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RÉPUBLIQUE FRANÇAISE

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

Second national report
on implementation by France
of its obligations under the Convention

English version - Original report in French

September 2005

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Section A - Introduction

A.1 General introduction

A.1.1 Subject of the report

The Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management, hereinafter referred to as the "Joint Convention", is the result of international discussions which took place following adoption of the Convention on Nuclear Safety in 1994. France signed the Joint Convention on 29 September 1997, the first day on which it was opened for signature, during the General Conference of the International Atomic Energy Agency (IAEA). France approved it on 22 February 2000 and deposited 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 international action to reinforce nuclear safety and it considers the Joint Convention to be a key step in this direction. The fields it covers have for a long time been part of the French approach to nuclear safety.

This report, which is the second of its kind, is published in accordance with article 32 of the Joint Convention and presents the measures taken by France to meet each of the obligations set out in the Convention.

A.1.2 Facilities concerned

The facilities and radioactive materials which are the subject of this Convention are of widely differing types and in France are covered by different regulatory authorities, as explained in section E of this report.

Above a certain radioactive content threshold, a facility is referred to as a "basic nuclear installation" (BNI) and is placed under the authority of the Nuclear Safety Authority. This category includes in particular all facilities receiving spent fuel (reactors, reprocessing plants, storage facilities, etc.), most of the facilities whose "main purpose is management of radioactive waste" as defined by this Convention, and a large number of facilities containing radioactive waste, even if management of the waste is not their primary objective: the total number of all types of BNIs is about 125 facilities.

Below this threshold, an installation containing radioactive materials can be an "installation classified on environmental protection grounds" (ICPEs) and is placed under the supervision of the Ministry for the Environment. In France there are about 600,000 industrial facilities in the ICPE category, including nearly 65,000 subject to issue of an authorisation. If we consider only those ICPEs which are classified owing to the radioactive substances they contain or use, we obtain about 800 facilities.

Facilities only containing small quantities of radioactive materials are not subject to regulatory supervision in this respect. The radioactive sources they use may nonetheless be subject to supervision, as mentioned in this report and remain subject to the general radiation protection regulations.

A.1.3 Authors of the report

This report was produced by the Nuclear Safety Authority (ASN), which was responsible for coordination, with contributions on the one hand from the Directorate for the Prevention of Pollution and Risks, the Directorate for Regional Action and Quality and Industrial Safety, the Directorate General for Energy and Raw Materials and the Institute for Radiation Protection and Nuclear safety, and on the other from the main nuclear facility operators, Electricité de France (EDF), AREVA, namely its subsidiary the Compagnie générale des matières nucléaires (COGEMA), the French atomic energy commission (CEA) and the national radioactive waste management agency (Andra). Drafting of the final version was completed on September 2005 after consultation with the French parties concerned.

A.1.4 Structure of the report

For this second report, France took account of the experience acquired with its first report on the subject and on the three reports for the Convention on Nuclear Safety: this report is a stand-alone document based on existing documents and reflecting the viewpoints of the various stakeholders (regulatory authorities and operators). Thus, for each of the chapters in which the regulatory authority is not the only party to express its point of view, we adopted a three-stage structure: first of all a description by the regulatory authority of the regulations, followed by a presentation by the operators of the steps taken to meet the regulations and finally, 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 this Convention, in other words with an "article by article" presentation. Each article is the subject of a separate chapter at the beginning of which the corresponding text of the Convention article is recalled in a shaded box. After this introduction (section A) the various sections deal with the following topics, in the order proposed in the "guidelines":

- section B: policy and practices in the field of the Convention (article 32-1);
- section C: the scope of application (article 3);
- section D: the spent fuel and radioactive waste inventories, along with the list of facilities concerned (article 32-2);
- section E: the legislative and regulatory framework in force (articles 18 to 20);
- section F: the 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);
- section K: the planned activities to improve safety.

Finally, it is completed by a number of appendices (section L).

It should be noted that the regulations common to the safety of spent fuel management facilities and to the safety of radioactive waste management facilities have been placed in section E in order to avoid partial duplication between sections G and H, as recommended in the guidelines for drafting national reports.

A.1.5 Publication of the report

The Joint Convention comprises no obligation regarding public communication of the report stipulated in article 32. Nonetheless, given its duty to inform the public and its permanent desire to improve the transparency of its activities, the Nuclear Safety Authority has decided to make it accessible to anyone who so wishes. The report is therefore available, in both French and English on the Nuclear Safety Authority's website (*www.asn.gouv.fr*).

A.2 Conclusion of the first review meeting (3-14 November 2003)

A.2.1 General observations on factors of special interest (summary report)

Below we present observations regarding points of special interest, covered in paragraph 17 of the summary report from the first review meeting (3-14 November 2003).

17. During the Country Group sessions, many issues of special interest to both spent fuel and radioactive waste management emerged:

- *there were several comments on clearance levels for the disposal or reuse of materials with very low levels of radioactive contamination. It was agreed that renewed efforts should be made to get international consensus on this issue;*
- *there was some discussion on how to manage mixed wastes, i.e. radioactive and other hazardous materials. It was suggested that this would be a suitable area for additional guidance;*
- *there were several comments on the scope of the Convention in relation to uranium mining and milling wastes and wastes from the use of other naturally occurring radioactive materials. Some Contracting Parties had included these in their reports, others had not. This issue was discussed in the plenary session;*
- *there were several other comments on the scope of the Convention in relation to the storage of spent fuel at the reactor in which it had been irradiated. Some Contracting Parties had included these in their reports, others had not. This issue was again discussed in the plenary session;*
- *there was some discussion on the development and use of effective safety assessment tools for radioactive waste facilities. It was acknowledged that for some applications the tools available were adequate but for others, there was scope for further development, possibly through improving the IAEA Safety Standards;*
- *there was some discussion on the criteria for the design life of facilities for the storage of spent fuel and radioactive waste, pending decisions on future management including disposal. Some Contracting Parties indicated that the storage lifetimes would depend on their national policies;*
- *there was a growing recognition of the need for the development and implementation of integrated decommissioning and radioactive waste management plans. Such plans should be comprehensive. They should take into account all radioactive waste streams, including wastes arising from decommissioning. They could be presented, for instance, in the shape of a matrix providing for each type of waste the associated management channel (existing or under construction). Their purpose would be (a) to identify possible gaps in the current practices, and (b) to prepare and enable effective decisions on the ultimate management solutions for all streams. Several Contracting Parties reported on progress in this area and regarded such plans as crucial to the delivery of the successful decommissioning of nuclear sites and making them safe for future generations;*
- *there were several comments made on the long term storage of spent fuel. Some Contracting Parties favoured central storage facilities while others favoured storing spent fuel at the power stations pending the availability of a national disposal facility. Contracting Parties considered either practice to be acceptable;*
- *there were large variations reported in the status of national plans for the ultimate management solution of spent fuel and radioactive wastes. Some Contracting Parties had disposal facilities for certain categories of waste, others have facilities under development or construction, others have consultation programmes underway after which decisions will be made, others have no existing plans for disposal, some Contracting Parties expressed interest in exploring possible regional solutions for the management of radioactive waste, and at least one country sends its wastes to another. It was agreed that the Convention and the Review Meeting had given Contracting Parties the opportunity to exchange views and examine areas of good practice in this important area.*

A.2.2 Particular conclusions concerning discussion of the French report

France's first report elicited 210 questions from 20 countries who took part in the first review meeting session on 5 November 2003, devoted to presentation of the report and discussion of the questions it raised. Apart from opinions on the report, the written replies to the questions received and the presentation during the session, the rapporteur's conclusions mention the following points.

