-shutdown and dismantling licences are described in § E.2.2.4.5.

In order to prevent any fractionation of the dismantling project and to improve the overall consistency, the supporting documentation of the licence application submitted by the operator must describe the overall work plan starting from the final shutdown until the last scheduled objective to be achieved. For every step of the procedure, it must also provide detailed information about the nature and scope of the potential hazards induced by the facility and the proposed means to counter them. The final-shutdown and dismantling phase may be preceded by a preparatory period to the final shutdown, in the framework of the initial operating licence. That preparatory period is designed notably to evacuate part of or all source terms and to prepare the dismantling operations (layout of premises, worksite preparations, team training, etc.).

The supporting documentation submitted by the operator must detail the scheduled work over the short term (i.e., approximately five years after licensing), but a summary of subsequent operations is sufficient.

Hence, the final-shutdown and dismantling decree concerns mainly the first post-closure period. For further phases, the decree mentions only the main obligations and mentions which specific authorisations will be required in order to initiate certain important safety-related tasks. Any such authorisation will be issued by ASN on the basis of detailed application to be submitted by the operator.

In cases where the work does not compromise significantly the safety of the facility, ASN may dispense the operator with the declaration procedure to modify his facility provided that he set in place an internal control mechanism with sufficient quality, autonomy and transparency guarantees ("internal authorisation"). That possibility has now been integrated in *Decree No. 2007-1557*. However, any operation involving significantly the safety report of the facility or likely to increase significantly the impact on human beings and the environment (especially operations referred to in the licensing decree) must be declared to ASN and, as mentioned above, be justified by supporting documents and necessary updates.

After dismantling, an INB may be declassified and removed from the INB list, and therefore be cleared from the INB legal and administrative system. However, it has appeared necessary to preserve the memory of the past existence of all INBs after declassification and to set in place, if need be, relevant use restrictions commensurate with the final state of the site. In the past, ASN has established conventional easements for the benefit of the State in consultation with the local State offices involved. Those easements were recorded in the Mortgage Register in order to testify to their existence. They were established systematically during the recent INB declassifications. From now on, the *TSN Act* authorises the possibility to set public-utility easements after the declassification of an INB with regard to the potential residual risks of the dismantled facility and of its implementation site. Those new provisions require a public inquiry and will be applicable for the new declassifications.

In 2003, an ASN guide detailed the regulatory framework for the dismantling of INBs. In 2007, ASN revised that guide and drafted complementary guides in order to integrate regulatory changes resulting from the *TSN Act*, *Decree No. 2007-1557* and WENRA's work.

The additions brought by the *TSN Act* for all dismantling operations will be integrated and detailed by the creation or revision of ASN Guides, notably on the following topics:

- public consultation has now become systematic for all dismantling projects, irrespective of the nature of the facility involved;
- the dismantling issue must be taken into account from the early creation of the facilities and followed up throughout their operation, by the preparation and regular update of a document called the "Dismantling Plan";
- depending on the final state achieved and the state of the site after dismantling, public-utility easements may be instituted after dismantling, and
- the possibility for ASN to intervene after the declassification of an INB.

ASN strives to complete the regulatory framework instituted by the law, rules, guides and control actions, while aiming at clarity and comprehensiveness. Hence, many topics are under consideration, as follows:

- financing dismantling operations and the management of the associated waste in the framework of the *2006 Planning Act,* in co-operation with the DGEMP;
- the systematic review of dismantling strategies implemented by the operators;
- the standardisation of dismantling practices (final state of facilities after dismantling, re-use of facilities or sites, etc.), and
- INB declassification procedures.

ASN feels that managing the dismantling waste constitutes a crucial step that conditions the sound evolution of ongoing dismantling programmes (availability of systems, management of waste flows). Hence, waste-management procedures are assessed systematically during the review of the operators' overall dismantling strategies. The launching of dismantling operators is therefore closely related to the availability of suitable elimination systems for all residues likely to be generated (see notably the case of graphite in gas-graphite reactor [GGR] vessels in § F.6.3).

In order to ensure the consistency of ongoing work with the best international practices, ASN participates actively in actions and international working groups involved in INB dismantling and declassification, such as the IAEA, the OECD/NEA and the WENRA.

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 decommissioned 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, and
- the completion of dismantling and cleanup operations at the Grenoble and Fontenay-aux-Roses research facilities by 2015 and 2018, respectively.

Since about 30 facilities are concerned over two decades (2001-2010 and 2011-2020), the programme represents a major endeavour in terms of volume and cost.

The total cost of the works is currently estimated by the CEA to be around 6 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 scenarii 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 final disposal solutions for certain waste categories, especially in the case of dismantling residues (specific waste, such as oils, solvents and graphite) raises an additional obstacle even though the development of new technologies, notably for the disposal of graphite waste, is now beginning to emerge.

F.6.2.2 Steps taken by AREVA

F.6.2.2.1 Availability of qualified personnel and adequate financial resources

The AREVA Group's decommissioning strategy is to proceed with the prompt dismantling at the end of the facility's operating lifetime, without any waiting period, in order to benefit from the operators' skills in the dismantling of their facilities.

As discussed in § F.2.2.3, the corresponding human and financial resources will provide a guarantee that resources are adequate and that dismantling operations may be conducted under sound conditions.

F.6.2.2.2 Radiation-protection measures regarding operation, effluent discharges, unforeseen and unmonitored emissions

The provisions concerning radiation protection and discharge monitoring apply to all activities conducted in all facilities, without exception. A single discharge licence, for instance, is granted for each site as a whole. Hence, decommissioning activities are, by definition, subject to those provisions. If some dismantling operations were to result in discharge levels higher than during the operation of the facility, or be of a different type, a supplementary discharge licence would need to be obtained.

F.6.2.2.3 Provisions related to emergency preparedness

The provisions concerning emergency preparedness are also applicable during the decommissioning phase. The periodic review of these provisions, which are filed with ASN for approval, allows them to be adapted to specific decommissioning situations, if necessary.

F.6.2.2.4 Maintaining dossiers containing crucial information for decommissioning

The application of quality-assurance requirements to the design, modification and operation of the facility, demands rigorous traceability of all sizing, design and construction data and of any events involving those facilities. Steps are taken to ensure that relevant archives are kept (back-up, redundancy, etc.) and available throughout nuclear cleanup and dismantling operations.

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 UNGG reactors 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.

The programme also includes the construction and operation of a packaging and storage facility for activated waste (*Installation de conditionnement et d'entreposage de déchets activés* – ICEDA) to accommodate IL-LL deconstruction waste, pending the commissioning of the corresponding waste repository (*2006 Planning Act*).

Until 2001, the preferred scenario was to aim for the immediate and partial dismantling of power reactors up to Level 2 (removal of special fissile material and readily-dismantled parts, minimisation of the contained zone and conversion of the outside barrier) and to transform it into a basic nuclear and storage facility (*installation nucléaire de base et d'entreposage* – INBE). Complete dismantling (Level 3) was envisaged after several decades of containment.

In 2001, the decision was made to select deconstruction over a period of approximately 25 years in order to speed up the programme.

Type of facility	Unit	Power *(MWe)*	Commissioning year	Shutdown year	INB No.
6 GGR power plants	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 (EL4)	Brennilis	70	1967	1985	162
1 PWR reactor	Chooz A	300	1967	1991	163
1 fast-neutron reactor (SUPERPHÉNIX)	Creys-Malville	1,200	1986	1997	91
2 storage silos at Saint-Laurent	Silos	–	–	–	74
1 conditioning facility and interim storage for activated waste	ICEDA				To be built

Table 15: EDF facility-dismantling programme

Facility	Application date for dismantling authorisation decree	Beginning of public enquiry	CIINB	Publication of dismantling authorisation decree
Creys-Malville	6 May 2003	1 April 2004	11 May 2005	21 March 2006
Brennilis (EL4)	22 July 2003	–	6 July 2005	12 February 2006
Chooz A	30 November 2004	28 August 2006	8 December 2006	29 September 2007
Bugey 1	29 September 2005	13 June 2006	22 February 2008	
Saint-Laurent A	11 October 2006	26 January 2007		
Chinon A	29 September 2006	2 March 2007		

Table 16: Administrative deadlines for full-dismantling decree

The term of the programme undertaken in 2002 is 25 years, with due account of Andra's storage arrangements for LL-LL waste in accordance with the *2006 Planning Act,* in order to allow the storage of graphite waste, since if affects the progress of UNGG-deconstruction operations.

In order to fulfil the programme, six projects were created within the Engineering Centre for Nuclear Deconstruction and Environment (*Centre d'ingénierie de la déconstruction et de l'environnement* – CIDEN) of the Nuclear Engineering Division, 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 will be added the scheduled ICEDA storage facility.

The corresponding human and financial resources were mentioned above 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

At ASN's request, EDF has adopted, in 2001, a new dismantling strategy based on the full dismantling of all its permanent shut-down INBs (Brennilis, Bugey 1, Saint-Laurent-des-Eaux A, Chinon A, Chooz A and SUPERPHÉNIX) without any waiting period by 2025. The report describing EDF's new strategy and including the relevant technical justifications (safety of each facility concerned; management of associated waste and especially graphite waste; organisation, implementation and maintenance of skills, description of the final expected state) was examined by ASN with the IRSN's technical support. The relevant Expert Advisory Group provided its opinion in March 2004. ASN considers that there are no unacceptable elements likely to question the feasibility of the planned full-dismantling scenarios. At ASN's request, EDF is updating its case with a view to submitting it to ASN in 2008.

In December 2006, Expert Advisory Groups for plants and waste issued their opinion of the CEA's strategy for the dismantling of its civilian facilities. The strategy was deemed satisfactory in general from the safety standpoint. The dismantling schedule for the facilities involved is consistent with the selected strategy. ASN feels that they should help ensuring an acceptable safety level for those facilities until their declassification. The documents describing the CEA's dismantling strategy will be updated and re-assessed every five years.

The former UP2-400 reprocessing plant and its associated workshops (INB Nos. 33, 38, 47 and 80), have been shut down since the beginning of 2004 and are intended for dismantling. In 2008, AREVA NC will submit its dismantling strategy for those facilities. The case will be examined in parallel with the review of the applications for the final shutdown and dismantling of the UP2-400 Plant. The scope of future operations requires the strictest attention from ASN. More specifically, ASN has requested AREVA NC to provide a better description of the final expected state of the UP2-400 Plant and of its associated workshops, notably with regard to cleanup levels involved, the management procedure for the waste resulting from the civil-engineering cleanup operations and the potential reuse of buildings or workshops.

F.6.3.1 Internal authorisations

ASN may dispense any operator with complying with the declaration procedure prescribed by Article 26 of *Decree No. 2007-1557* for minor operations in terms of safety, provided that the operator set in place an internal control mechanism with sufficient quality, autonomy and transparency guarantees.

That possibility was applied first by the CEA. EDF followed suit with its facilities intended for dismantling (ASN licence issued in February 2004). It has now been integrated in the *Decree No. 2007-1557*.

ASN controls the operator's mechanism for internal authorisations with the understanding that ASN 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.6.3.2 EDF facilities undergoing dismantling

The dismantling decree for the EL4 reactor at the Monts-d'Arrée NPP was cancelled by the State Court following a claim by an association and dismantling activities are currently stopped. As for ASN, it indicated in its *Decision of 8 October 2007* which regulatory framework is to be applied, pending a new decree to authorise the final shutdown and full dismantling of the NPP.

The implementation of the UNGG-reactor dismantling programme relies on the availability of adequate elimination channels for the associated waste. ASN ensures indeed that no dismantling operation is conducted if the responsible operator has failed to propose a sustainable management solution for his waste. In that perspective, the availability of a storage facility for activated waste and of a disposal facility for irradiated graphite is the main prerequisite for opening any reactor vessel and extracting the graphite it contains. Nevertheless, ASN is very vigilant regarding the dismantling schedule and has asked EDF to assume its responsibility as a waste producer and to work in close connection with Andra, in order to find a suitable solution for conditioning graphite waste to be used in the future graphite waste-disposal facility.

The dismantling-licence applications for UNGG reactors are being reviewed. Public enquiries have taken place concerning Chinon A3, Saint-Laurent-des-Eaux A1 and A2 and their conclusions were favourable. Applications are still under review at ASN prior to drafting the necessary decrees.

With regard to the SUPERPHÉNIX reactor, the dismantling authorisation was issued in March 2006, once ASN had reviewed the corresponding application.

F.6.3.3 CEA facilities undergoing dismantling

Regarding the Fontenay-aux-Roses site, ASN considers that INB cleanup operations implemented to date have, overall, been carried out satisfactorily. Prior to administrative decommissioning of the INBs on the site, ASN will be called upon to declare its assessment of the overall radiological condition of the site for which the operator has initiated a major study to identify any traces of radiological activity resulting from past experimental programmes and soil rehabilitation.

Regarding the Grenoble Site, ASN considers that the cleanup and dismantling operations for facilities at the Grenoble site are going ahead properly, and that the dismantling worksites are well managed. The SILOETTE reactor (100 kWth), mainly used for training personnel, was decommissioned following approval of analysis results and of the detailed report on operations and the final site assessment and after the operator, together with State representatives, had signed a deed granting easement to the State, encumbering the land located within the perimeter of the INB. The easement deed requires that, in the event of the land being sold, the buyer be informed that an INB once stood on the land. ASN's *Decision of 10 July 2007* was approved by the *Order of 1 August 2007*. The facility has therefore been withdrawn from the list of INBs.

Regarding the Cadarache Site, ASN considers that the cleanup and dismantling operations for facilities at the Cadarache Site are going ahead satisfactorily. The example of dismantling the HARMONIE reactor, scheduled for decommissioning in 2008, once again demonstrates the feasibility of complete dismantling. ASN has nonetheless drawn the operator's attention to the issue of management of waste generated in the future by the dismantling of certain facilities, in particular the RAPSODIE reactor (sodium waste). ASN is not in favour of the prolonged storage of such waste in INBs undergoing dismantling and the CEA must therefore either use dedicated storage facilities at these sites pending treatment or design and develop the facilities required for treating this waste.

Taking human and organisational factors into account is one of ASN's major concerns and this concern is demonstrated in the example of the final shutdown of the Plutonium Technology Workshop (*Atelier de technologie du plutonium*). In 2007, following the incident that occurred in November 2006 (a grinding mill was overloaded, exceeding the maximum weight of nuclear material allowed) and was classified as a Level-2 incident on the INES Scale, AREVA NC is deploying an extensive action plan aimed at integrating organisational and human factors more effectively. ASN, which is monitoring the actions undertaken within this framework by the operator very closely, considers that it will be possible to draw up a full review in the course of 2008. Nonetheless, based on initial results, it may be concluded that the company has made significant progress, enabling it to respond formally to the malfunctions observed. Expected improvements in the company's safety culture need to be assessed over the longer-term.