Under observations on factors of special interest, the research programme investigating options for HLW management to be submitted to the Parliament in 2006, as well as France's Radioactive Waste Management Plan to be presented to Parliament in 2006, attracted much interest. Questions related to both the purpose and the schedule for the plan. The primary purpose of the Plan was stated to be the establishment of the amounts and characteristics of all French radioactive waste streams, in order to enable effective decision-making related to the ultimate solutions for these streams. In the opinion of one country, the schedule is ambitious, and in particular it is both necessary and difficult to deal with smaller waste streams such as those from research programmes, which may pose particular technical difficulties. In response to two other questions, it was confirmed that possible means to deal with radium sources and with uranium tailings will be included in the overall plan.

With respect to the timing, it was made clear that the schedule was related to the Parliamentary requirement to report in 2006 on the results of the research programme on the management of high-level waste, and that future actions after the 2006 report depended very much on the parliamentary debate. It is not yet clear whether this debate will take place before or after the next Review Meeting of the Joint Convention.

Under observations on policies and practices, there were several questions on clearance and exemption criteria and how France applies them, in particular with respect to the differences between LLW, VLLW and conventional waste. France responded that it does not base its case-by-case decisions regarding clearance on numerical concentration limits, but relies on matters such as the provenance of the material (e.g. from inside a potentially-affected zone vs. from a clear area). Measurements of activity concentrations are considered to be for confirmation of clearance decisions, rather than as a basis for clearing material. With regard to exemption, if material is below the exemption criterion it does not enter regulatory control, but once it is under regulatory control, the exemption limit no longer applies. In response to a question on the role of public consultation in case-by-case clearance decisions, France indicated that regulatory requirements for such consultation are still being developed.

A particular question related to the option of long-term storage for high-level waste, and how it relates to the principle of avoiding undue burden on future generations. It was clarified that this option is only considered an interim measure pending a more final solution, and is not considered a final solution in itself.

A question about waste management at the source installations elicited the response that it is necessary that wastes be well-characterized and well-controlled starting at the time and place they are first generated, and that this is part of existing policies and practices in France.

Under observations on legislative and regulatory systems, there were a number of comments and questions on the regulatory structure, under which certain categories of waste are subject to more than one regulatory body. France acknowledged that the arrangement was somewhat complex, and in some respects the formal status might be improved, but that de facto both the independence of the regulator and the cooperation between regulators was very good.

A question was posed as to the role of regional authorities. In response, it was noted that while there are regional offices of the various regulatory bodies, these are centrally directed and were not controlled by local authorities.

Given that the regulatory body (ASN) reports to three different Ministries, a question was put as to how it is funded. ASN receives its budget from the Ministry for the Economy, Finance and Industry.

Under observations on general safety provisions, a question was posed on the issue of maintaining knowledge both of technical issues and of the characteristics of particular sites. France replied that it has fewer difficulties on technical issues than many other countries because of its active and continuing nuclear power programme, but acknowledged that it must continue to ensure that the knowledge and experience necessary continue to be available as the programme evolves. Retaining knowledge of site characteristics was cited as one reason for preferring the early decommissioning strategy.

Another question related to Periodic Safety Reviews. In response, France indicated that such reviews are carried out for all nuclear facilities (BNIs), and that they included two parts: a review of the conformity of the installation with the safety case, and a re-evaluation of this safety case against current regulatory requirements in order to improve the safety of the installation.

Under observations on the safety of decommissioning, there was a question about the choice of immediate vs. deferred decommissioning strategies. For plants already shut down, the option chosen is to proceed without delay. For the reactors still in operation, both strategies are still under consideration, although the regulator expressed a preference for early decommissioning.

Under observations on the safety of spent fuel management, one country asked whether there was a link between the various options being considered and the type of fuel (e.g. UO_2 vs. MOX vs. research reactor spent fuel). France responded that there was no direct link between the waste management option and the fuel type, i.e. in principle the option chosen, whatever it is, must deal with all types of high-level waste. The currently adopted strategy for the fuel cycle is reprocessing, but France is also pursuing research which would enable it to deal with wastes such as unreprocessed spent fuel of all types.

France agreed to respond positively and without delay to the official request introduced by a neighbouring Contracting Party concerning the communication of the results of the feasibility studies of the Bure programme.

Under observations on the safety of radioactive waste management, Article 12 on past practices attracted a question on France's proposals to deal with its uranium mine tailings sites. It was noted that these include not only mill tailings, but also heap leach wastes. France has established engineered impoundments and has covered tailings with several layers: heap leach wastes or waste rock, clean rock, and finally topsoil and vegetation. Programmes of monitoring for both radiological and geotechnical aspects have been established.

A question of clarification related to chemical toxicity of radioactive wastes. France confirmed that according to legal requirements that apply to all wastes, criteria and procedures for waste acceptance must also deal with chemical hazards.

Two other clarification questions involved remediation measures being applied at the La Manche waste site. A description of the covering layers applied to the site, as well as monitoring methods to confirm the integrity of these covering layers, was given. With respect to public access and security, access to the disposal site has been and is currently controlled. In the longer term, measures for long-term institutional control remain to be determined. In particular, methods of assuring continuing societal memory of the site need to be further developed.

A question was asked about a proposed concept for disposal of the contents of disused sealed sources in a near-surface repository. It was indicated that this suggested strategy is only being considered for sources containing short-lived material, and that the proposal was still being studied by the regulatory body.

Under observations on disused sealed sources, a question was asked about the methods by which foreign suppliers are included in the existing guarantee regime. It was noted that the existing industry pool arrangement is voluntary, but that it includes not only domestic but also foreign suppliers of radioactive sources used in France. France is currently studying the possibility of replacing or supplementing this voluntary system with formal requirements for financial guarantees.

Good practices described by France and noted by some delegates present include the periodic safety review process, the waste zoning and characterization process, the programmes to deal with historic practices and situations such as uranium mine tailings, and the public consultation processes.

As a general observation, the Country Group was satisfied with the answers and believes that France meets the obligations of the Joint Convention. Country Group members will be very interested in learning about the development of National Radioactive Waste Management Plan. A particular subject of great interest to many Contracting Parties will be the development of solutions for the long-term management of high-level waste.

A.3 Main changes since France's first report

The main changes since the first report concern implementation of the National Radioactive Waste Management Plan and the preparation of the discussions organised by the National Commission for Public Debate in view of the Parliament debates in 2006.

The new facts chiefly concern:

- commissioning of the VLL waste repository at Morvilliers,
- the June 2005 submission by Andra and the CEA of the reports presenting the results of 15 years of study as required by the 1991 law on radioactive waste, (Art L.542 of the Environment Code)
- publication by Messrs Bataille and Birraux of the Parliamentary office for the assessment of scientific and technological options (OPECST) report presenting the conclusions and recommendations of the Office with a view to the 2006 Parliamentary debate.

With regard to the safety of transboundary movements, France asked the IAEA in 2002 to organise a mission to assess its organisation of radioactive materials transportation and application of international regulations. The TranSAS (Transport Safety Appraisal Service) mission ran from 29 March to 8 April 2004.

The main modification concerns the structure of the report with the radiation protection regulations being moved from chapter E.2.1 (Article 19) to chapter F.4.1 (Article 24).

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 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 Spent fuel management policy

Energy policy in France is supervised by the Ministry for Industry. In France, electricity production from nuclear power reached 427 TWh in 2004. This nuclear production of electricity today entails about 1,150 to 1,200 tons of spent fuel being unloaded from the reactors every year.

Like a number of other countries, France has opted for the reprocessing-recycling option for its spent fuel. To do this, it has set up a consistent and efficient industrial tool at each step in the nuclear fuel cycle, following strategic decisions taken in the 1970s. This system comprises a spent fuel reprocessing plant with a total annual capacity of 1,700 tons (this figure changes depending on the burn up of the fuels considered). In addition, the French nuclear power plant fleet comprises a total of 58 standardised reactors, including 20 operating with MOX fuel produced by recycling, and another eight whose design enables this fuel to be used after minor operational modifications. This choice was made primarily for energy and environmental reasons.

To avoid building up stocks of separated plutonium for which there is no use, the fuel is reprocessed as and when uses for the extracted plutonium appear ("equal flow" principle), which today enables about 850 tons of fuel to be reprocessed annually, out of the 1,150 tons unloaded from the reactors in France, with the plutonium being recycled in the form of about 100 tons of MOX fuel. This means that the gradually reprocessed fuel has to be stored in cooling pools. Other options are also being looked at, such as long-term storage of fuel which is not reprocessed immediately. The eventual development (or not) of fast neutron or other types of reactors able to incinerate waste will be a determining factor in the storage time for these fuels, the rate at which they are disposed of and their final destination.

This option demands that the authorities maintain a constant watch on its radiological impact on the population and the environment, through epidemiological and impact assessments which have so far revealed no significant consequences and therefore no harmful impact.

B.2 Spent fuel management practices

B.2.1 EDF management of spent fuel from its nuclear power reactors

EDF assumes its responsibility for the future and the reprocessing of its spent fuel and the associated waste, in accordance with the guidelines defined with the authorities and in accordance with the safety requirements concerning basic nuclear installations and radioactive material transportation.

EDF's current fuel cycle strategy is to reprocess spent fuel while at the same time increasing the energy efficiency of fuels for the coming decade.

After a cooling period in the fuel building pools in the nuclear units, spent fuel assemblies are shipped to the COGEMA plant at La Hague.

After a few years, the spent fuel is reprocessed by dissolution, to separate the high-level waste (fission products and minor actinides: 4%), which is vitrified, from the materials that can still be reused (95% uranium and 1% plutonium). These materials are reused in MOX fuels (plutonium) and some (uranium) is currently used in fuel, recycling the uranium separated out during spent fuel reprocessing after re-enrichment. This amount will rise, this being the result of the significant rise in the price of natural uranium, which is replaced by the uranium separated out through reprocessing.

With today's facilities and using proven techniques, this industrial reprocessing – recycling process:

- ensures specific conditioning of high-level waste by vitrification, with today's existing, recognised and approved techniques guaranteeing safe long-term confinement in a compact volume (about 140 m^3/an);
- reduces the toxicity of the radionuclides conditioned in the waste by a factor of about 10, given that quantitatively, plutonium is the most radiotoxic element present in the spent fuel;
- ensures long-term control of the quantities of spent fuel pending reprocessing, using existing facilities and current storage capacity, if necessary after adaptation, owing to the spent fuel volumes sent for reprocessing and improvements to fuel energy efficiency, which reduces the volume unloaded from the reactor;
- keeps open the option in the coming decades and depending on the energy context, of eventually using the potential energy resource contained in the spent fuel assemblies (in particular the plutonium concentrated in spent MOX fuels, which can be reused to start the GEN4 future fast reactors);
- ensures that the flexibility of choices concerning the future of high-level, long-lived waste is maintained according to guidelines to be defined in 2006 under application of article L.542 of the environment code (see. § B.4.1).

An examination of the entire fuel cycle from the point of view of the safety of facilities and associated transportation, radiation protection and control of the waste produced, was conducted by the operators and presented to the Nuclear Safety Authority.

EDF, together with the industrial partners in the fuel cycle, thus keeps an up to date file concerning the compatibility between changes in new and spent fuel properties and changes to the facilities in the cycle and the impact on them of the envisaged changes, taking into account:

- the quantities of stored radioactive material produced by past fuel management policies and practices in particular storage of waste in vitrified form, inside the existing facilities;
- current management, which could require a review of the safety reference systems for the fuel cycle facilities, or even adaptation of these facilities;
- the fuel cycles in which the structural or rod cladding materials are different from those taken into account in the cycle facilities safety studies;
- the scenarios concerning the new forms of fuel management and the new products which are to be implemented in the coming ten years;
- the unloaded spent fuel management scenarios;
- the consequences of these management forms and management hypotheses until 2010 on the one hand, and then beyond 2010 on the other, for the by-products and waste resulting from fuel manufacture and spent fuel reprocessing (reprocessing possibilities and corresponding technologies, interim storage or disposal possibilities).

This file is supplemented as and when fuel evolution files are issued. It is examined and monitored by the Nuclear Safety Authority.

As required, R&D is continuing into a certain number of subjects. New decrees and authorisations concerning the La Hague spent fuel reprocessing plants were also published (on 13 January 2003).