F.6.3.4 Dismantling operations under way on the La Hague Site

At the end of 2003, AREVA NC announced its decision to stop treating spent fuel in the UP2-400 plant. That announcement was accompanied by a file described the planned activities during the preparatory phase for final shutdown. Those activities are under way. The UP2-400 plant and its associated buildings were discussed in § F.6.3.

In addition to the facilities operated by COGEMA and AREVA NC at La Hague since 1976, two other buildings were also operated by the CEA: AT1 and ELAN IIB. Now under the supervision of AREVA NC, both buildings will be integrated in the licence applications to dismantle the old treatment plant.

F.6.3.5 Other dismantling activities

As regards the Strasbourg University reactor, ASN feels that work is progressing satisfactorily.

With respect to the Veurey-Voroize Plant of *Société industrielle de combustible nucléaire* (SICN), ASN feels that, in spite of inherent technical contingencies to dismantling worksites, operations are progressing satisfactorily according to a methodology it approved.

In the case of AREVA NC's storage facility at Miramas, ASN decommissioned the facility by the *Decision of 20 April 2007* and ratified by the Ministers in charge of nuclear safety through the *Ministerial Order of 1 August 2007*.

F.6.4 ICPEs and mines

F.6.4.1 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 shall 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 shall be given at least six months before the expiry date of the licence.

For facilities subject to a declaration, the notice shall indicate the nature of site-cleanup steps been taken or planned.

For licensed facilities, the operator shall 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;
- as 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 hazard or inconvenience for the neighbourhood or the environment. If the cleanup work has not been included in the licensing 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 the 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 the Prefect to issue a supplementary order setting the requirements for site cleanup.

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 licensing has been operated on the land, but also of any residual pollution problems on the site.

F.6.4.2 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 its obligations.

However, even if acknowledging formally the declaration for the final cessation of work and validating the claim waiver mean that the operator is no longer subject to the jurisdiction of the special mine police, the third-party liability of operators and claim holders remains permanent. 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 all former parameters prescribed during the operating lifetime. If monitoring does not detect disturbances, subsequent orders may lift any or all monitoring requirements. Since ICPEs represent the prevailing source of radioactive-pollution hazards, mine-police orders merely accompany related ICPE orders, given the interconnection of certain facilities, including water-treatment stations.

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, except for the CSTFA, any spent-fuel management facility constitutes an INB or part of an INB. In that respect, the various fuel-management facilities are subject to the general safety provisions in force, 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, removal of residual heat, the protection of individuals, chemical and biological hazards and the 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 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, 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 licence decrees for the creation of new facilities, orders licensing liquid and gaseous-effluent discharges and water intake, as well as technical prescriptions 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 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 through inspections.

G.1.2 Safety policies of INB operators

G.1.2.1 CEA's and ILL's safety policy

The CEA's safety policy requires that safety be controlled in facilities. 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 personnel and the environment.

Nuclear safety is one of the CEA's top priorities and must be reflected in sound decision-making processes and actions that remain in line with it. That approach constitutes the basis of "safety culture". The CEA's nuclear-safety structure is based 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, skills and responsibilities in the area of 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 a licence-application file (*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 for consultation purposes regarding the specific needs of the operation at stake.

As far as the ILL is concerned, the smooth running of activities requires total control of safety, which involves preventing the dispersal of radioactive materials and minimising 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, as well as the second and third containment barriers within the reactor building, are able to withstand an earthquake.

G.1.2.2 AREVA's safety policy

Before the commissioning of any facility, AREVA submits a file that includes: the impact study, the preliminary safety analysis report, the risk-management study and the dismantling plan containing the methodological principles and the planned dismantling stages, as well as contemplated steps for the site's remediation and further monitoring. The file covers all facilities and equipment, whether in service or planned, which, due to their proximity or connection to the facility for which a licence is requested, are of a nature to modify its hazards or inconveniences.

The preliminary safety report describes:

- the types of accidents that may occur, whether their cause is internal or external, including any malicious act;
- the nature and extent of effects resulting from a potential accident, and
- the steps being planned to prevent accidents or to limit the probability or the effects thereof.

With due account of current knowledge and practices and of the vulnerability of the plant's surroundings, the report demonstrates that the project may attain a risk level consistent with the ALARA principle.

The safety analysis report, the facility's general safety programme (*Programme général de sûreté de l'établissement* – PGSE), the general operating rules (*règles générales d'exploitation* – RGE) and the On-site Emergency Plan all define the operating envelope of the facility on the basis of the safety analyses being conducted. They cover the actual operation, as well as maintenance, monitoring and periodic testing, and constitute the operational reference system. No change may be brought to those documents without ASN's prior authorisation, after reviewing the technical file submitted by the operator and containing the updated safety analyses. Those safety analyses are reviewed on a regular basis in order to account for experience feedback and may result in updating operating documents in order to incorporate:

- the changes made to the facilities since the previous update. Major changes were approved by ASN prior to implementation, based on the submission of a technical file;
- anomalies or incidents that occurred in the facility since the previous update and which have led to preventive changes to the facilities or change in their operation, and
- possible improvements in knowledge, whether arising from independent work (i.e., improved seismic or metallurgical data) or from anomalies detected in other INBs.

Hence, the periodic safety review is somehow permanent.

G.1.2.3 EDF's safety policy

The responsibility of nuclear operator within the EDF Group is divided into four main levels: the Chairman; the Senior Executive Vice-President for Production and Engineering; the Director of the Nuclear Power Generation Division (*Division de la production nucléaire* – DPN), who is responsible for the operation of the entire French NPP fleet, and individual NPP managers. In the specific case of an INB currently being dismantled on an isolated site, EDF, as the nuclear operator, is represented by the Director of the DIN, who reports to the Senior Executive Vice-President 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 priorities and concerns (the latest version of the policy was published in 2000), and
- an operational safety management system, the general principles of which were defined in 1997, 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.

The information provided and reviewed so far provide useful clarifications on the operation of the fuel cycle and on safety challenges, further completed particularly by technical and regulatory limits that changes in fuel-management procedures may modify at some point in time, subject to appropriate justifications. In order to maintain an overall view of the fuel cycle, ASN considers that the case must be updated periodically.

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 spread to 15 years). It should also include any major planned changes and, where appropriate, the provisional end-of-life date of the facility.

The primary objective of the safety reassessment is to assess safety at the facility and to identify any variation in the baseline safety documentation in force and with current safety and radiation-protection regulations and practices.

The process requires first that the CEA define its strategy regarding the facility in terms of describing the functions and purposes of the facility's future operating life, together with their perennity.

The second objective is to adopt 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 subject to safety analysis. The conclusions of the reassessment are presented to ASN, which provides its opinion, prior to undertaking any changes and demonstrating that the upgraded facility is safe. 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

Safety analyses are reconsidered to integrate experience feedback and to update operating documents with regard to:

- the changes to facilities since the last update: important changes were approved by ASN prior to implementation, based on the presentation of a technical file, and the update consists in consolidating that file into the safety analysis report;
- anomalies or incidents in the facility since the last update, which may have led to preventive changes to the facilities or their operation, and
- potential knowledge improvements, whether arising from independent work (i.e., improved seismic or metallurgical data) or from anomalies detected in other INBs.

G.2.2.3 EDF's safety review

G.2.2.3.1 EDF's safety revision process of existing facilities

EDF conducts safety reviews on a regular basis on each plant series. For reactors, the review process, which includes a compliance check on each unit in relation to its standard state and in accordance with safety requirements, is implemented in conjunction with the decennial inspections of the specified nuclear steam-supply 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 each unit with the standard 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 pools and to spent-fuel storage and disposal operations

The safety review encompasses the safety the fuel building and spent-fuel cooling pool (seismic resistance, cooling capacity and limitations, monitoring, incidental operating procedures).

Among thematic reviews should be mentioned the technical review initiated by EDF on criticality-hazard control, following the Tokai-Mura incident in 1999.

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.

The resulting rules constitute the "Shipment Reference Framework" and involves the following:

- the responsibility of the shipper, particularly for the quality of checks and shipment documents;
- qualification of the conveyors used by EDF;
- the declaration, analysis and experience feedback from shipment incidents in case of deviations, and
- the creation of local and national shipment-security advisers, in accordance with the regulations.

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 reexamined approximately every 10 years.

Depending on the conclusions of the periodic review, ASN may authorise 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.

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, is 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.

No distinction is made between the fact that the fuel has been examined before or after irradiation.

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.

After such 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

Licenses 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 authorised by ASN.

The documents constituting the safety reference systems are completed by a set of procedures and operating methods drawn up by the operators with a view to ensuring that all operating procedures performed at the facility are consistent with the safety reference systems and their scope.

Any incident occurring at a CEA facility must be notified to ASN in real time. All incidents are analysed to identify the root causes and to define any corrective and preventive action to be taken to avoid any recurrence. An incident report must be prepared and sent to ASN within two months.

In 1999, the CEA set up a Central Experience Database (*Fichier central de l'expérience*), which provides all parties concerned with information on incidents as well as an incident analysis guide, designed to harmonise the drafting of incident reports, to improve their evaluation and to codify results.

By drawing on these 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.

Significant safety-related incidents are declared to ASN and other national authorities within 24 hours. An incident report, which must include an initial analysis, must be filed with ASN within two months. If further time is needed for the analysis, the additional analysis is submitted later.

Decommissioning 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 decommissioning 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 decommissioning, practices are described in § F.6.

G.6.3 ASN analysis

Through its analytical, inspection and penalty system, 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.

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 fourth-generation reactors are commissioned.

As a precaution, however, Andra and the CEA, as stakeholders in the management of HL-IL/LL waste, have investigated the feasibility of a long-term storage facility and of a direct disposal facility for spent fuel, 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 underground research laboratory located in 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.

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 for INBs

In accordance with Article 11 of the *Joint Convention,* INB Regulations prescribe that appropriate steps be taken in order 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 permitted for the current generation.

According to the regulatory system (legislation, *Order of 31 December 1999*), reducing volumes and radiological toxicity is a key objective.

The *Order of 31 December 1999* and RFSes require that all aspects regarding criticality and heat discharges be taken into account.

Biological risks must also be taken into account by hospitals and all establishments involved in biological or academic research.

All risks associated with toxic chemicals must be taken into account in safety reports and in all studies dealing with disposal projects.

The CSTFA constitutes an ICPE and is subject to a licensing procedure for its creation, which involved an environmental impact assessment and a risk study in accordance with Articles 2 and 3 of *Decree No. 77-1133 of 21 September 1977*.

H.1.2 Steps taken by ING 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 of waste-management activities in INBs.

Waste is collected selectively, either directly during normal operations or by personnel 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 is 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 surveys” conduced by AREVA and EDF were completed in 2002 and submitted to ASN’s approval.

On the basis of that reference system, each operator must prepare an annual waste-management report according to a specified format described in ASN specifications and send it to ASN and to the competent territorial DRIRE. All information contained in that report must be accessible to the public, unless protected by trade or defence secret.

For each of its establishments, the CEA produces annual reports on the steps that were taken with regard to safety and radiation protection, incidents, measured discharges in the environment, stored waste in INBs. In 2007, the CEA published an assessment report on the costs for dismantling and cleaning up its establishments, including the management of its historical waste, AREVA NC and EDF proceed similarly.

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 is 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 5 shows the evolution of deliveries of LIL-SL packages since 1969.

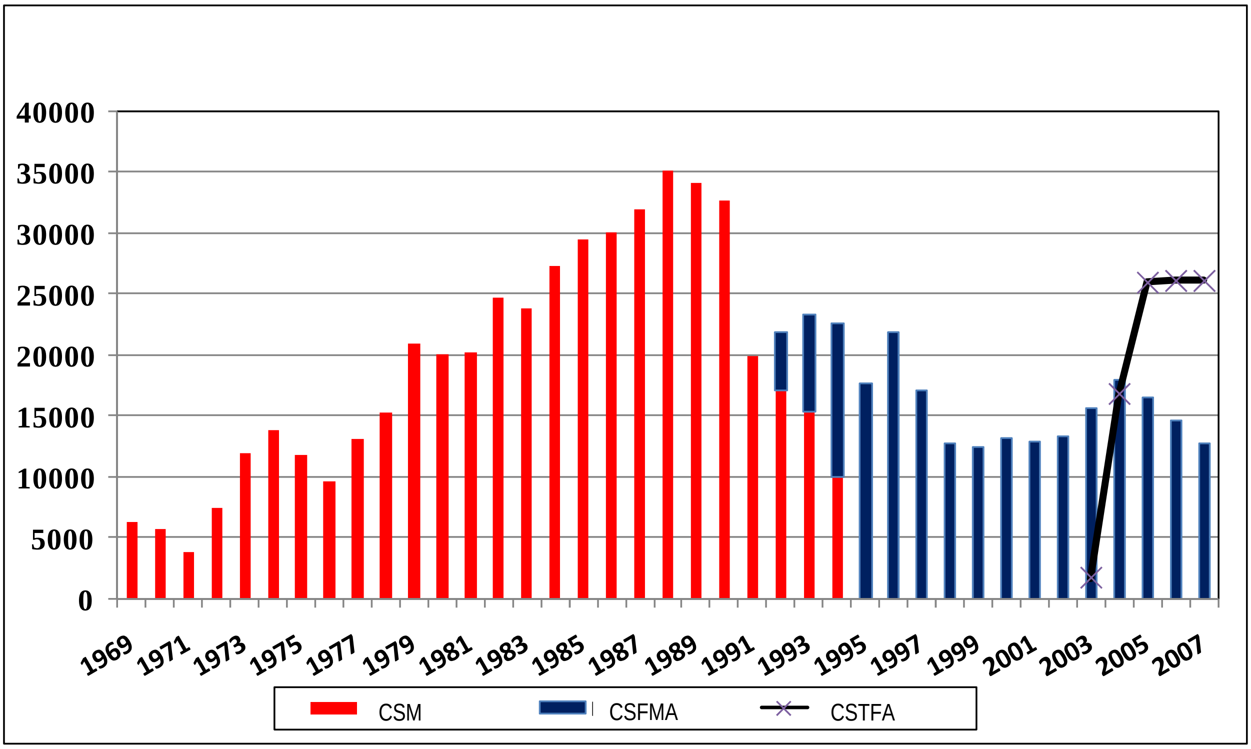

Figure 5 : Delivered waste volumes at Andra disposal facilities (in cubic metres)

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 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.

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.

A circular issued by the Minister of Health on 9 July 2001 specifies the steps to be taken into account 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. Discussions are under way to develop general requirements concerning the sound management of radioactive waste resulting from those activities (see § B.6.2.3)

H.1.4 ASN analysis for INBs

French regulations take into account the obligations specified in Articles 11 to 17 of the Joint Convention. The policy and strategy of each major producer with regard to the management of his radioactive waste is the subject of a comprehensive review and includes generally the technical support of the IRSN and of the Expert Advisory Group.

H.1.4.1 EDF

EDF's policy regarding fuel management may have some impact not only on fuel-cycle facilities, but also on waste quantities and characteristics. The topic has already been addressed by GPEs on reactors, fuel-cycle facilities and waste in late 2001 and early 2002. Following ASN's request for an update of the safety case, the updated case was submitted at the end of 2007 and is now being reviewed by ASN.

In addition, EDF's waste-management policy, both at corporate level and on NPP sites and in the case of both operational and historical waste, has been examined at a meeting of the GPEs on reactors and waste in 2002. Following that review and reports by ASN's INB Inspectors, ASN has raised new issues with EDF.

In 2004, EDF provided clarifications on its waste-management structure. It also conducted and submitted to ASN various safety analyses on waste management and on buildings involved in the treatment of waste and radioactive discharges.

Furthermore, EDF applied in 2005 to create a centralised interim storage for activated waste (ICEDA). The project was submitted to a public enquiry in summer 2006. The review of the case continued in 2007 and further information was requested from EDF. Lastly, regarding the interim storage of Saint-Laurent-des-Eaux graphite sleeves, ASN requested EDF to improve the safety of the interim-storage sites on site pending the creation of a suitable disposal facility.

H.1.4.2 CEA

CEA's waste-management methodology for its civilian waste and its spent fuel was examined in 1999 at a meeting between the Laboratories and Plants GPE and the Waste Management GPE. In light of recent developments and in terms of organisation (dismantling of the UP1 Plant at Marcoule and abandonment of certain projects), ASN intends to reassess all CEA activities regarding its INB and INBS waste and spent fuel. In liaison with the DSND, ASN has requested the CEA to submit by 2008 a report on its management policy and strategy. In 2009, once the report has been reviewed by the relevant GPEs and the control authorities for INBSes, ASN and the DSND will make a joint statement regarding the CEA's waste and spent-fuel management methodology.

H.1.4.3 AREVA NC

The policies and strategies for managing the waste generated at La Hague were reviewed during a joint meeting of the Laboratories and Plants GPE and Waste GPE, in late 2005. Overall, the current methods used at La Hague plant appear sufficient to ensure the processing, packaging and storage of the waste associated with all operations to be carried out at that facility over the next few years (fuel treatment, recovery and packaging of historical waste and the programmes relating to the preparation stage for the final shutdown of UP2-400). However, ASN monitors closely the adherence to deadlines for the recovery and packaging of historical waste on the basis of the age of the waste-storage facilities.

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.

In 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.

H.2.2 Steps taken by INBs

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 the 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.

The historical-waste recovery programme involves, firstly, the “denuclearisation” of the Fontenay-aux-Roses and Grenoble Sites (see § F.6.2.1) and, secondly, the cleanup of old facilities at Cadarache, Saclay and, more recently, Marcoule. Once the waste has been sorted, the aim is to transfer it to Andra’s CSFMA or CSTFA, or to the CEDRA storage facility at Cadarache. All those operations, especially those regarding the Marcoule Site, will last until 2030.

H.2.2.3 Steps taken by AREVA: recovery of La Hague's historical waste

Contrary to the new UP2-800 and UP3-A plants, some operating waste from the UP2-400 plant was stored pending final packaging.

AREVA has set up a Project on Allocated Tools for the Design of Distributed Applications (*Outils répartis pour la conception d'applications distribuées* – ORCADE), the purpose of which is to ensure successful recovery and packaging of historical waste present at La Hague. The project is part of the operations of the Nuclear Site Value Development Business Unit that performs, on behalf of AREVA, all dismantling and nuclear cleanup operations at the back-end of the cycle (SICN Veurey, AREVA NC La Hague, CEA Marcoule and CEA Cadarache).

Some facilities, which are already in service, will be able to handle most of the waste from UP 2-400.

Today, practically all fission products are vitrified. R&D initiatives has been conducted on the treatment of the sludges from the STE2 Workshop, particularly to determine suitable recovery and transfer procedures.

AREVA plans to compact in the ACC Building the hulls and end-pieces contained in the HAO silo and in the S1, S2 and S3 pools. The initial step consists in charactering the hulls and end-pieces involved for subsequent waste recovery, sorting and transfer to the packaging units.

AREVA is currently developing a mechanical system to recover the waste from Silos 115 and 130 and is working on characterising it. After the study phase, recovery operations should begin around 2010.

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
- Andra's CSTFA in 2003.

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.

A certain number of ongoing actions are in place:

- 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/LL, 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
- the search for specific waste-removal systems: neon tubes, lead, asbestos waste, electronic waste, etc.

H.2.2.4.2 Waste conditioning and disposal on EDF dismantling sites

Dismantling waste from EDF's nine shut-down reactors is managed the same way as the operating waste from NPPs in service. They are characterised, sorted and packaged, before being transported to compatible storage facilities with their nature.

According to current studies, the ongoing deconstruction of 10 INBs, including eight first-generation reactors, the Creys-Malville SUPERPHÉNIX reactor and the Saint-Laurent-des-Eaux graphite-sleeve storage facility 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, most of which consists of concrete and cleaned-up rubble to be used to fill holes left by the destroyed facilities on the site, and
- 175,000 t of mostly SL radioactive waste (18%), destined 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 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 at the Bugey NPP, Ain *département*, before transferring the waste to Andra's deep geological repository by the *2006 Planning Act,* when available, and
- LL-LL radioactive waste from UNGG reactors (around 18,500 t), for which the *2006 Planning Act* provides for the commissioning of a waste repository, on which the successful completion of UNGG-reactor dismantling operations depends.

In addition, 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 the sodium hydroxide in concrete blocks. Those VLL radioactive concrete blocks will then be stored on the site for about 30 years, during which their radioactivity level will decrease close to that of natural radioactivity.

By creating the specific CIDEN Facility, EDF has made sure it has the expertise to define and to operate the various packaging and removing systems for the different residual waste categories resulting from reactors-dismantling operations.

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 creation of treatment and conditioning facilities, which comply with the current safety criteria for facilities and conditioning, including new or renovated facilities, such as the CEA's effluent-processing stations;
- waste recovery by implementing specific treatment equipment or facilities, as in La Hague (sludges from the STE 2 treatment station, hulls and ends from the HAO Silo, waste from Silos 115 and 130 and alpha waste from Building 119) and in Cadarache (equipment for the treatment of historical waste contained in the "trenches" and pits of INB No. 56 Storage Park), and
- the deployment of storage facilities designed for a lifetime compatible with the implementation of final solutions once investigations on the management of HL-IL/LL waste will be completed.

Among historical waste, ASN is particularly interested in residues for which there is currently no suitable disposal system. Those residues include notably the following types of waste, the future of which is taken into account in the *2006 Planning Act* and in the PNGMDR:

- tritiated waste (i.e., 2,000 m^3), mostly located at Valduc and Marcoule: due to their tritium content, those residues are difficult to contain within waste packages. Although Andra has agreed in principle to accept a few of those packages, the conclusions of the studies conducted by the CEA discard the possibility to accept the entire inventory of tritiated waste, which, according to Andra's estimates, would otherwise induce tritium markings in the environment of the CSFMA. For the time being, the only management system is limited to storing residues in dedicated facilities, pending the radioactive decay of their content. The *2006 Planning Act* prescribes that storage solutions be thoroughly established by 2008 with regard to safety orientations, as well as the design, implementation and operation steps for the storage facility, and
- graphite waste is unsuitable for disposal at the CSFMA. For that specific waste category, Andra is currently investigating one or several appropriate disposal concepts. The *2006 Planning Act* calls for the commissioning of a disposal facility for graphite (and radium-bearing) waste by 2013, but according to 2008 forecasts, the project is not expected to be completed until 2019.

Pending waste recovery, ASN ensures that facilities are monitored satisfactorily and adequate corrective steps are taken to meet current safety criteria. In the more problematic cases, it may be necessary to find an alternative facility.

ASN believes that one of the CEA's challenges in radioactive-waste management is the implementation of new processing facilities for which the deadline is compatible with existing commitments with regard to the shutdown of older facilities where safety standards are not consistent with current requirements.

Certain projects have advanced regularly in accordance with existing commitments (AGATE, STELLA, PÉGASE). However, the CEA encountered problems in the recovery of historical waste, such as those located in trenches at Cadarache, and in the evacuation of liquid organic waste from the effluent and waste treatment station, also located at Cadarache.

A significant issue for EDF with regard to historical waste is the storage of graphite sleeves from the graphite-moderated gas-cooled reactor system. With due account of the required time to build and commission a graphite-waste disposal facility and of the fact that storage silos are now inconsistent with current safety criteria, ASN has requested EDF to take all appropriate steps to face the situation. EDF has proposed to implement a containment barrier around the silos and that proposal is being reviewed.

In the case of AREVA NC, the following two issues are worth mentioning as examples:

- currently, sludges from the STE 2 effluent-treatment station are bitumised at the AREVA NC STE 3 Plant. However, all licences until now have concerned only a limited number of drums for the development of the bitumisation process. In addition, ASN has requested AREVA to pursue actively its investigations concerning an alternate process to bitumisation, and
- AREVA NC has proposed to develop a compaction process and to implement a disposal facility for the alpha waste currently stored in Building No. 119 and the waste of the MELOX Plant. That strategy calls for the use of the disposal cells located in the STE 3 Disposal Facility for that type of drums, pending the opening of the new facility. Since 2006, a working group whose membership includes representatives from AREVA, Andra, ASN and the IRSN has been created in order to examine the characteristics of packages that would be produced by the newly-proposed process. AREVA has put forward sound arguments that lead to conclude that hydrogen discharges, which constituted the last redhibitory parameter for a deep geological waste repository, amounted to lower values than Andra requirements. The same model will be applied to hydrochloric-acid (HCl) discharges, although its value clearly is less than the quantity likely to alter the robustness of the package.

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 in the 40s to the 60s 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 to accommodate contaminated soil.

In certain specific cases where there is no responsible party, special mechanisms have been set in place in order to ensure 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 in the case of disposal facilities, RFS I-2 is the basic safety rule for surface disposal facilities for LIL-SL waste and for deep geological repositories, whereas the *Safety Guide for Deep Geological Repositories* (superseding RFS III-2-f), specify qualitative criteria for selecting such sites. For LL-LL waste, ASN should publish in 2008 a general orientation safety notice for the selection of disposal sites for those residues, including elements on the characteristics of the geological formation in which the repository will be implemented. The orientation notice may become a safety guide in the years ahead.

All issues relating to the proposed site are examined during the preliminary opinion request preceding the INB-creation licensing procedure and during the licensing application itself.

The *2006 Planning Act* prescribes a certain number of specific requirements for the creation-licence application for a deep geological repository (Article 12), one of which requires that such application must concern a given geological formation, which has been investigated through an underground laboratory.

According to the *1991 Law* (consolidated later in the *Environmental Code*), any underground-laboratory project must be the subject of a consultation mission with elected officials and populations involved as set by decree. The law also states that the construction and operation licence of an underground laboratory must also be issued on the basis of a technical report prepared by Andra after holding a public inquiry and receiving the views of the different stakeholders. In practice, Andra submitted in 1996 three reports corresponding to three different sites. Only the East Laboratory, located in Bure, was licensed in 1999.

On each site of a disposal facility or of an underground laboratory a CLI must be created, the membership of which must include State representatives, elected officials and association members.

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 responsible for the R&D Programme for the implementation of the deep geological repository to be commissioned in 2025. The Programme follows 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 250-km² transposition zone around the Laboratory. Investigations and studies also help to define a "transposition zone" where the properties of the clay rock appear to be similar to those located perpendicularly to the underground laboratory. The transposition zone covers an area of about 250 km² to the north and west of the Laboratory.

The current goal is to continue the research and engineering programmes in accordance with the objectives prescribed by the *2006 Planning Act* and *Decree No. 2008-357*. The new research phase, led by Andra in consultation with other research establishments, focuses primarily on narrowing down the potential location of a deep geological repository within t he transposition zone mentioned above. It also involves the pursuit of investigations in the MHM-URL. In the field of engineering and repository architecture, the programme also addresses the technical design options described in the 2005 Clay Report and on certain changes brought to them, while characterising and comparing them with regard to the following aspects:

- technical reliability;
- operational safety;
- reversibility;
- cost, and
- long-term safety (simulations).

Those activities should provide an optimised definition of facilities and of the operation of the repository, a more detailed and more precise estimate of its cost and an assessment of its safety throughout the different lifetime phases of the repository.

According to *Decree No. 2008-357,* Andra shall:

- no later than 31 December 2009, propose to the Ministers for Energy, Research and the Environment:
    - a suitable interest zone, within the above-mentioned transposition zone, for comprehensive surveys to be carried out for the implementation of a deep geological repository and for extensive prospecting techniques to be implemented;
    - various options regarding design, operational and long-term safety, as well as reversibility;
    - a waste-inventory model to be taken into consideration, and
    - storage solutions as complementary options to disposal;
- no later than 31 December 2012, submit to the Ministers for Energy, Research and the Environment, a report in support of the public debate prescribed by the *2006 Planning Act* and containing a proposal for the implementation of the deep geological repository, and
- no later than 31 December 2014, the licence application for the creation of the deep geological repository, pursuant to the *2006 Planning Act* (transposed in Article L542-10-1 of the *Environmental Code*).

In addition, Andra is also responsible of the disposal project for LL-LL waste for which no management system exists so far. Those residues include graphite waste consisting of stacks and sleeves resulting from old graphite-moderated gas-cooled [UNGG] reactors 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 towards 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. Applications will be reviewed with a view to selecting two or three zones, if possible, in which Andra would be able to carry out comprehensive geological surveys in 2009 and 2010. That *in-situ* investigation phase will be complemented by exchanges with local elected officials and the populations involved.

The selected technical solution for graphite waste is a disposal facility under a shallow intact cover of a clay formation at a depth ranging from 15 to 200 m. In the case of radium-bearing waste, Andra is studying two solutions : first, together with graphite waste under an intact cover, and second, under a reworked cover made of excavated clay. Andra must also study the possibility to include in the radium-bearing waste disposal facility various items containing radium, uranium and thorium with low specific activity and disused LL-LL spent sources, such as fire detectors and lightning-conductor sources. In addition, Andra will study the possibility to use the facility for disposing of low-level bitumen waste that are currently stored at Marcoule.