The action taken regarding the future of the spent fuel is consistent with the requirement that the burden of processing the high level waste produced today not be passed down to future generations, but that the necessary steps be taken now, while continuing to study the solutions representing the best choices for society.

Current facilities are thus able to accommodate long-term spent fuel management, in proven conditions today recognised as being safe, provided that there is appropriate monitoring and supervision.

Furthermore, studies are also under way into the interim storage and disposal of spent fuels, in particular in accordance with article L.542 of the Environment Code, in order to keep open as many options as possible:

- industrial vitrified waste and spent fuel dry storage concepts exist internationally, for time frames of several decades, and are now applicable;
- long-term vitrified waste and spent fuel storage concepts are also being examined under article L.542 of the Environment Code;
- deep repository studies cover vitrified waste as well as spent fuel packaged in containers.

A significant part of these studies is consistent with article L542 of the Environment Code, which broadens the scope of research to strategies constituting major breakthroughs. EDF's industrial reference is based on immediate or deferred reprocessing of all the fuel unloaded.

Current spent fuel packaging studies also cover the transitional phases between the various options: industrial storage, reprocessing, long term storage, disposal.

Spent fuel management and reprocessing as today conducted are consistent with the fact that spent fuel remains a potential energy source and is not waste. This keeps open the option of recycling the recoverable materials and possibly reusing the spent fuel as an energy resource in future fuels and future reactors and which could be called on, at least in part, in an energy context different from that prevailing today.

B.2.2 CEA management of spent fuel from research reactors

The CEA's reference strategy is to send unused fuels to the "downstream" plants in the fuel cycle for processing, as soon as possible. In practice, they were shipped to the COGEMA UP1 spent fuel reprocessing plant in Marcoule, primarily used for military and defence programmes, until it was finally closed down in 1997. Closure of this facility led the CEA to develop its own storage capacity and to size it to ensure robust compliance with current and foreseeable safety rules, in the light of the programmed experimental fuels reprocessing at the COGEMA La Hague plant.

The CEA's current interim storage facilities consist of the PEGASE pit and the CASCAD dry storage area in Cadarache (dry storage bunker for irradiated fuel elements, with the pits cooled by natural convection). PEGASE is an old facility which should cease operations around the year 2010. CASCAD is more recent and will be able to store most CEA civil fuels.

In addition, as of 2006, the CEA will have an interim storage capacity in a new pit in Cadarache.

Provisional storage capacity still exists in Saclay and Marcoule: the fuel they contain will be removed during the course of the coming decade.

B.2.3 Spent fuel management by COGEMA

COGEMA offers the French operators access to all the resources needed to implement their spent fuel management policy.

This range of services is also made available to the electricity utilities located outside France who have adopted a similar policy. The spent fuels are shipped to the La Hague site where they are cooled for the appropriate period. The recyclable products and the waste are conditioned for return to their owners, in accordance with article L.542 of the Environment Code as regards waste.

The recyclable materials are separated from the various wastes, and both are then conditioned in the La Hague plants, while plutonium is recycled in MOX fuel in the MELOX plant in Marcoule, the capacity of which was raised to 145 tons of heavy metal and could soon be extended beyond this to absorb the shutdown of the CFCA production capacity in Cadarache.

B.3 Criteria used to define and categorise radioactive wastes

Radioactive wastes vary considerably in their radioactivity, their lifetime, their volume and their nature. Each type of waste requires an appropriate treatment and disposal solution in order to control the potential risks, in particular radiological. Radioactive waste classification is therefore linked to the disposal channels.

Two main parameters are used to assess the radiological risk: on the one hand the activity level, contributing to the toxicity of the waste, and on the other its half-life, which depends on the radioactive decay of the radionuclides present in the waste. Therefore distinction is made between very low, low, medium or high level waste, and on the other between very short-lived waste (radioactivity halved in less than 100 days) originating mainly from medical activities, short-lived waste, which mainly contains short half-life radionuclides (radioactivity halved in less than 30 years) and long-lived waste containing a large quantity of long half-life radionuclides (radioactivity halved in more than 30 years).

The following table shows the progress made in implementing the various waste management channels, in particular the channel chosen for disposal. It shows that for certain waste no final disposal solution has been decided. The potential channels are being discussed as part of the process to draft the National Plan for Management of Radioactive Waste and Recoverable Material .

Existing or future disposal channels for the main solid radioactive wastes

<table>
<tr><th>half-life
activity level</th><th>very short lived
(half-life < 100 days)</th><th>short-lived
(half-life < 30 years)</th><th>long-lived</th></tr>
<tr><td>very low level (VLLW)</td><td rowspan="4">management by radioactive decay</td><td colspan="2">dedicated surface repository (Morvilliers repository)
recycling technologies</td></tr>
<tr><td>low level (LLW)</td><td rowspan="2">surface disposal (Aube repository) except tritiated waste, sealed sources (under study)</td><td>dedicated subsurface repositories under study</td></tr>
<tr><td>intermediate level (ILW)</td><td>technologies under study under article L.542 of the Environment Code (law of 30 December 1991)</td></tr>
<tr><td>high level (HLW)</td><td colspan="2">technologies under study under article L.542 of the Environment Code (law of 30 December 1991)</td></tr>
</table>

The various categories defined above are generally abbreviated as follows:

- HLW	High level waste	(HA in French)
- ILW-LL	Intermediate level waste – long-lived	(MA –VL " ")
- LLW-LL	Low level waste - long-lived	(FA –VL " ")
- LILW-SL	Low/Intermediate level waste – short-lived	(FA/MA –VC " ")
- VLLW	Very low level waste	(TFA " ")

B.3.1 Very low level waste (VLLW)

Apart from waste generated by former uranium mine operations in France, very low level waste today primarily comes from dismantling of nuclear facilities, of conventional industrial or research sites which use low level radioactive substances in their production, or from clean-up of sites polluted by radioactive substances. The quantity produced will rise significantly when the time comes for large-scale complete dismantling of the power reactors and plants currently in operation. The radioactivity of this waste is a few becquerels per gram.

The Morvilliers repository designed to take very low level waste was commissioned in August 2003. Its capacity of 650,000 m^3 is compatible with the VLL waste volumes that will be produced within about 30 years.

B.3.2 Low level long-lived waste

This waste usually originates in industrial activities which concentrated radionuclides of natural origin (former radium industry for example) or the nuclear industry (such as the irradiated graphite contained in the structures of the gas-graphite natural uranium reactor series [UNGG]).

Owing to their long life, this waste cannot be disposed of in a surface repository, as it would not be possible to take advantage of their radioactive decay within a time-frame compatible with long-term institutional surveillance. However, their low intrinsic hazard means that they could be disposed of in a subsurface repository at about fifteen metres depth in a clay stratum about forty metres thick.

This depth of about fifteen metres complies with the target of minimising the effects of emanation of radon, which is a radium daughter product, but also of limiting the risk of intrusion. Graphite waste and radium containing waste, presenting specific containment issue, will be packed and stored according different ways.

The future of this waste is being discussed by the working group on the National Plan for Management of Radioactive Waste and Recoverable Material.

A working group coordinated jointly by the ASN and the services of the Defence Nuclear Safety and Radiation Protection Delegate (DSND) brings together Andra and the waste producers concerned.

The Nuclear Safety Authority has approved the overall concept of a repository for waste containing radium. A similar concept for graphite waste, stressing the advantages of combining the two projects was submitted to the Nuclear Safety Authority at the beginning of 2004.

On this basis, a programme was launched jointly with the competent French authorities to find a possible site where a common repository could be located for both types of waste envisaged. According to the estimated schedule, the repository project should be operational by 2010, thereby meeting the needs of EDF.

B.3.3 Low and intermediate level, short-lived waste

The activity of low or intermediate level short-lived waste, called "A waste" by the nuclear operators, is primarily the result of the presence of radionuclides emitting beta or gamma radiation, with a half-life of less than 30 years. In these waste, the long-lived radionuclides such as the alpha particle emitters are strictly limited. The waste in this category comes from nuclear reactors, fuel cycle plants, research centres, university laboratories and hospitals. It mainly comprises filters or ion exchanger resins used to purify water circuits, used equipment and materials, cleaning cloths and protective clothing. This category also includes some products resulting from treatment of liquid and gaseous effluent discharged from nuclear facilities.

The technical solution generally adopted for this type of waste is removal to a surface repository, either directly or after incineration or melting, where the waste packages are stored in concrete structures. This concept ensures containment of the radionuclides for a period enabling full advantage to be taken of the radioactive decay phenomenon, as well as institutional surveillance of the site for 300 years. This disposal channel has been operational since 1969, when France abandoned deepwater disposal of low level radioactive waste. Until then, 14,300 tons of radioactive waste originating in France had been disposed of at sea. In France there are now two repositories for this type of waste: the Manche repository, today full and which in January 2003 entered its institutional surveillance phase, and the Aube repository, commissioned in 1992.

Of the low or intermediate level, short-lived waste, some have properties such that they cannot currently be accepted in the Aube repository in Soulaines, without a specific safety assessment and an additional authorisation from the ASN.

This is for example the case of waste containing significant quantities of tritium, a radionuclide that is hard to confine, or sealed sources. A working group, coordinated jointly by the competent Regulatory Authorities and comprising Andra and the leading waste producers (CEA, COGEMA and EDF), has been tasked with examining the most appropriate management channels for this type of waste.

Most sealed sources fall into this category: in industrial or medical activities, the radioactive elements are often confined in perfectly sealed packages. The tightness of the packaging is guaranteed, either by periodic tightness tests, or by a strictly limited source service life; it is consequently clear that the items in contact with it cannot be contaminated by radioactivity and can thus be disposed of as conventional waste. After use, the sources must be returned to their manufacturer.

A specific characteristic of these sources is that the radioactivity they contain is often highly concentrated. Consequently, even when the radioactive elements concerned have a relatively short half-life, they cannot always be accepted in a surface repository as-is, because even after 300 years, they could still contain significant radioactivity; furthermore, their envelope which is often made of corrosion-resistant materials, could be attractive to persons excavating the repository. The future of used sources is being examined by a special working group coordinated by the ASN and working on drafting the National Plan for Management of Radioactive Waste and Recoverable Material.

B.3.4 High level waste and intermediate level long-lived waste

HLW and ILW-LL waste contain emitters with a long half-life, particularly alpha radiation emitters. Distinction is made between intermediate level waste on the one hand and high level waste on the other.

Whether or not directly, this waste comes primarily from spent fuel. After having produced energy in the reactor for 4 to 5 years, the spent nuclear fuel contains:

- 96% recyclable material (uranium and plutonium atoms);
- 4% high level, long-lived waste (HLW-LL) which is the "ash" from the nuclear combustion process and comprises caesium, cadmium, tin, molybdenum, americium, etc. atoms;

Its casing (non-recyclable metal tubes containing the fuel) becomes intermediate level, long-lived waste (ILW-LL). Other waste corresponding to spare parts (technological waste) also falls into this category.

High level waste is characterised by the release of large amounts of heat (up to 4 kilowatts per 180-litre container). In other countries, high-level waste can also include spent fuel from research reactors and spent fuel from reactors producing electricity and which are not intended for reprocessing. It should be recalled that even though this is not the case in France, investigations into long-term management of all HLW and ILW-LL waste (including spent fuel, notwithstanding the national strategy) currently stored on the production sites, are being carried out along the three lines defined by article L.542 of the Environment Code (law of 30 December 1991) presented below.

B.4 Radioactive waste management policy

B.4.1 General framework

In the same way as any industrial activity, nuclear activities generate waste. Radioactive waste management therefore falls within the general framework defined by law n° 75-633 of 15 July 1975 (article L.541 of the Environment Code), supplemented by the law of 13 July 1992 and its implementation decrees, concerning the disposal of waste and retrieval of materials. The basic principles of this law are the prevention of waste production, the responsibility of the waste producers up until disposal, the traceability of these wastes and the need for public information. In addition only ultimate waste, for which reuse or recycling cannot be envisaged in current technical and economic conditions, can be disposed of.

Waste management begins with the design of the facilities and continues through operation, with the aim of limiting the volume of waste produced, its toxicity and the quantity of residual hazardous materials. It ends with disposal of the waste (recycling or disposal), after identification, sorting, processing, conditioning, transport and interim storage. All the operations associated with management of a waste category from production to disposal form a channel. Each channel must be appropriate to the nature of the waste being dealt with. There may be several channels for a particular type of waste.

As regards the traceability of very low level radioactive waste, decree 2005-635 of 30 May 2005 published in the Official Gazette of 31 May 2005, concerning control of waste processing systems, prepared by the Ministry for the Environment, aims to ensure improved control and monitoring of waste throughout the processing and disposal phases, by requiring that traceability systems be set up (registers, periodic declarations to the administration and waste monitoring schedules). It will concern radioactive waste that can be eliminated in ICPEs.

The operations in a given channel are closely linked, and all the channels are inter-dependent. All the radioactive waste operations and channels thus constitute a system which has to be optimised as part of a global approach to the management of these wastes, which takes account of safety, traceability and volume reduction issues.

Finally, article L.542 of the Environment Code (resulting from the law of 30 December 1991) set the broad guidelines for research into management of high level and long-lived radioactive wastes:

- high-level long-lived radioactive waste must be managed in such a way as to protect nature, the environment and human health, taking into consideration the rights of future generations;
- work is conducted into:
  - the search for solutions for separating and transmuting the long-lived radioactive elements present in these wastes (line 1);
  - study of the possibility of reversible or irreversible disposal in deep geological formations, in particular by building underground laboratories (line 2);
  - study of conditioning processes and long-term surface or subsurface storage for these wastes (line 3).