The ultimate goal is to select a suitable site by the end of 2010, to submit the creation-licence application by the end of 2013 and to commission the facility in 2019.

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, as in the case of the STELLA Facility, the CEA's new liquid effluent treatment facility at Saclay, in 2004.

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, including an extensive public information campaign encompassing the neighbouring towns and CLI meetings. The creation-licence decree is expected in 2008

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 licensing, any licence 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 planned measures of the applicant to eliminate, restrict and, if possible, 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 file, must be made public and submitted to the populations concerned by the project within 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 the steps being 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. For the application of the creation-licence decree, ASN may issue technical prescriptions concerning the design, construction or operation of the planned facility (see Article 18 of *Decree No. 2007-1557*).

There are no specific technical requirements concerning materials and technologies, except for the relevant objectives and constraints referred to in the RFSes. However, the safety report must demonstrate that the materials and technologies used for sizing and constructing the facilities rely on experience, testing and analysis.

With regard to INB dismantling, a 1973 circular required that technical modalities be described in a specific chapter of the safety report submitted in support of the licence application for the creation of the facility. That chapter, which used to be brief in the past, will be more detailed for new INBs in the future. Such is the case of EDF's ICEDA Project to be built at Bugey, Ain *département*.

In order to facilitate dismantling operations and to limit waste production, special attention must be given to the following items:

- the choice of materials;
- constructive steps to facilitate dismantling activities (easy access to unbolting, handling and miscellaneous equipment) and the removal of contaminated equipment and structures. Constructive steps include also technical measures to ensure the stability of structures during dismantling;
- steps relating to circuits in order to prevent active deposits, to limit the contamination range, to facilitate the decontamination of premises as well as to shut down power in buildings, and
- the collection and archiving of necessary documents and data.

According to the *TSN Act*, the operator is required to demonstrate, as early as his creation-licence application, that his proposed general dismantling principles are able to prevent or limit any potential risk or inconvenience 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 limit such risk or inconvenience. *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 period between the final decommissioning 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.

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, which are INBs. Their description with regard the safety assessment is presented in § E.2.2.3.1 and E.2.2.4, while their general principles are summarised below.

The preliminary safety report submitted by the operator in support of his creation-licence application, must include a risk inventory of all origins, the steps taken to prevent those risks and a description of suitable steps to limit the probability of accidents and their effects. Hence, a systematic safety and environmental-impact assessments must be carried out before the construction of any radioactive-waste management facility and must address its lifetime phases. The licence is delivered by decree after consultation with ASN and all organisations involved and after holding a public inquiry. Technical requirements relating to the construction or operation of an INB are issued by ASN as need be.

Once the facility is built, the operator must submit the following information to ASN before being authorised to commission the facility:

- the safety report including the update of the preliminary safety report and sufficient information to assess the compliance of the completed facility with the conditions of the creation-licence decree and the prescriptions relating to design and construction;
- general operating rules that the operator plans to implement;
- a study on the management of the facility's waste;
- the internal emergency plan, and
- except for radioactive-waste disposal facilities, an update, if need be, of the dismantling plan.

ASN and its technical support must review the case and, if the conclusions of that review are favourable, ASN licences the commissioning of the facility. In its decision, ASN sets the deadline at the end of which the operator must submit an end-of-commissioning report for the facility, including the following items:

- a summary report on the commissioning tests of the facility;
- a report of acquired feedback experience, and
- an update of the above-mentioned documents with regard to commissioning.

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 warrants it.

In the case of surface disposal facilities, waste containment relies on a three-barrier system; the package, the structure and its cover, as well as the geological formation.

The safety demonstration comprises the three following parts:

- the safety demonstration for the operational phase (estimated at 50 years for the CSFMA);
- the safety demonstration for the monitoring phase (assumed to be 300 years for the CSFMA), and
- the safety demonstration for the post-closure monitoring phase.

Transfer modes under review include airborne transfers (during the operational and post-monitoring phases) and water-borne transfers (during the monitoring and post-monitoring phases).

As mentioned in § D.3.3.2, the *Public Health Code* specifies that any impact due to the overall nuclear activities (except medical uses) on the public must not induce a higher dose than 1 mSv/a. In that context, Andra allows a maximum impact value of 0.25 mSv/a under normal conditions during the operation of the facility and after its closure. For all hypothetical situations (altered scenarios); the value of 0.25 mSv/a remains a reference, but it may be exceeded. The criteria to decide whether the calculated impact is acceptable or not rest on the exposure mode and time, and on the conservative calculation hypotheses being used.

The safety report must also address toxic chemicals (see § D.3.3.2).

During the review of the CSFMA's safety activities in 2006, the following items were reviewed carefully:

- the update of the radiological inventory;
- safety-related items and associated equipment;
- experience feedback acquired from the facility over 10 years, including on packages with certain specificities (irradiating packages, bulky packages);
- consequences associated with complexing agents;
- waste-acceptance specifications (issued by Andra), and
- reflections and studies carried out by Andra concerning the future cover of the facility.

ASN has issued a favourable opinion concerning the continuation of disposal activities in the non-operational area and formulated a certain number of questions to the operator.

With regard to deep geological disposal, the dose must not exceed 0.25 mSv/a for extended exposures associated with actual or very likely events and for a minimum stability period of the geological barrier for 10,000 years. Beyond that period, the value of 0.25 mSv is considered as a reference value to assess whether the safety study is acceptable or not.

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.

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 "passive-safety" phase. The design of the disposal structures and the specifications applicable to waste packages take into account the long-term passive-safety imperative. 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

Radioactive waste management facilities are not subject to any specific regulations. Their impact and safety are assessed prior to the delivery of their creation and commissioning licences (see § E.2.2). In the case of disposal facilities, the long-term safety of the facility forms an integral part of the safety demonstration made as early as the design stage and the licensing of the facility.

H.5.4 ICPEs and mine tailings

Assessing the design choices made by the operator 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 was 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 requirements

As 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.2.2.7.2.1).

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 re-assessment, all experience feedback on incidents that occurred over the last decade in France and abroad must be assessed in order to propose potential safety improvements.

Criteria for declaring events in INBs

The following criteria apply for declaring events occurring in INBs:

- nuclear or non-nuclear events causing death or serious injury and requiring the hospitalisation of the injured person(s), when the origin of the injuries is directly related to the safety of the facility (e.g., in case of fall, worksite and traffic accident);
- activation of a safeguard system: manual or automatic, unintentional or intentional activation of a safeguard system, except intentional activation resulting from scheduled actions;
- events leading to:
  - exceeding of one or more security limits prescribed by the safety reference system or the creation-licence decree of the facility, or

  - a common mode failure on safety-related systems;
- internal or external aggression in the facilities: occurrence of an external phenomenon of natural origin or associated with human activity, or internal flooding, fire or other phenomenon likely to have significant consequences or to affect the availability of safety-related equipment;
- actual or attempted malicious act likely to affect the safety of the facility;
- events disabling all barriers placed between the hazardous substances and persons, and leading to the dispersal of those substances. That situation concerns incidents, other than deliberate actions that induce or may have induced significant radioactive discharges or personal exposures to serious consequences inside or outside the facility, in relation to regulatory limits;
- events that, although not affecting all barriers, lead or may have led to significant discharges of hazardous substances or personal exposures to ionising radiation, inside or outside the facility;
- faults, degradations or failures, affecting an essential safety function that have or may have had significant consequences, whether detected during the operation or outage of a facility;
- events not being consistent with the above-mentioned criteria and affecting a safety-related function, but of a redundant nature of unknown origin or likely to generate accidents, which constitutes early warning signs of an accident, and
- any other event deemed significant by the operator or by ASN, and likely to affect the safety of the facility.

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 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 are subject to the formal approval of ASN.

Environmental-monitoring plans are also drawn up by Andra and prescribe the nature and frequency of measurements to be taken in or around the disposal facilities in order to control their impact. 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

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.

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 disposal facility to have moved unto its monitoring phase (final shutdown according to the definition given by he *Joint Convention*), as described in § D.3.3.1.

Andra applied for the relevant licence in 1995. Following the favourable results of the corresponding public inquiry, the government entrusted upon a commission to assess the situation of the CSM and to provide its opinion on the environmental impact of the disposal facility. Andra was then requested to submit a new application with due account of the commission's recommendations.

Consequently, Andra filed a new licence application in September 1998 in order to move unto the monitoring phase, which was completed in 1999. The supporting safety documents for that application were submitted to ASN, which approved them officially in early 1999.

At the end of 1997, Andra also submitted at ASN's request an application for a discharge licence, which was revised in 1999.

Both applications were submitted to a public inquiry in 2000. The Inquiry Committee issued a favourable opinion concerning each application, but formulated the following three reservations concerning the transition unto the monitoring phase: the extension to 10 years of the first monitoring phase of the disposal facility, studies on the implementation of reinforced monitoring resources in the vicinity of the structures with the highest potential hazards, and the implementation of an inspection and maintenance programme for water-collection drains throughout the facility.

Jointly with the various ministerial services concerned and with due account of the recommendations of the Public Inquiry Committee, ASN prepared a draft transition licence to move unto the monitoring phase, thus amending the initial 1969 creation-licence decree, as well as a draft discharge licensing order. Both the Order and the Decree were published on 11 January 2003.

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.

As mentioned in § D.3.3.1, the transition decree to move unto the monitoring phase requires that Andra file by January 2009 an update of the relevant safety report and monitoring plan. The monitoring plan must be supported by a report on the advantages of installing a new cover to ensure the passive safety of the disposal facility over the long term. Further updates of the safety report will be required every 10 years.

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.

H.7.2 Mine tailings

In order to enlighten administrative services about the long-term steps to be taken for the management of old Limousin uranium mines, a multidisciplinary expert group consisting of representatives from environmental associations, administrations and technical specialists was implemented in 2006 and should submit its conclusions in 2009.

The objective of operators and agents responsible for administrative monitoring is to avoid excessive site-monitoring or maintenance constraints in place over the long term.

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. Mine tailings containing less than 0.03% uranium are used in order to cover the most active residues resulting from chemical processing.

At the Bois-Noirs Site, investigations are still under way for a long-term formula focusing mainly on processing waste and, to a lesser extent, on overflowing waters from mine works.

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.

Radon and the various radionuclides contained in the mine tailings are taken into account in impact assessments and site-monitoring data.

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*

   v) *a Contracting Party which is a State of origin shall take the appropriate steps to permit re-entry into its territory, if a transboundary movement is not or cannot be completed in conformity with this Article, unless an alternative safe arrangement can be made.*

2. *A Contracting Party shall not licence 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

In France, transboundary movements of spent fuel and radioactive waste concern primarily the spent-fuel reprocessing operations performed at the La Hague Plant for Belgian, Dutch, German, Italian, Japanese and Swiss customers.

French authorities are committed to the principle whereby each NPP operator is responsible for the waste he generates, a principle that was incorporated into the *1991 Law* and more recently in the *2006 Planning Act.* Article 8 of that act states that the disposal of imported radioactive waste and of waste arising from the reprocessing of spent fuel and of imported waste is prohibited in France.

Similarly, the introduction of spent fuel or foreign radioactive waste for treatment purposes in France is now subject to intergovernmental agreements.

All agreements must mention the provisional reception and treatment dates of the spent fuel, potential prospects for the radioactive materials separated during the process and the return dates of the residuall waste.

Hence, spent-fuel reprocessing contracts with foreign nuclear power companies require that the ultimate waste be returned to the country of origin. The waste is packaged in a suitable form for safe transport and interim storage in order to protect both the environment and public health. Contracts are reinforced by intergovernmental agreements guaranteeing the return of the waste. France ensures that the countries of destination of the waste abide by the obligations set by § 1 of Article 27 of the *Joint Convention*.

With regard to the organisation of transboundary movement, France follows all international, European and national safety, transport, security, physical-protection and public-order regulations.

More particularly, it abides by *EURATOM Directive 92/3,* as modified by *Directive 2006/117* being currently transposed, which corresponds to the obligations of the *Joint Convention*. The transposition must be completed by 31 December 2008.

Most transboundary movements within European countries are made by rail. Sea routes are used for Japan 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.

It should be noted that, in accordance with § 2 of Article 27 of the *Joint Convention*, France has never authorised any spent-fuel or radioactive-waste shipment south of 60° latitude South.

French authorities are particularly committed to fulfilling the transport provisions of Article 27 of the *Joint Convention*. They supplement them readily 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 nuclear 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 authorisation procedures (certification of packages and organisations);
- organising and implementing inspection procedures, 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* (ADNR 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 the Sea and Transport (*Direction générale de la mer et des transports* – 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, responsibility for safety lies with the operator requesting transport, 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 authorised 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 600 inspections have been carried out in that field.

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.

I.2.5 Assessment of the French structure: TranSAS mission in France

In 2002, France asked the IAEA to organise a mission in order to assess the French structure for the transport of radioactive materials and the enforcement of international regulations in France. The TranSAS Mission ran from 29 March to 8 April 2004. The report, which may be consulted on ASN's Website (*www.asn.fr*), includes notably three recommendations, 16 suggestions and 12 good practices. The general conclusion is that the application of international regulations is consistent with IAEA requirements and that improvements are possible, not only with regard to the upgrading of guides and procedures, but to the formalised demonstration that all requirements are actually met.

Good practices dealt particularly with sea transport, emergency preparedness, inspections and protocols with other administrations in charge of the various transport modes.

Recommendations involved the following:

- the development of a suitable programme for non-certified packages;
- the revision of the agreement with the IRSN, by developing a specification on the scope and requirements regarding package certification, and
- the revision of appraisal procedures in order to formalise the demonstration that all regulatory requirements have been met regarding certified packages, special arrangements and shipment approvals.

The last two recommendations consisted mostly in formalising existing practices in corresponding documents; the task is now completed.

With regard to non-certified packages, ASN has conducted investigations in order to identify which packages were used and which manufacturers were involved. It has also increased the number of inspections in that field. Those inspections confirm a general lack of rigour to determine the compliance of non-certified packages. In order to reinforce the efficiency of its activities in that field, ASN has sent out to operators a guide on the compliance of non-certified packages. It may also be consulter on ASN's Website (*www.asn.fr*).

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, ASN is currently discussing a proposed technical decision specifying the conditions under which the licence of a source might be extended. 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.