Research into line 1, in particular in the CEA's Atalante laboratory in Marcoule, provided a laboratory-scale demonstration of the feasibility of separating americium and curium. Similarly, the feasibility of separating certain fission products of which certain isotopes have long radioactive half-lives, such as caesium, has apparently been demonstrated.

Transmutation of minor actinides would also appear to be theoretically feasible. The transmutation of fission products would seem to be more hypothetical given the low transmutation yield observed. Quite apart from the theoretical feasibility, there is the problem of reproducing in the reactors the results obtained in the laboratory. A number of experiments to demonstrate technical feasibility are therefore underway in the CEA's Phénix reactor in Marcoule.

Research into geological disposal of HLW-LL waste is being carried out by Andra. Andra was authorised in 1999 to create an underground laboratory on a site located on the border between the *départements* of Haute-Marne and Meuse, designed to examine the Callovo-Oxfordian clay formation. Soundings made on the site helped characterise the geological environment. Excavation of the shafts for access to the drifts in which the experiments are to take place is currently being completed. An experimental niche was excavated in the second half of 2004 in the main shaft at a depth of -445 m in order to examine the effects of shaft excavation on the Callovo-Oxfordian clay.

Finally, research work into long-term storage of HLW-LL waste is being run by the CEA. This work concerns treatment and packaging processes, storage containers, container characterisation and supervision of packages and the long-term storage concepts. It should be recalled that the long-term storage solutions are not definitive long-term management solutions, but must be included in management strategies involving other methods.

Budget allocated, from 1992 to 2004, to research conducted under the law of 30 December 1991 are given in the table hereafter expressed in millions Euros :

	1992	*1993*	*1994*	*1995*	*1996*	*1997*	*1998*	*1999*	*2000*	*2001*	*2002*	*2003*	*2004*	***Total***
Axe 1	23.8	34.2	45.4	55.6	54.9	66.2	64.0	70.2	72.1	73.4	72.8	96.5	80.9	**810**
Axe 2	50.5	41.1	69.0	80.0	77.4	67.0	65.0	61.9	91.0	83.7	80.9	103.6	135.9	**1,007**
Axe 3	33.2	33.8	33.4	35.8	39.6	41.9	48.4	73.6	76.6	65.9	69.5	56.6	63.9	**672**
Total	107.5	109.1	147.8	171.4	171.9	175.1	177.4	207.7	239.7	223.1	223.2	256.8	280.6	**2,489**

In anticipation of the Parliamentary debate scheduled for 2006 and concluding 15 years of R&D as stipulated by the law of December 1991, The Parliamentary office for the assessment of scientific and technological options (OPECST) published a report at the beginning of 2005 comprising the following recommendations:

Recommendation 1: Information concerning the results of research into radioactive waste management must be improved at all levels: local, national and international.

Recommendation 2: Research into separation-transmutation and reversible disposal in deep geological formations must continue beyond 2006, with the Parliament continuing to provide impetus and setting milestones.

Recommendation 3: The research data resulting from the law of 1991 must be exploited locally and nationally at the scientific, university and industrial levels, through combined action by the public authorities and nuclear operators.

Recommendation 4: Parliament should enshrine three radioactive waste management principles in law, which are that France sets separation-transmutation as an ultimate goal in this field, while employing reversible disposal in deep geological formations as well as long-term storage.

Recommendation 5: Parliament could set a number of goals for action by the public authorities: 2016 as the date for commissioning of a long-term storage facility and authorisation to build a reversible deep *geological disposal repository, 2020-2025 for startup of a transmutation reactor demonstrator and commissioning of the geological repository, and 2040 for industrial transmutation.*

Recommendation 6: The National Plan for Management of Radioactive Waste and Recoverable Material (PNGDR-MV) could, as a general framework for radioactive waste management, be incorporated into legislation.

Recommendation 7: The creation of a dedicated fund for financing research into radioactive waste and its industrial management, placed under the responsibility of the State and collecting contributions from the waste producers, should be decided on by Parliament in order to provide long-term guarantees for funding of the necessary efforts.

Recommendation 8: The duties of Andra concerning disposal of radioactive waste could be extended to cover long-term storage of all radioactive waste and spent UOx or MOX fuels which are not reprocessed.

The PNGDR-MV and the national inventory

There is a clear need for a general framework for consistent management of all radioactive waste, regardless of the producer, in order to guarantee its safe management and the associated financing, in particular by defining the relevant priorities.

Further to a request from the Parliamentary office for the assessment of scientific and technological options in 2000, the Nuclear Safety Authority organised meetings in the first half of 2003 to examine the feasibility of a national radioactive waste management plan.

The Minister for Environment officially stated the intention of drafting such a plan during the Government Cabinet meeting of 4 June 2003.

Several meetings of the full working group responsible for drafting this plan have taken place since then. Invitations to attend these meetings are issued to certain technical entities, that is the waste producers (all sectors), waste disposal facilities, Andra, the directorates of the ministries concerned, but also environmental protection associations and elected representatives. An initial version of the National Plan for Management of Radioactive Waste and Recoverable Material was distributed to the working group responsible for drafting in September 2004. A second version taking account of all the remarks made by the participants was distributed at the beginning of 2005

The plan is based on work aimed at identifying the waste that exists nationwide. This is primarily the Andra national inventory. The interfaces with the existing work aimed at designating the management channels for high level long-lived waste, in accordance with the provisions of article L. 542 of the environment code, are also specified.

The guidelines of the National Plan for Management of Radioactive Waste and Recoverable Material

The national management plan will be based on common principles, on the one hand concerning waste management in general and on the other concerning radiation protection. These guidelines were also examined by the stakeholders. They should be as follows:

- compliance with the main principles of protection against ionising radiation: (justification, optimisation, limitation) and protection of the environment (principles of precaution, polluter-pays, etc.);
- prevention or reduction at source of waste production and waste harmfulness;
- responsibility of the waste producers, who are responsible for disposal in conditions such as to avoid all harm to human health and to the environment;

- information and active involvement of the citizens;
- traceability of waste management (concerning the radioactive nature of the waste and during waste management operations), and definition of any associated constraining measures;
- inclusion of risks linked to the transport of radioactive waste, with a view to optimising all the risks linked to its management;
- definition of management and disposal channels appropriate to the characteristics of the various types of waste, in particular with regard to storage of waste for which there is as yet no disposal channel, or assuming responsibility for disused waste, usually resulting from past practices;
- optimisation of each channel and definition of the corresponding controls;
- quantifiable progress concerning methods and techniques.