In the framework of the implementation of the justification and optimisation principles, the assessment of the expected benefits to be drawn from a nuclear activity and of the resulting health detriment may lead to prohibit a given activity for which the benefits would appear to be insufficient in relation to the risk involved. Either a generic prohibition is applied (e.g., no intentional addition of radioactive substances allowed in consumer goods) or no licence is renewed for radiation-protection purposes.

With respect to the banning of any intentional addition or radionuclides in consumer goods and construction products (Articles R. 1333-2 and 3 of the *Public Health Code*), the sale of any irradiated precious stones, accessories such as key rings, hunting equipment (aiming devices), navigation equipment (bearing compass), freshwater-fishery gear (touch detectors) equipped with sealed tritium sources, and lightning conductors, is prohibited.

For current activities, a re-assessment of the justification is initiated if the state of knowledge and of techniques warrants it. Such is the case for smoke detection and various other activities, which tend to disappear due to the evolution in techniques.

In the case of smoke detectors in which many types of radioelements are being used (americium-241, plutonium-238, nickel-63, krypton-85), a practice that may have been justified a few years ago due to its advantages for the security of people, the justification is no longer valid since new optical-detection techniques have been developed and help to meet fire-detection regulations and standards. In accordance with Article L1333-1 of the *Public Health Code,* that evolution requires the recovery of smoke detectors containing radionuclides. In the framework of the PNGMDR, a progressive collection campaign of ionic detectors in use has been launched in order to withdraw all such detectors from circulation by 2017. Nevertheless, the widespread use of such devices requires the presence of an ultimate disposal facility where they would be eliminated. Relevant proposals have been formulated in the framework of the PNGMDR.

J.2 Role of the CEA

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, it stores in its own facilities a large quantity of disused sources that have been entrusted to Andra by public authorities. 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 or insufficiency of the accompanying documentation.

The inventory of CEA radioactive sources is maintained via a database thanks to the input from the waste-holding units. The database indicates the status of the source (in use or disused), its disposal system, if known, or interim-storage conditions pending final disposal (surface or deep geological disposal, etc.).

Disused radioactive sources are treated through appropriate disposal processes, which are currently being drafted within a specific procedure to declassify the sources into waste.

Hence, the CEA's management strategy regarding disused sources is, in terms of its rationale, similar to that defined for radioactive-waste management.

Section K– PROPOSED SAFETY IMPROVEMENT ACTIONS

K.1 National measures

K.1.1 ASN objectives

France is committed to improving constantly the safety of its spent-fuel management facilities and its radioactive-waste management facilities.

Bearing such objective in mind, one of ASN's primary goals is to contribute to the enforcement of the *2006 Planning Act*. The task will involve notably to carry out studies and to issue opinions on studies performed by third parties in accordance with *Decree No. 2008-357* specifying the requirements relating to the PNGMDR.

Moreover, with regard to INBs, ASN's objectives concern the following aspects:

- to ensure the continued recovery of historical waste stored under unsatisfactory conditions;
- to formalise all pending requirements and administrative practices into regulatory texts in order to maintain ASN's clear and strong position once market deregulation will increase economic stresses on operators;
- to ensure that the safety of activities relating to spent-fuel and waste management continues to be dealt with on an equal footing with activities relating to reactors, not only by enforcing the *1984 Quality Order,* but also by promoting the development of the safety culture around those activities, and
- to improve the awareness of operators with regard to human factors and organisational problems, since those issues are often the cause of incidents.

K.1.2 Operators' objectives

K.1.2.1 Andra objectives

In 2005, Andra signed a new contract with the State in order to consolidate the general framework of its activities and to formalise the objectives to be met between 2005 and 2008.

The general goals of the Agency were also listed in the contract.

More particularly, Andra committed itself to have its research work audited on a regular basis, as it did in 2005 for its investigations relating to the research programme prescribed by the *1991 Law*.

The future contract for 2009-12 is being drafted and will rely essentially on the content of the *2006 Planning Act* and on the objectives that have already been assigned to the Agency.

K.1.2.2 CEA objectives

The CEA has also renewed its contract with the State from 2006 to 2009, in which maintaining the highest safety levels at its INBs remains 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 considers that the health of its employees and subcontractors' employees is an absolute priority and is consolidating its concrete drive towards reducing and managing exposure risks proactively by involving fully 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

Operators wish for complete and adequate disposal channels to be implemented and are participating both technically and financially in that endeavour. The CSTFA is the most recent management tool. The *2006 Planning Act* has set specific objectives for graphite waste, radium-bearing waste, tritiated waste, sealed sources and for reinforced natural radioactivity. It also establishes a suitable framework for the development and implementation of the new matching management systems. Operators are in the process of characterising and conditioning waste for their future disposal and participate in the technical actions aimed at defining disposal options. Regarding HL/IL-LL waste, they contribute to the funding of the full range of Andra's actions, in accordance with the revamped framework prescribed by the *2006 Planning Act*.

K.2 International co-operation measures

K.2.1 Co-operation between ASN and its technical supports

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.

With regard to safety in radioactive-waste and spent-fuel management, the IRSN's international relations, which support ASN activities, revolve mainly around the following development areas:

- to understand the processes governing the transfer of radioactive materials in the geosphere and to reach a consensus on technical questions;
- to develop international co-operation projects on topics concerning spent fuel and deep geological radioactive-waste repositories;
- to undertake research on deep earthquakes and their consequences on groundwater circulation;
- to undertake forecast studies on seismic movements;
- to develop instrumentation resources;
- to model all safety-related phenomena in disposal facilities and all potential dosimetric impact of those installations, and
- to assist Eastern European countries through the European PHARE/TACIS programmes and the projects of the European Bank's Research and Development (EBRD) projects concerning the safety of storage and disposal facilities for the waste originating from the Chernobyl NPP.

IRSN's main partners include the following:

- GRS (Germany) and AVN (Belgium), for analysing the safety of disposal facilities and modelling their long-term behaviour;
- NAGRA (Switzerland), for conducting studies on the underground work of a deep geological repository;
- JAERI (Japan), for activities relating to the safety of waste-disposal facilities;
- SSTC (Ukraine) and SEC-NRS (Russia), for improving waste and spent-fuel management, and
- CIST (Europe and Armenia), for selecting a potential site for an underground repository.

Work to enhance knowledge and to improve assessment tools is also carried out throughout international organisations. In that context, the IRSN has participated or is still participating in various programmes, such as the following:

- BORIS (EC), for studying the injection of liquid effluents into the subsoil at Krasnoyarsk, as part of the European programme;
- NF-PRO (CE), for modelling physico-chemical parameters in a deep geological waste repository;
- CIP (EC), for studying the governance of waste management, and
- PAMINA (EC), for assessing the performances of deep geological waste repositories in order to orient the development of reference cases.

As the IRSN participates also in international working groups in order to draft technical recommendations, guides and standards for radioactive waste and spent fuel, such as the IAEA's methodology guide for the use of historical and archaeological data on earthquakes, and the NEA Radioactive Waste Management Committee's (RWMC) "Clay-Club" Expert Group on radioactive-waste management and deep geological repositories.

K.2.2 Co-operation between operators

K.2.2.1 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. Consequently, it integrates its research activities within projects with its European partners, particularly through joint R&D programmes. It opens up its programmes and facilities to its foreign partners, such as the MHM-URL for studies on the deep geological disposal of HL/IL-LL waste. In 1996, it had its LIL-SL waste management approach assessed by the IAEA (WATRAP Exercise);
- to be represented on leading international bodies: European co-ordinating bodies, the OECD/NEA and the IAEA;
- to conduct a scientific, technical and economic watch, which forms a structured activity within Andra;
- to organise occasional outreach missions with a view to demonstrating the Agency's know-how, 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. For instance, it co-ordinates the ESDRED Project, which aims at developing specific technological solutions.

K.2.2.2 CEA's international co-operation

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.2.2.3 AREVA's international co-operation

AREVA takes part in international actions concerning the engineering aspects of waste-disposal and storage facilities, whenever safety is involved (i.e., contracts on the design of surface facilities at the Yucca Mountain Disposal Site, in the United States). Other actions consist in designing and building spent-fuel storage facilities (COVRA facility in the Netherlands) or spent-fuel storage containers (NUHOM in the United States, etc.). In addition, AREVA takes part in discharge working groups, such as OSPAR and MARINA II.

With Shaw, its partner, AREVA is participating in the construction of a MOX fuel facility at Savannah River (South Carolina, U.S.A.), within the framework of the policy to use up surplus American military plutonium. The technologies used are those of the AREVA Group.

Moreover, AREVA and its partners (Mitsubishi Heavy Industries [MHI], the leader for fast reactors, Japan Nuclear Fuel Limited [JNFL] for recycling support, the Washington Group for engineering, Babcock & Wilcox Technologies [BWXT] for security and Battelle for R&D/new products, have presented the initial design work for a spent-fuel reprocessing plant to the American government in response to a call for tender to which four groups have replied.

Furthermore, AREVA has prepared initial plans for a reprocessing plant in China as part of a contract signed at the end of 2007.

As a member of a consortium, AREVA has been awarded the management and operation of a storage facility for low-level radioactive waste in West Cumbria, Northwestern Britain, for a five-year period. The contract was awarded by the Nuclear Decommissioning Authority (NDA), the British government agency responsible for dismantling NPs; the contract also provides for the creation of a national strategy for managing the low-level radioactive waste resulting from the dismantling of 20 facilities by NDA.

Lastly, a large number of exchanges have been organised between AREVA and the nuclear safety authorities in AREVA's customer countries, especially with regard to knowledge about the waste packages produced by AREVA. Hence, packages constitute international "standards", since they are used as the basic data in many deep-geological repository concepts in Belgium, Germany, Japan, Switzerland, etc.).

K.2.2.4 EDF's international co-operation

EDF's international activities concern a number of key areas:

- international activities within the EDF Group (EnBW, etc.) and foreign nuclear development projects (China, South Africa, United States, United Kingdom, etc.);
- 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), European Nuclear Installations Safety Standards (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).

Section L – ANNEXES

Of the facilities concerned by radioactive-waste management f or 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 6.

Figure 6 : 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 2007

L.1.1 Spent-fuel generating facilities

Spent fuel is generated or likely to be generated in the INBs shown in Table 17.

INB No.	Name and location of facility	Operator	Type of installation	Declaration date	Authorisation date	Publication date[4]	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 (*J.O.*, 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 (*J.O.*, 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 (*J.O.*, 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 (*J.O.*, 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 (*J.O.*, 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 (*J.O.*, 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	

4. In the official gazette called *Journal officiel* (*J.O.*).

INB No.	Name and location of facility	Operator	Type of installation	Declaration date	Authorisation date	Publication date[4]	Remarks
100	SAINT-LAURENT-DES-EAUX NPP (reactors B1 and B2) 41220 La Ferté-St-Cyr	EDF	Reactors		08.03.78	21.03.78	
101	ORPHÉE (Saclay) 91191 Gif-sur-Yvette Cedex	CEA	Reactor		08.03.78	21.03.78	
103	PALUEL 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 (*J.O.*, 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 (*J.O.*, 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 (*J.O.*, 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 (*J.O.*, 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 (*J.O.*, 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 (*J.O.*, 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	

INB No.	Name and location of facility	Operator	Type of installation	Declaration date	Authorisation date	Publication date[4]	Remarks
139	CHOOZ B NPP (reactor 1) 08600 Givet	EDF	Reactor		09.10.84	13.10.84	Commissioning postponed: Decrees of 18.10.93 (*J.O.*, 23.10.93) and of 11.06.99 (*J.O.*, 18.06.99)
140	PENLY NPP (reactor 2) 76370 Neuville-lès-Dieppe	EDF	Reactor		09.10.84	13.10.84	
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	Commissioning postponed: Decrees of 18.10.93 (*J.O.*, 23.10.93) and of 11.06.99 (*J.O.*, 18.06.99)
158	CIVAUX NPP (reactor 1) BP 1 86320 Civaux	EDF	Reactor		06.12.93	12.12.93	commissioning postponed: Decree of 11.06.99 (*J.O.*, of 18.06.99)
159	CIVAUX NPP (reactor 2) BP 1 86320 Civaux	EDF	Reactor		06.12.93	12.12.93	Commissioning postponed: Decree of 11.06.99 (*J.O.*, 18.06.99)

Table 17: Spent-fuel-generating INBs

L.1.2 Spent-fuel storage or reprocessing facilities

Spent fuel is stored or reprocessed in the INBs shown in Table 18.

INB No.	Name and location of facility	Operator	Type of installation	Declaration date	Authorisation date	Publication date[5]	Remarks
22	PÉGASE/CASCAD TEMPORARY STORAGE FACILITY (Cadarache) 13115 Saint-Paul-lez-Durance	CEA	Radioactive substance storage facility	27.05.64	17.04.80	27.04.80	Former reactor decommissioned 19.12.75. Modification: Decree of 04.09.89 04.09.89 (*J.O.*, 08.09.89)
33	SPENT FUEL REPROCESSING PLANT (UP2 and AT1) (La Hague) 50107 Cherbourg	COGEMA	Radioactive substance transform. plant	27.05.64			Modification: Decree of 17.01.74 (*J.O*,. 05.02.74) Change of operator: Decree of 09.08.78 (*J.O.*, 19.08.78)
47	ELAN II B SHOP (La Hague) 50107 Cherbourg	COGEMA	Radioactive substance transform. plant		03.11.67	09.11.67	Change of operator: Decree of 09.08.78 (*J.O.*, 19.08.78)
50	TESTING LABORATORY ON IRRADIATED FUEL (LECI) (Saclay) 91191 Gif-sur-Yvette Cedex	CEA	Facility using radioactive substance	08.01.68			Modification: Decree of 30.05.00 (*J.O.*, 03.06.00)
55	ACTIVE FUEL EXAMINATION LABORATORY (LECA/STAR) (Cadarache) 13115 Saint-Paul-lez-Durance	CEA	Facility using radioactive substance	08.01.68			Extension: Decree of 04.09.89 (*J.O.*, 08.09.89)
56	RADIOACTIVE WASTE INTERIM STORAGE UNIT (Cadarache) 13115 Saint-Paul-lez-Durance	CEA	Radioactive substance storage facility	08.01.68			

5. In the official gazette called *Journal official* (*J.O.*).

INB No.	Name and location of facility	Operator	Type of installation	Declaration date	Authorisation date	Publication date[5]	Remarks
72	SOLID RADWASTE MANAGEMENT ZONE (Saclay) 91191 Gif-sur-Yvette Cedex	CEA	Radioactive substance interim storage or warehouse facility		14.06.71	22.06.71	
80	HIGH ACTIVITY OXIDE SHOP (HAO) (La Hague) 50107 Cherbourg	COGEMA	Radioactive substance transform. plant		17.01.74	05.02.74	Change of operator: Decree of 09.08.78 (*J.O.*, 19.08.78)
91	SUPERPHÉNIX REACTOR 38510 Morestel	EDF	Fast-neutron reactor		12.05.77 10.01.89	28.05.77 12.01.89	Modification to perimeter: Decree of 24.07.85 (*J.O.*, of 31.07.85) Postponement of commissioning: Decree of 25.07.86 (*J.O.*, 26.07.86) Final shutdown and change of operator: Decree of 30.12.98 (*J.O.*, 31.12.98)
94	IRRADIATED MATERIAL WORKSHOP (Chinon) 37420 Avoine	EDF	Facility using radioactive substance	29.01.64			Modification: Decree of 15.04.85 (*J.O.*, 19.04.85)
116	UP3-A PWR SPENT FUEL REPROCESSING PLANT (La Hague) 50107 Cherbourg	COGEMA	Radioactive substance transform. plant		12.05.81	16.05.81	Commissioning postponed: Decree of 28.03.89 (*J.O.*, 07.04.89) Modification: Decree of 18.01.93 (*J.O.*, 24.01.93)
117	UP2-800 PWR SPENT FUEL REPROCESSING PLANT (La Hague) 50107 Cherbourg	COGEMA	Radioactive substance transform. plant		12.05.81	16.05.81	Postponement of commissioning: Decree of 28.03.89 (*J.O.*, 07.04.89) Modification: Decree of 18.01.93 (*J.O.*, 24.01.93)
141	ON-SITE SPENT FUEL STORAGE UNIT (Creys-Malville) 38510 Morestel	EDF	Radioactive substance interim storage or warehouse facility		24.07.85	31.07.85	Commissioning postponed: Decree of 28.07.93 (*J.O.*, 29.07.93) Change of operator: decree of 30.12.98 (*J.O.*, 31.12.98)
148	ATALANTE CEN VALRHO Chusclan 30205 Bagnols-sur-Cèze	CEA	Laboratory for actinide R&D and production studies		19.07.89	25.07.89	Commissioning postponed: Decree of 22.07.99 (*J.O.*, 23.07.99)

Table 18: INB storage or reprocessing facilities

L.2 Radioactive-waste management facilities on 30 June 2007

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 19.

INB No.	Name and location of facility	Operator	Type of installation	Declaration date	Authorisation date	Publication date	Remarks
19	MÉLUSINE 38041 Grenoble Cedex	CEA	Reactor	27.05.64			Final shutdown: 30.06.93
20	SILOÉ 38041 Grenoble Cedex	CEA	Reactor	27.05.64			Final shutdown: 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			Final shutdown: 15.04.83
29	ARTIFICIAL RADIONUCLIDE FACTORY (Saclay) 91191 Gif-sur-Yvette Cedex	CEA (Oris-Industrie)	Radioactive substance fabrication or transform. plant	27.05.64			
32	PLUTONIUM TECHNOLOGY SHOP (ATPu) (Cadarache) 13115 Saint-Paul-lez-Durance	CEA	Radioactive substance fabrication or transform. plant	27.05.64			
43	LINEAR ACCELERATOR (Saclay) 91191 Gif-sur-Yvette Cedex	CEA	Particle accelerator		08.10.65	13.10.65	
44	STRASBOURG UNIVERSITY REACTOR 67037 Strasbourg Cedex	Université Louis Pasteur	Reactor		25.06.65	01.07.65	
45	BUGEY NPP (reactor 1) 01980 Loyettes	EDF	Reactor		22.11.68	24.11.68	Modification to perimeter: Decree of 10.12.85 (*J.O.,* 18.12.85) Final shutdown of reactor on 27.05.94. Final shutdown Decree of 30.08.96 (*J.O.,* 07.09.96)
46	SAINT-LAURENT-DES-EAUX NPP (reactors A1 and A2) 41220 La Ferté-Saint-Cyr	EDF	Reactors		22.11.68	24.11.68	Modification to perimeter: Decree of 10.12.85 (*J.O.,* 18.12.85) Final shutdown Decree of 11.04.94 (*J.O.,* 16.04.94)
48	SATURNE SYNCHROTRON (Saclay) 91191 Gif-sur-Yvette Cedex	CEA	Particle accelerator	17.02.67			Final shutdown: Decree of 08.10.02 (*J.O.,* 15.10.02)
49	HIGH LEVEL ACTIVITY LABORATORY (Saclay) 91191 Gif-sur-Yvette Cedex	CEA	Facility using radioactive substance	08.01.68			Extension: Decree of 22.02.88 (*J.O.,* 24.02.88)
52	ENRICHED URANIUM SHOP (ATUE) (Cadarache) 13115 Saint-Paul-lez-Durance	CEA	Radioactive substance fabrication plant	08.01.68			
53	ENRICHED URANIUM AND PLUTONIUM WAREHOUSE (Cadarache) 13115 Saint-Paul-lez-Durance	CEA	Radioactive substance storage facility	08.01.68			
54	CHEMICAL PURIFICATION LABORATORY (Cadarache) 13115 Saint-Paul-lez-Durance	CEA	Radioactive substance transform. plant	08.01.68			

INB No.	Name and location of facility	Operator	Type of installation	Declaration date	Authorisation date	Publication date	Remarks
57	PLUTONIUM CHEMISTRY LABORATORY (LCPu) 92265 Fontenay-aux-Roses Cedex	CEA	Facility using radioactive substance	08.01.68			Cessation of production: 01.07.95
59	PLUTONIUM-BASED FUEL RESEARCH LABORATORY (RM2) 92265 Fontenay-aux-Roses Cedex	CEA	Facility using radioactive substance	08.01.68			Final shutdown on 31.07.82
61	ACTIVE MATERIAL ANALYSIS LABORATORY (LAMA) 38041 Grenoble Cedex	CEA	Facility using radioactive substance	08.01.68			
63	FUEL ELEMENT FABRICATION PLANT 26104 Romans-sur-Isère	FBFC	Radioactive substance fabrication plant	09.05.67			Modification: Decree of 09.08.78 (*J.O.*, 08.09.78)
65	NUCLEAR FUEL FABRICATION PLANT 38113 Veurey-Voroize	SICN	Radioactive substance fabrication plant	27.10.67			
68	DAGNEUX IONISING FACILITY Z.I. Les Chartinières 01120 Dagneux	IONISOS	Facility using radioactive substance		20.07.71	25.07.71	Increase in maximum activity level of ionising source: Decree of 15.06.78 (*J.O.*, 27.06.78) Change of operator: decree of 23.10.95 (*J.O.*, 28.10.95)
77	POSÉIDON – CAPRI IRRADIATION FACILITIES (Saclay) 91191 Gif-sur-Yvette Cedex	CEA	Facility using radioactive substance		07.08.72	15.08.72	
90	PELLET FABRICATION SHOP 38113 Veurey-Voroize	SICN	Radioactive substance fabrication plant		27.01.77	29.01.77	Modifications: Decree of 15.06.77 (*J.O.*, 19.06.77) decree of 14.10.86 (*J.O.*, 17.10.86)
93	GEORGES BESSE PLANT FOR ISOTOPE SEPARATION BY GASEOUS DIFFUSION (Eurodif) 26702 Pierrelatte Cedex	EURODIF Production	Radioactive substance transform. plant		08.09.77	10.09.77	Modification to perimeter: Decree of 22.06.85 (*J.O.*, 30.06.85)
98	NUCLEAR FUEL FABRICATION UNIT 26104 Romans-sur-Isère	FBFC	Radioactive substance fabrication plant		02.03.78	10.03.78	
99	CHINON INTER-REGIONAL WAREHOUSE 37420 Avoine	EDF	Storage of new fuel		02.03.78	11.03.78	Modification: Decree of 04.06.98 (*J.O.*, 06.06.98)
102	BUGEY INTER-REGIONAL WAREHOUSE 01980 Loyettes	EDF	Storage of new fuel		15.06.78	27.06.78	Modification: Decree of 04.06.98 (*J.O.*, 06.06.98)
105	URANIUM HEXAFLUORIDE PREPARATION PLANT (COMURHEX) 26130 Saint-Paul-Trois-Châteaux	COMURHEX	Radioactive substance transform. plant				Classified up to 31.12.78
106	LABORATORY FOR THE USE OF ELECTROMAGNETIC RADIATION (LURE) 91405 Orsay Cedex	CNRS	Particle accelerator				Change of operator: Decree of 08.07.85 (*J.O.*, 12.07.85) Modification: Decree of 02.07.92 (*J.O.*, 08.07.92)
113	NATIONAL HEAVY ION ACCELERATOR (GANIL) 14021 Caen Cedex	G.I.E GANIL Consortium	Particle accelerator		29.12.80	10.01.81	Modification: Decree of 06.06.01 (*J.O.*, 13.06.01)
121	CADARACHE IRRADIATOR (IRCA) 13115 Saint-Paul-lez-Durance	CEA	Facility using radioactive substance		16.12.81	18.12.81	

INB No.	Name and location of facility	Operator	Type of installation	Declaration date	Authorisation date	Publication date	Remarks
123	LABORATORY FOR THE EXPERIMENTAL DESIGN AND FABRICATION OF ADVANCED NUCLEAR FUEL (LEFCA) (Cadarache) 13115 Saint-Paul-lez-Durance	CEA	Radioactive substance fabrication plant		23.12.81	26.12.81	
131	NUCLEAR FUEL FABRICATION PLANT 26701 Pierrelatte Cedex	FBFC	Radioactive substance fabrication plant		07.09.82	09.09.82	Change of operator: Decree of 18.10.85 (*J.O.*, 26.10.85) Final shutdown and dismantling: Decree of 22.05.00 (*J.O.*, 25.05.00)
133	CHINON A1 D 37420 Avoine	EDF	Radioactive substance interim storage or warehouse facility		11.10.82	16.10.82	Shutdown of former reactor on 16.04.73
134	URANIUM WAREHOUSE 13140 Miramas	COGEMA	Interim storage of substances containing uranium		16.11.83	19.11.83	
138	URANIUM PURIFICATION AND RECOVERY PLANT (Tricastin) 26130 Saint-Paul-Trois-Châteaux	SOCATRI	Factory		22.06.84	30.06.84	Modification: Decree of 29.11.93 (*J.O.*, 07.12.93)
143	NUCLEAR MAINTENANCE UNIT (SOMANU) 59600 Maubeuge	SOMANU	Nuclear maintenance facility		18.10.85	22.10.85	
146	POUZAUGES IONISATION UNIT Z.I. de Monlifant 85700 Pouzauges	IONISOS	Ionisation unit		30.01.89	31.01.89	Change of operator: Decree of 23.10.95 (*J.O.*, 28.10.95)
147	GAMMASTER IONISATION UNIT M.I.N. 712 13323 Marseille Cedex 14	GAMMAS-TER	Ionisation unit		30.01.89	31.01.89	
151	NUCLEAR FUEL FABRICATION PLANT (MELOX) BP 2 – 30200 Chusclan	COGEMA	Radioactive substance fabrication plant		21.05.90	22.05.90	Modification: Decree of 30.07.99 (*J.O.*, 31.07.99)
153	CHINON A2 D 37420 Avoine	EDF	Radioactive substance interim storage or warehouse facility		07.02.91	13.02.91	Shutdown of former reactor on 14.06.85
154	SABLÉ-SUR-SARTHE IONISATION UNIT Z.I. de l'Aubrée 72300 Sablé-sur-Sarthe	IONISOS	Ionisation unit		01.04.92	04.04.92	Change of operator: Decree of 23.10.95 (*J.O.*, 28.10.95)
155	TU 5 FACILITY BP 16 26701 Pierrelatte	COGEMA	Radioactive substance transform. plant		07.07.92	11.07.92	Modification: Decree of 15.09.94 (*J.O.*, 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	TRICASTIN OPERATIONAL HOT UNIT (BCOT) BP 127 84504 Bollène Cedex	EDF	Nuclear maintenance facility		29.11.93	07.12.93	
161	CHINON A3 D 37420 Avoine	EDF	Radioactive substance interim storage or warehouse facility		27.08.96	31.08.96	Shutdown of former reactor on 17.03.93

INB No.	Name and location of facility	Operator	Type of installation	Declaration date	Authorisation date	Publication date	Remarks
162	MONTS D'ARRÉE EL4 D Brennilis 29218 Huelgoat	EDF	Radioactive substance interim storage or warehouse facility		31.10.96	08.11.96	Shutdown of former reactor on 31.07.85. Change of operator: Decree of 19.09.00 (*J.O.*, 26.09.00)
163	ARDENNES NPP CNA-D 08600 Givet	EDF	Radioactive substance interim storage or warehouse facility		19.03.99	21.03.99	Shutdown of former reactor on 17.03.93
164	CEDRA (Cadarache) 13155 St Paul lez Durance	CEA	Radioactive material conditioning and storage		04.10.04	05.10.04	

Table 19: Radioactive-waste-generating INBs

L.2.2 Radioactive-waste storage or reprocessing facilities

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 20.