Two versions of the PNGDR-MV were presented to the members of the working group in 2004 and at the beginning of 2005. A consolidated version of the plan is available for consultation by the public since mi 2005 on the ASN website. As part of the work in progress to draft a bill on the future of high level long-lived waste, the principles and recommendations of the PNGDR-MV could be appended to the bill to be tabled before Parliament in 2006.

On 9 December 1998, the Government asked the Chairman of Andra to "propose all reforms such as to provide a reliable inventory of these wastes, in particular with extrapolation of the inventory to the medium and long term". Consequently, the Chairman of Andra recommended in June 2000 production of a national reference inventory, based on a broad definition of the notion of waste (including unused spent fuel) and giving forward-looking assessments of the waste "committed" in existing facilities. The aim was to go further than the purely geographical approach on which Andra's annual inventories had been based since 1993 and produce an accounting picture such as to offer a more suitable basis for national work on overall management. In July 2001, the Government confirmed its decision to launch the national radioactive waste reference inventory and finance it from the budget of the Minister of Industry. This is one of the elements of the four-year contract signed by the State and Andra. The first national inventory of radioactive waste and recoverable materials was published in November 2004. It comprises the inventory of waste produced to date and estimates of the quantities to be produced by 2010 and 2020. An estimation of the waste to be produced by installations being dismantled after 2020 was also made. An updated version is scheduled for publication in 2006.

The largest volumes concern very low level or low and intermediate level, short-lived waste, which only account for a few terabecquerels, or a tiny fraction of the total activity. Conversely, high level long-lived waste will in 2020 represent more than one billion terabecquerels, for a total volume of only a few thousand cubic metres.

B.4.2 Conventional waste, radioactive waste, very low level waste

The waste produced in facilities conducting nuclear activities are of two types, depending on whether or not they are radioactive.

Non-radioactive, or "conventional" waste mainly comes from areas on sites in which no radioactive materials are handled, or which are considered to be non-contaminating (administrative buildings, technical areas, etc.). It can also for example comprise packagings removed before equipment or products enter one of the nuclear parts of the sites. With regard to BNIs, this conventional waste is sorted, packaged and then disposed of using the same rules and in the same facilities as the waste produced by installations classified on environmental protection grounds (ICPEs). The facilities which receive conventional waste from a BNI are placed in a particular category of the ICPEs nomenclature, so that monitoring and traceability can be guaranteed.

Nuclear waste, on the other hand, comes from areas in facilities likely to be contaminated or activated. This definition clearly implies a degree of precaution. Management of these wastes incorporates a number of operations designed in the short and long term to protect persons, preserve the environment and minimise the constraints imposed on future generations. This management must be safe, strict and clear.

It should be recalled that in France, there is no universal clearance threshold below which a nuclear waste can be considered as no longer constituting a radioactive hazard. The clearance authorisations can be granted on a case by case basis subject to sufficient knowledge of the situation and the origin of the waste, and according to a specially authorised disposal channel ensuring sufficient traceability.

Reuse of waste for the manufacture of consumer goods or reuse of construction products originating from nuclear activities likely to be contaminated is not authorised by the Public Health Code, which nonetheless stipulates that the Minister for Health may grant a waiver to this rule. However, the Minister for Health, in a procedure to authorise recovery of waste from nuclear activities, announced that he was not in favour of reuse outside nuclear facilities of waste from nuclear activities.

Waste containing only natural radioactivity and originating from facilities other than those classified according to the radioactive substances they contain, are managed with no particular radioprotection measures, unless a radiological impact assessment demonstrates that the doses received by workers (considered to be the most heavily exposed category) exceed one millisievert per year. An optimisation process is implemented as and when necessary.

An order from the Ministers for Labour, Health and the Environment aims to impose a radiological impact assessment on professional activities employing materials which are not primarily used for their radioactive properties.

B.4.3 Sealed sources unlikely to activate the materials

The use of sealed sources not able to activate the materials produces no radioactive waste other than the source itself. There are regulatory mechanisms which in particular comprise a system of financial guarantees to ensure that at the end of its service life, the source will be retrieved by its supplier who may either return it to the manufacturer, or dispose of it in the long-term management channel authorised. All the other wastes from the corresponding facility will be managed as conventional waste.

B.4.4 Other sources, ICPEs and mining residue

The nomenclature of installations classified on environmental protection grounds (ICPE) defines several classification headings according to the conditioning of the radioactive substances used and the uses to which they are put. For each of these headings, the classification thresholds are set in order to regulate those installations concerned which have the most significant impact.

The radioactivity involved in ICPE is far lower than in BNI. However, there is a possibility of contamination of materials and wastes. The general provisions concerning hazardous industrial waste apply, as radioactivity is simply one of the characteristics which can constitute a hazard: waste from ICPE can only be disposed of in duly authorised facilities, on the basis of an impact assessment taking account of all toxicity factors of the waste handled. Current regulations prohibit the presence of radioactive waste in conventional industrial hazardous waste storage facilities, and radioactive waste can only be disposed of in dedicated repositories.

However, given that no substance is completely free of radionuclides, natural or otherwise, the provisions of paragraph B.4.2 are implemented in practice to determine the radioactive or conventional nature of the waste, in other words, a specific impact assessment is conducted as and when needed.

For medical waste, a circular explains the need to sort waste likely to have been contaminated by radioactive substances from other waste. For ICPE, there are standard general provisions that the departmental authority can modify according to the toxicity of the radionuclides used in the installation.

The intentional addition of radionuclides to consumer goods or construction materials is prohibited by the Public Health Code. Marketing of radioactive lightning arresters was thus banned in 1984. Fire detectors using radioactivity were limited to professional sectors identified beforehand and banned from use by the general public. However, the widespread use of this type of object means that disposal facilities for eliminating them will eventually be required. Proposals were thus submitted as part of the process to draft the National Plan for Management of Radioactive Waste and Recoverable Material.

Finally, French regulations applicable to the restriction and evaluation of the dosimetric impact of mining residue repositories comprises general legislative texts relative to environmental protection and legislation specific to the mining industries. These regulations are based on decree 77-1133 of 21 September 1977 concerning ICPE, decree 80-331 of 7 May 1980, as modified, creating the general regulations for the mining industries (Mining Code) and decree 90-222 of 9 March 1990 supplementing the previous degree with regard to protection of the environment against ionising radiation.