INB No.	Name and location of facility	Operator	Type of installation	Declaration date	Authorisation date	Publication date	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 (Saclay) 91191 Gif-sur-Yvette Cedex	CEA	Radioactive substance transform. plant	27.05.64			
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)

INB No.	Name and location of facility	Operator	Type of installation	Declaration date	Authorisation date	Publication date	Remarks
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 20: Other radioactive-waste storage or reprocessing facilities

L.3 Nuclear facilities undergoing dismantling

L.3.1 Decommissioned reactors or in the process of being decommissioned

Name and location of facility	INB No.	Startup	Final cessation of operation	Power rating *(MWTh)*	Last regulatory acts	Current status
EL2 Saclay	(formerly INB 13)	1952	1965	2.8	Removed from INB list	Sealed source
Chinon A1D (ex-Chinon A1)	133 (formerly INB 5)	1963	1973	300	1982: Licensing decree for containment of Chinon A1 and setting up of waste storage INB Chinon A1D	Partially dismantled. transformed into INB for storage of in situ waste (museum)
CÉSAR Cadarache	(formerly INB 26)	1964	1974	0.01	1978: Removed from INB list	Dismantled
ZOÉ Fontenay-aux-Roses	(formerly INB 11)	1948	1975	0.25	1978: 1978 removed from INB list and classified as ICPE	Contained (museum)
PEGGY Cadarache	(formerly INB 23)	1961	1975	0.001	1976: Removed from INB list	Dismantled
PÉGASE Cadarache	22	1963	1975	35	1980: Decree transforming the reactor into a radio-active substance storage facility (amended in 1989)	Partially dismantled. new radioactive storage substance facility
MINERVE Fontenay-aux-Roses	(formerly INB 12)	1959	1976	0.0001	1977: Removed from INB list	Dismantled at Fontenay and reassembled at Cadarache
EL 3Saclay	(formerly INB 14)	1957	1979	18	1988: 1978 removed from INB list and classified as ICPE	Partially dismantled. containment of remaining structures
NÉRÉIDE Fontenay-aux-Roses	(formerly INB 10)	1960	1981	0.5	1987: Removed from INB list	Dismantled
TRITON Fontenay-aux-Roses	(formerly INB 10)	1959	1982	6.5	1987: 1978 removed from INB list and classified as ICPE	Dismantled
RAPSODIE Cadarache	25	1967	1983	20, then 40		Dismantling in progress
MARIUS Cadarache	(formerly INB 27)	1960 at Marcoule, 1964 at Cadarache	1983	0.0004	1987: Removed from INB list	Dismantled
EL-4D (ex-EL4) Brennilis	162 (formerly INB 28)	1966	1985	250	1996: Decree authorising partial dismantling of EL4 and setting up of waste storage INB EL-4D	Dismantling in progress
CHINON A2D (ex-Chinon A2)	153 (formerly INB 6)	1965	1985	865	1991: Decree authorising partial dismantling of Chinon A2 and setting up of waste storage INB Chinon A2D	Partially dismantled, transformed into INB for storage of *in-situ* waste
MÉLUSINE Grenoble	19	1958	1988	8		Final shutdown completed
CHINON A3D (ex-Chinon A3)	161 (formerly INB 7)	1966	1990	1360	1996: Decree authorising partial dismantling of Chinon A3 and setting up of waste storage INB Chinon A3D	Partially dismantled, transformed into INB for storage of *in-situ* waste
SAINT-LAURENT-DES-EAUX A1	46	1969	1990	1662	1994: Decree authorising final shutdown	Final shutdown in progress
CHOOZ AD (ex-Chooz A)	163 (formerly INB A1, 2, 3)	1967	1991	1040	1999: Decree authorising partial dismantling of Chooz A and setting up of waste storage INB Chooz AD	Partially dismantled, transformed into INB for storage of *in-situ* waste
SAINT-LAURENT-DES-EAUX A2	46	1971	1992	1801	1994: Decree authorising final shutdown	Final shutdown in progress

Name and location of facility	INB No.	Startup	Final cessation of operation	Power rating *(MWTh)*	Last regulatory acts	Current status
BUGEY 1	45	1972	1994	1920	1996: Decree authorising final shutdown	Final shutdown in progress
HARMONIE Cadarache	41	1965	1996	0.001		Final cessation of operation in progress
SILOE Grenoble	21	1963	1997	35		Final cessation of operation in progress
RUS Strasbourg	44	1967	1997	0.1		Final cessation of operation in progress
SUPERPHÉNIX Creys-Malville	91	1985	1997	3000	1998: Decree authorising final shutdown	Final shutdown in progress

Table 21: Decommissioned reactors or in the process of being decommissioned

L.3.2 Other decommissioned facilities or in the process of being decommissioned

Name and location of plant	INB No.	Type of plant	Startup	Final cessation of operation	Last regulatory acts	Current status
LE BOUCHET	(formerly INB 30)	Ore-treatment facility	1953	1970	Removed from INB list	Dismantled
ATTILA Fontenay-aux-Roses	57	Reprocessing pilot unit	1966	1975		Dismantled
LCPu Fontenay-aux-Roses	57	Plutonium-chemistry laboratory	1966	1995		Dismantling in progress
ELAN II B La Hague	47	^{137}Cs source fabrication plant	1970	1973		Dismantling in progress
AT1 La Hague	33	FBR fuel reprocessing	1969	1979		Dismantling in progress
GUEUGNON	(formerly INB 31)	Ore treatment facility		1980	Removed from INB list	Dismantled
BAT. 19 Fontenay-aux-Roses	(formerly INB 58)	Plutonium metallurgy unit	1968	1984	1984: Removed from INB list	Dismantled
RM2 Fontenay-aux-Roses	59	Radio-metallurgy unit	1968	1982		Dismantling in progress
LCAC Grenoble	(formerly INB 60)	Fuel analysis	1968	1984	1997: Removed from INB list	Dismantled
SATURNE Saclay	48	Accelerator	1958	1997	2002: Decree author. final shutdown and dismantling	Shut down
SNCS Osmanville	(formerly INB 152)	Ioniser	1990	1995	2002: Decree author. final shutdown and dismantling	Dismantling in progress
ATUE Cadarache	52	Uranium processing plant	1963	1997		Cleanup in progress
ARAC Saclay	(formerly INB 81)	Fuel fabrication	1975	1995	1999: Removed from INB list	Cleanup completed
ALS Saclay	43	Accelerator	1965	1996		Final cessation of operation in progress
FBFC Pierrelatte	131	Fuel fabrication	1983	1998	2000: Decree author. final shutdown and dismantling	Dismantling in progress

Table 22: Other decommissioned facilities or in the process of being decommissioned

L.4 Major legislative and regulatory texts

L.4.1 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

on Transparency and Security in the Nuclear Field (*TSN Act*).

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.4.2 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.5 Structure of major nuclear operators

L.5.1 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 International Affairs Division.

Operational divisions include:

- the Safety, Quality and Environmental Division, in charge of selecting relevant orientations in its field of competence and ensuring their implementation by other Andra units. It is also responsible for drawing up the inventory of all existing radioactive waste throughout the country;
- the Project Division, in charge of designing and developing research projects with a view to establish new management solutions for radioactive waste. It also conducts technical and design studies for all other Andra units.

  That activity includes the following tasks:

  - structuring and organising projects;
  - planning, managing and following up projects, and
  - co-ordinating relations with waste producers involved in the different project, the conduct of design and technical;
- the Scientific Division, in charge of drafting and implementing the Agency's scientific programmes in response to the objectives set by other Andra units. In order to achieve that goal, it defines the scientific policy and implements it after validation by the Chief Executive Officer. It conducts or has conducted corresponding research, ensures their follow-up, summary and delivery. It warrants the quality of scientific data. It provides assistance as well as scientific and technical expertise to the other Andra units in support of the Agency's activities in the fields of geology, hydrogeology, materials science, radionuclide transfers to the biosphere and human beings, as well as mathematical modelling;
- the MHM-URL Division, in charge of the scientific tool designed to study the geological environment and to characterise its host clay formation. Its activities cover the construction and implementation of facilities, as well as the conduct of scientific experiments. It also ensures various surveys of the zone for the future HL-waste repository, and
- the Industrial Division, 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.

L.5.2 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 presented in Figure 7 : 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.

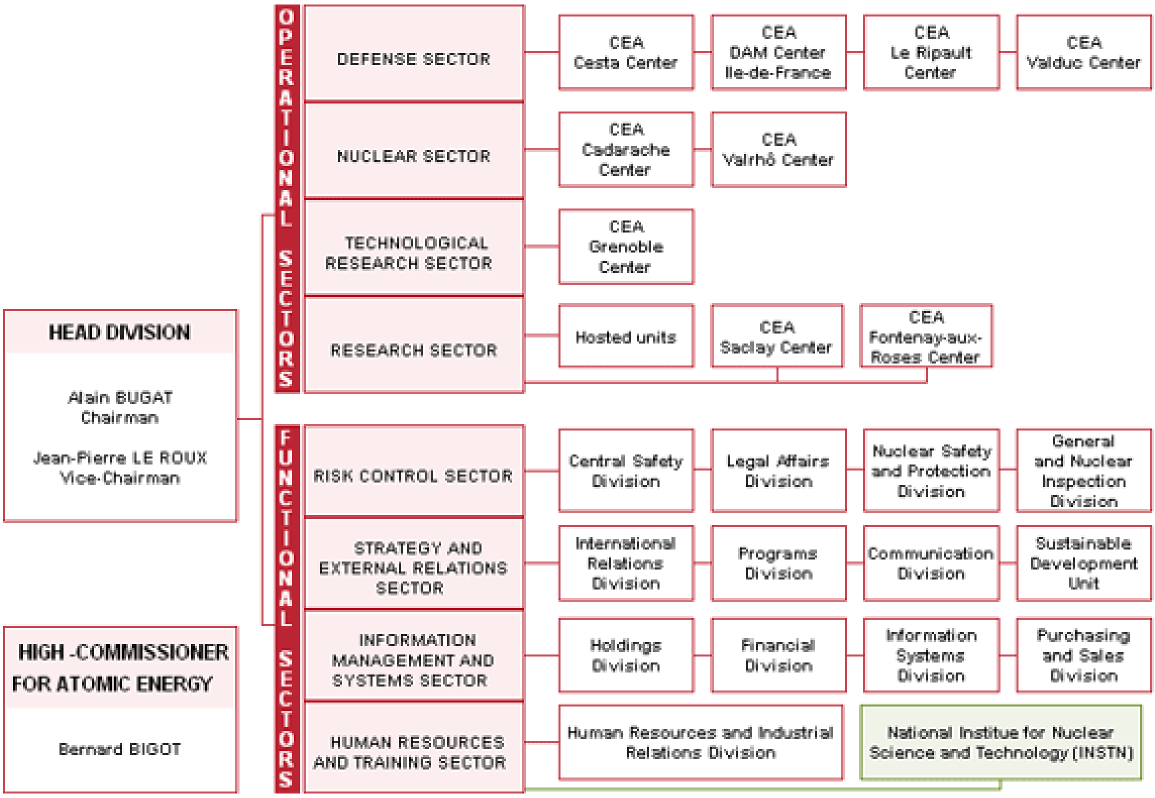

Figure 7 : CEA's organisation chart

L.5.3 AREVA

The AREVA Group's main activity covers all stages of the nuclear fuel cycle: front-end, reactors and back-end.

AREVA's organisation chart is shown in Figure 8.

EXECUTIVE BOARD Anne Lauvergeon: Chief Executive Officer		
Executive Committee		
CORPORATE DEPARTMENTS		
Front-end Division	Reactors and Services Division	Back-end Division
Mining	Reactors	Treatment - Recycling
Chemistry	Equipment	Site valuation
Enrichment	Nuclear Services	Logistics
	Nuclear measurement	
	Consulting and Information Systems	Cleanup
Fuel	AREVA TA	Engineering

Figure 8: AREVA's organisation chart

The general nuclear safety inspection function pertains to the Corporate Safety, Security and Health Department.

L.5.4 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.5.4.1 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.5.4.1.1 Power and nuclear power generating stations

In accordance with the *1975 Law* and the *2006 Planning Act*, NPPs are responsible for their waste (from the production site up to their final destination) and for the quality of 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.5.4.1.2 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 nuclear 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 Nuclear 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.5.4.2 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 the nine shut-down NPPs.

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 plants being dismantled and is responsible for their operational management. It designs and ensures responsibility for the provision of specific waste-treatment facilities.

L.5.4.3 Nuclear Fuel Division

The Nuclear Fuel Division (*Division Combustible nucléaire* – DCN) draws up strategies concerning the back-end of the cycle and notably the disposal of nuclear 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.

L.6 Measurements taken in the environment

L.6.1 Monitoring stations

L.6.1.1 Téléray network (ambient gamma dose rate)

The ambient dose rate is monitored by the Téléray network comprising 180 stations that measure ambient gamma radiation on an ongoing basis. Those stations are scattered throughout the country in 81 prefectures or subprefectures or cities, 14 in Paris, 38 on nuclear sites, 16 in airports and nine on mountain peaks, as shown in Figure 9. The network also includes 22 recorders abroad and in French overseas territories.

Figure 9: Téléray network in France

L.6.1.2 Measurement and reference stations

Radioactivity monitoring concerns the atmosphere, water, soil, plant life and the food chain. Besides the seven 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 in Figure 10.

Figure 10: French measurement and reference stations

Measurements taken in reference stations amount to about 3,000 annual samples, as shown in Table 23.

Environment	Sample	Analysis
Atmosphere	Integrating dosimeter bi-yearly)	Ambient γ radiation
Aerosols	Filter (daily)	Total β (daily), γ spectrometry (monthly)
Rainwaters	Collector 0.2 m^2 (monthly)	Total β, γ spectrometry, ^3H, ^{90}Sr
Soil	Thickness 20 cm (quarterly)	Total β, γ spectrometry, ^{90}Sr
Plants	Harvest 6 m^2 (monthly)	Total β, γ spectrometry, ^{90}Sr (annual mix)
Animals	Milk (twice a month) Bone (quarterly)	Total β, γ spectrometry, ^{89}Sr, ^{90}Sr Total β, ^{90}Sr (annual mix)

Table 23: Samples of measurement and reference stations in France

L.6.1.3 Atmospheric monitoring

Apart from the measurements recorded by the seven reference stations, the atmosphere is monitored by 35 stations near nuclear sites and 27 stations near cities. About 23,000 samples are collected annually and 46,000 measurements are made, as shown in Table 24.

Environment	Sample	Analysis
Atmosphere	Téléray recorder (continuous) Integrating dosimeter (6-monthly)	Ambient γ radiation
Aerosols	Filter (daily)	Total β (daily), γ spectrometry (monthly)
Rainwaters	Collector 0.2 m^2 (monthly)	Total β, γ spectrometry

Table 24: Samples of atmospheric-monitoring stations

L.6.1.4 Water monitoring

Water monitoring concerns rainwaters (28 nuclear sites, 16 weather stations, seven reference stations), mineral and mains water (nationwide), groundwaters (dumps and ionisation centres), river water (23 nuclear sites, six mining sites, five main rivers), seawater (five nuclear sites and all coastlines) and waste waters (Achères sewerage plant). It involves about 2,700 samples and 8,000 measurements every year, as shown in Table 25.

Environment	Sample	Analysis
Rainwaters	Nuclear sites: weekly Others: monthly	Total β, ^3H (monthly) + γ spectrometry, ^{90}Sr (others)
Drinking water	Monthly to annual	Total β, total K + α, ^{226}Ra, U (mines) + γ spectrometry, ^3H, ^{90}Sr (Rhône Valley)
Mains water	For health approval	Total α, total β, K, ^3H, ^{90}Sr, ^{222}Rn, ^{226}Ra, U
Mineral waters	For health approval	Total β, K, ^3H, ^{90}Sr, ^{222}Rn, ^{226}Ra, U, Th
River water	Rivers: continuous + quarterly Mines: monthly	Total α, total β, K, ^3H, spectrometry + ^{131}I Total α, total β, K, ^{226}Ra, U (monthly)
Groundwaters	Ionisation centres: monthly Dumps: 6-monthly	Total α, total β, K, γ spectrometry Total β, K, ^{60}Co, γ spectrometry
Seawater	Nuclear sites: continuous Coasts: monthly	Total β, K, ^3H, γ spectrometry (monthly) K, ^3H, γ spectrometry (6-monthly)
Wastewater	Achères (Paris): continuous	Total β, K, ^{125}I, ^{131}I (weekly)

Table 25: Samples of water-monitoring stations

L.6.1.5 Food-chain monitoring

Food-chain monitoring includes milk (90 departmental co-operatives, 29 nuclear sites and seven reference stations), wheat (290 silos in 84 *département*s and 26 nuclear sites), specific foodstuffs (fish, honey, bovine thyroids) and three canteens. It involves about 1,800 samples and 2,400 measurements annually, as shown in Table 26.

Subject	Sample	Analysis
Milk	Co-operatives: bi-annual 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 7 days (monthly)	Total β, Ca, K, ^{90}Sr, U, γ spectrometry ^{226}Ra (annual)

Table 26: Samples of food-chain monitoring

L.6.1.6 Fauna and flora monitoring

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 27.

Subject	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)	— Total α, total β, Ca, K, ^{90}Sr, Th, γ spectrometry — Total α, total β, Ca, K, ^{90}Sr, Th, γ spectrometry, ^{210}Po, U, ^{238}Pu, ^{226}Ra — Total α, total β, Ca, K, ^{90}Sr, Th, γ spectrometry, ^{210}Po, U, ^{238}Pu, ^{226}Ra
English Channel and North Sea	— Fish (annual)	— Total α, total β, Ca, K, ^{90}Sr, γ spectrometry
Terrestrial plants	Seven reference stations and 1 nuclear site (monthly)	Total β, γ spectrometry β (Sr + lanthanides), ^{90}Sr (6-monthly)

Table 27: Samples of monitored fauna and flora

L.6.1.7 Monitoring around nuclear sites

Radioactive discharges around nuclear sites are monitored by the operators in accordance with the regulatory specifications described below. Those provisions represent a general minimum requirement, but, depending on the situation, the operators may be required to take more measurements, in particular around the AREVA site at La Hague.

The principle of regulating the monitoring of INB environments differs slightly depending on whether one is dealing with an NPP, a plant or a laboratory. The types of measurements associated with each of the monitored environments are presented in Tables 28 and 29.

L.6.1.7.1 Regulatory environmental monitoring of NPPs

The principle of regulatory monitoring of the environment around an NPP is summarised in Table 28.

Environment monitored	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 the total β — One continuous sample under the prevailing wind with weekly measurement of atmospheric tritium
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) Measurements: *total β, γ* spectrometry (+ ^{14}C and C, quarterly) — Main agricultural crops (annual check) Measurements: total β, γ spectrometry
Milk	Two sampling points (monthly check) withmeasurements: β (^{40}K excluded), K (+^{14}C, annually)
Liquid discharges reception environment	— Samples at mid-discharge into the river or after dilution in cooling water (case of coastal NPPs), with measurement of total β, potassium and tritium — Continuous sampling from the river or after dilution in the cooling water (case of coastal power plants) with daily tritium measurements — Seawater samples (coastal power plants only) twice a month with measurement of total β, potassium and tritium — 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, potassium and tritium
Environment monitored	Regulatory samplings and checks to be performed by the operator

Table 28: Regulatory environmental monitoring at NPPs

L.6.1.7.2 Regulatory environmental monitoring of the CEA or AREVA facilities

The principles behind regulatory environmental monitoring in the area surrounding a laboratory or plant are summed in Table 29.

Environment monitored	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 radionuclides — One continuous sampling station providing weekly measurements of tritium 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 continuous measurements — 10 integrator dosimeters at the site boundaries (monthly readings)
Vegetation	— Four grass-sampling points (monthly monitoring) — Major farms in the area (annual monitoring) Measurements taken: overall β, 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
Liquid-waste receiving environment	— 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 spectrometry
Groundwaters	— Five sampling points (monthly monitoring) measuring overall α, overall β. potassium and tritium

Table 29: Regulatory environmental monitoring at CEA or AREVA facilities

L.6.2 Measurements in the environment and around nuclear sites

L.6.2.1 Gaseous discharges from nuclear sites in 2006

Gaseous discharges from major INBs are shown in Tables 30 and 31, along with their matching authorised limits, per group of radioactive-product categories as specified in valid licences on 1 January 2007.

L.6.2.1.1 Limits and values of gaseous discharges from EDF sites in initial licences

In certain NPP licences, gaseous discharges are divided into two categories, as shown in Table 30.

Site	Rare gases and tritium		Halogens and aerosols	
	Limit	2006 discharges	Limit	2006 discharges
	(TBq)	*(TBq)*	*(GBq)*	*(GBq)*
Le Bugey	2,590	1.42	111	0.083
Chooz	330	3.32	11	0.748
Civaux	330	1.96	11	0.549
Creys-Malville	220	0.54	5	0.001
Dampierre-en-Burly	2,220	3.28	74	0.062
Fessenheim	1,480	0.055	111	0.032
Penly	1,650	2.78	55	0.074

Table 30: Limits and discharge values of gaseous discharges from EDF sites in original licence

L.6.2.1.2 Limits and values of gaseous discharges from EDF sites with renewed licence

In the new licences established on the basis of the 1995 specifications when renewed for NPP sites, gaseous discharges are now split into five different categories including carbon-14, which is also measured, as shown in Table 31.

Site	Rare gases		Tritium		Carbon 14		Iodine		Others	
	Limit	2006 discharges	Limit	2006 discharges	Limit	2006 discharges	Limit	2006 discharges	Limit	2006 discharges
	(TBq)	*(TBq)*	*(TBq)*	*(TBq)*	*(TBq)*	*(TBq)*	*(GBq)*	*(GBq)*	*(GBq)*	*(GBq)*
Belleville-sur-Loire	45	1.59	5	2.47	1.4	0.40	0.8	0.028	0.8	0.09
Le Blayais	72	0.62	8	0.40	2.2	0.64	1.6	0.030	1.6	0.007
Cattenom	90	1.84	10	4.43	2.8	0.82	1.6	0.121	1.6	0.009
Chinon	72	0.081	8	1.28	2.2	0.58	1.6	0.021	1.6	0.002
Cruas-Meysse	72	1.82	8	0.38	2.2	0.55	1.6	0.033	1.6	0.014
Flamanville	45	0.82	5	1.59	1.4	0.43	0.8	0.036	0.8	0.005
Golfech	45	0.37	8	1.43	1.4	0.43	0.8	0.045	0.8	0.010
Gravelines	108	9.23	12	1.84	3.3	0.92	2.4	0.274	2.4	0.012
Nogent-sur-Seine	45	9.35	8	2.58	1.4	0.46	0.8	0.119	0.8	0.003
Paluel	90	1.31	10	5.11	2.8	0.82	1.6	0.070	1.6	0.011
Saint-Alban – Saint-Maurice	45	1.60	5	2.21	1.4	0.39	0.8	0.053	0.8	0.008
Saint-Laurent-des-Eaux	36	0.29	4	0.08	1.1	0.31	0.8	0.010	0.8	0.002
Le Tricastin	72	0.82	8	0.70	2.2	0.60	1.6	0.030	1.6	0.021

Table 31: Limits and values of gaseous discharges from EDF sites in renewed licence

L.6.2.1.3 Limits and values of gaseous discharges from AREVA's La Hague Site

The current licence (*Order of 8 January 2003*) subdivided the previous discharge categories and reduced authorised limits, as shown in Table 32.

Site	Tritium		Alpha emitters		Radioiodine		Rare gases	
	Limit	2006 discharges	Limit	2006 discharges	Limit	2006 discharges	Limit	2006 discharges
	(TBq/a)	*(TBq)*	*(GBq/a)*	*(GBq)*	*(TBq/a)*	*(TBq)*	*(TBq/a)*	*(TBq)*
La Hague	150	67.8	0.01	0.0017	0.02	0.0068	470.000	242.400

Site	Carbon 14		Other artificial beta and gamma emitters	
	Limit	2006 discharges	Limit	2006 discharges
	(TBq/a)	*(TBq)*	*(GBq/a)*	*(GBq)*
La Hague	28	14.2	1	0.106

Table 32: Limits and values of gaseous discharges from AREVA's La Hague Site

L.6.2.1.4 Limits and values of gaseous discharges from CEA sites in 2007

Current licences cover two or four gas categories depending on the site, as shown in Table 33.

Site	Noble gases		Tritium		Halogens		Aerosols	
	Limit	Discharges	Limit	Discharges	Limit	Discharges	Limit	Discharges
	(TBq)	*(TBq)*	*(TBq)*	*(TBq)*	*(GBq)*	*(GBq)*	*(GBq)*	*(GBq)*
Grenoble	0.4	0	8.39	0.0362			0.08	0.0001
Saclay	740	36.56	555	20.13	18.5	0.173	37	0.034
	Noble gases and tritium				Halogens and aerosols			
	Limit *(TBq)*		Discharge *(TBq)*		Limit *(GBq)*		Discharge *(GBq)*	
Cadarache	555		< 33.8		18.5		< 0.0093	

Table 33: Limits and values of gaseous discharges from AREVA's La Hague Site

L.6.2.2 Liquid discharges from nuclear sites in 2006

Liquid discharges from major INBs are presented in the following tables with their matching limits per category of radioactive product specified in current licences.

L.6.2.2.1 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 34.

Site	Tritium		Halogens and aerosols	
	Limit	2006 discharges	Limit	2006 discharges
	(TBq)	*(TBq)*	*(GBq)*	*(GBq)*
Le Bugey	185	45	2,035	2.1
Chooz	80	49	222	0.5
Civaux	80	54	222	0.3
Creys-Malville	15	0.005	250	0.013
Dampierre-en-Burly	111	31	1,480	0.9
Fessenheim	74	28	925	0.6
Penly	80	66	1,100	1.2

Table 34: Limits and values of gaseous discharges from EDF sites in initial licences

L.6.2.2.2 Limits and values of liquid discharges from EDF sites in renewed licences

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 35.

Site	Tritium		Carbon 14		Iodine		Miscellaneous	
	Limit	2006 discharges	Limit	2006 discharges	Limit	2006 discharges	Limit	2006 discharges
	(TBq)	*(TBq)*	*(GBq)*	*(GBq)*	*(GBq)*	*(GBq)*	*(GBq)*	*(GBq)*
Belleville-sur-Loire	60	52.6	400	29.8	0.1	0.01	25	0.4
Le Blayais	80	50.5	600	47.7	0.6	0.02	60	0.9
Cattenom	140	131.0	380	61.5	0.2	0.02	50	1.3
Chinon	80	42.2	600	43.4	0.6	0.01	60	0.4
Cruas-Meysse	80	48.4	600	41.6	0.6	0.04	60	1.6
Flamanville	60	51.7	400	32.0	0.1	0.02	25	0.5
Golfech	80	53.5	190	32.1	0.1	0.01	25	0.2
Gravelines	120	44.4	900	68.9	0.9	0.05	90	2.6
Nogent-sur-Seine	80	66.7	190	34.5	0.1	0.01	25	0.5
Paluel	120	109.0	800	61.6	0.2	0.04	50	1.3
Saint-Alban – Saint-Maurice	60	51.1	400	29.4	0.1	0.02	25	1.4
Saint-Laurent-des-Eaux	40	22.3	300	23.3	0.3	0.01	30	0.2
Le Tricastin	160	41.4	260	45.0	0.6	0.04	60	0.8

Table 35: Limits and values of liquid discharges from EDF sites in renewed licences

L.6.2.2.3 Limits and values of liquid discharges from AREVA's La Hague Site

The current licence (*Order of 8 January 2007*) subdivides the previous discharge categories and reduces authorised limits, as shown in Table 36.

Site: La Hague

Tritium		Alpha emitters		Strontium 90		Caesium 137		Caesium 134	
Limit	2006 discharges	Limit	2006 discharges	Limit	2006 discharges	Limit	2006 discharges	Limit	2006 discharges
(TBq/a)	*(TBq)*	*(TBq/a)*	*(TBq)*	*(TBq/a)*	*(TBq)*	*(TBq/a)*	*(TBq)*	*(TBq/a)*	*(TBq)*
18 500	11.100	0.14	0.025	11	0.22	8	0.62	0.5	0.061

Carbon 14		Ruthenium 106		Cobalt 60		Radioiodines		Other beta and gamma emitters	
Limit	2006 discharges	Limit	2006 discharges	Limit	2006 discharges	Limit	2006 discharges	Limit	2006 discharges
(TBq/a)	*(TBq)*	*(TBq/a)*	*(TBq)*	*(TBq/a)*	*(TBq)*	*(TBq/a)*	*(TBq)*	*(TBq/a)*	*(TBq)*
42	7.5	15	4.8	1.4	0.21	2.6	1.32	60	7.55

Table 36: Limits and values of liquid discharges from AREVA's La Hague Site

L.6.2.2.4 Limits and values of liquid discharges from CEA sites

Current licences concern four sites and cover three categories of liquid discharges, as shown in Table 37.

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	0.00002	1	0.008	40	0.215
Grenoble	0.097	0.00068	0.022	0.0001	0.22	0.0076
Saclay	7.4	0.043	0.74	0.112	37	1.22

Table 37: Limits and values of liquid discharges from CEA sites

L.7 Bibliography

L.7.1 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*[6], French version only.
   See: *www.legifrance.gouv.fr/affichCode.do?cidTexte=LEGITEXT000006072665&date Texte=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&date Texte=20080713.*

5. *Sûreté nucléaire en France: Législation et réglementation,* Recueil n°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.7.2 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*

IAEA: *www.iaea.org*

MEEDDAT: *www.developpement-durable.gouv.fr/*

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[6] A large number of legislative and regulatory texts may be consulted on the following Website: *www.legifrance.fr*

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 Fran*ce
EIP	*Entreposage intermédiaire polyvalent* – Multipurpose Interim Storage Facility
ENISS	European Nuclear Installations Safety Standards
EPIC	*établissement 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- and intermediate-level short-lived (waste)
LL	low-level *or* long-lived (waste)
LL-LL	low-level long-lived (waste)
LL-SL	low-level short-lived (waste)
LWR	light-water reactor
MEEDDAT	*Ministère de l'écologie, de l'énergie, du développement durable et de l'aménagement du territoire* – Ministry of Ecology, Energy, Sustainable Development and Regional Development)
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

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