B.4.5 Basic Nuclear Installations (BNI)

The management of radioactive waste from BNIs relies on a strict regulatory framework specified by an administrative order of 31 December 1999 setting the general technical regulations for preventing and limiting pollution and external risks resulting from operation of basic nuclear installations. It provides for:

- the production of "waste surveys" for each nuclear site, using an approach already employed for some ICPE; the waste survey, which should lead to an inventory of waste management on a site, in particular comprises the definition of "waste zoning"[1], distinguishing between the zones of the installation in which waste is likely to have been contaminated by radioactive substances or activated by radiation and zones in which the waste cannot contain any added radioactivity. The survey must be approved by the ASN;
- for each type of nuclear waste (see the definition in § B.4.2), definition of the appropriate and duly authorised channels, based on impact assessments and the subject of public information or consultation;
- setting up waste monitoring systems to ensure traceability.

The waste surveys system should help to improve overall management of the waste, in particular in terms of transparency, and to develop optimised management channels.

In addition, with regard to high level long-lived wastes, in accordance with article L.542 of the Environment Code mentioned above, Parliament will in the second half of 2006 be required to rule on the choice of solutions adopted for their disposal.

B.4.6 Responsibilities of the parties

The producer of the waste is responsible for it up to disposal in a duly authorised facility. However, various parties are also involved in the waste management process: shipping companies, treatment contractors, operators of the interim storage centres or repositories, research and development organisations working on waste management optimisation. Each of them is responsible for the safety of

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[1] "**Waste zoning**" divides the facilities into zones which generate nuclear (or radioactive) waste and zones which generate conventional waste. It takes account of the design and operating history of the facilities and is confirmed by radiological checks.

It should be noted that pending setting up of "waste zoning", all waste generated in a controlled zone is to be considered radioactive, barring rare waivers.

its own activities. The scope of the producer's responsibility includes its financial responsibility. The fact that a producer of radioactive waste has transferred its waste to a storage facility or repository belonging to Andra does not mean that it is no longer financially responsible. The producers of the waste must pursue an objective of minimising the volume and activity of their waste, upstream during the design and operation of the facilities and downstream during management of the waste. The quality of the conditioning and packaging must also be guaranteed. Monitoring compliance with these objectives is facilitated by the fact that the cost of waste treatment naturally encourages the producers to attempt to minimise the quantities. As part of the process to approve the BNI waste surveys, the ASN checks that the operator does all to comply with this objective.

The waste reprocessing (compacting, incineration, melting) contractors can be working on behalf of the producers, who retain ownership of their waste. These contractors are responsible for the safety of their installations.

The research organisations take part in technical optimisation of radioactive waste management, both during production and during development of treatment, conditioning and conditioned waste characterisation processes. Good coordination of these research programmes is needed to improve the overall safety of this waste management.

Managers of the interim storage centres and final waste repositories are responsible for the medium and long term safety of their facilities. Among these managers, Andra, a public body responsible for radioactive waste management, has a national duty of long-term management of repositories and coordination of waste disposal research. Andra is today responsible for all radioactive waste disposal facilities in France.

B.4.7 The role of Andra

As specified in article L.542-12 of the Environment Code, Andra is responsible for all operations involved in long-term management of radioactive waste. These operations include:

- joint participation with the CEA in defining and implementing R&D programmes concerning the long-term management of radioactive waste,
- ensuring long-term management of repositories, either directly or through a subcontractor,
- designing and building new repositories,
- in compliance with the safety rules, defining the packaging and disposal specifications for radioactive waste.
- conducting an inventory of the condition and location of all radioactive waste nationwide.

As a Public Industrial and Commercial Organisation, Andra has the necessary resources for performing the various tasks mentioned above, under the three-fold supervision of the Ministries for Industry, Research and Environment.

Statute of Andra

Andra is the Agency responsible for long-term management of all radioactive waste in France. It places its expertise and skills at the disposal of the policy defined by the Government. In this role, the Agency defines proposals for all problems in long-term management of radioactive waste and for credible management solutions for each category of radioactive waste.

The French law of 13 July 1992 defines the general principles of a programme for radioactive waste management: recovery of all the usable potential of the waste, optimum reduction of the harmful effects and disposal of ultimate waste. The Agency is involved in this process by providing the waste inventory.

It plays a major role in managing storage facilities and repositories. It also plays a more marginal role in reducing the harmful effects linked to the presence of this waste, although its role is significant in defining waste acceptance criteria for disposal and it helps develop overall and long-term management solutions, jointly with the other stakeholders.

More particularly in the context of the research conducted in accordance with the law of 30 December (Article L.542 of the Environment Code), the Agency is responsible for the programme linked to the feasibility of the design and operation of a deep geological formation repository. This programme is based on the construction and operation of an underground research laboratory located on the boundary between the Meuse and Haute-Marne *départements*.

The Agency has thus opted to move towards an environmental approach to radioactive waste management, within the framework of safe and exemplary industrial operation based on strict and transparent scientific and technical principles.

It is also developing disposal concepts for waste categories which for the time being have no disposal channel:

- graphite waste (stacks and sleeves) from the old "graphite-gas" reactors;
- radium containing waste;
- tritiated waste.

Andra has a three-fold role: industrial, research, and information.

The coexistence of these three complementary roles enables it to gain a complete, overall picture of waste management.

· The industrial role concerns the ability to implement concrete management solutions for different types of waste. The Agency's challenge is even to increase the exemplary nature of operation and cost control in its repositories while meeting human and environmental protection requirements.

· The research role covers all activities aimed at exploring new routes for managing radioactive waste for which there is currently no long-term management solution, in order to propose options that are viable over the long term.

This also includes improvements to existing solutions.

The Agency relies on a dynamic based on collection of the data needed to design and assess management solutions. This type of approach implies application of a scientific and technical approach underpinned by strict and thorough assessment. It also requires strengthening partnerships with other players in the research and technology fields, including setting up a policy of scientific exchanges. Finally, the Agency is responsible for incorporating this knowledge into its own projects in accordance with the terms of contracts signed with its partners.

. The information and inventory role is primarily focused on collecting, compiling and distributing information to ensure that as broad an audience as possible has access to verifiable information on the nature and location of the waste, the possible future management scenarios and existing management solutions. This type of role reflects a very real desire for transparency.

B.4.8 The policy of the French Nuclear Safety Authority

For its part, the Nuclear Safety Authority (ASN), responsible for controlling the safety of the BNI only, but in charge of radioprotection of all nuclear facilities and activities, drafts general regulations - consistent with the general regulations applicable to waste – concerning the management of radioactive waste and directly controls the general organisation put in place by Andra for the design and operation of the repositories as well as for acceptance by these repositories of waste from the producers. It assesses the waste management policy and practices implemented throughout the nuclear activities.

The ASN has three primary concerns:

- the safety of each step in radioactive waste management (production, treatment, conditioning, interim storage, transportation and disposal of the waste);
- the safety of the overall radioactive waste management strategy, ensuring that it forms a consistent whole;
- the development of management channels appropriate to each category of waste, given that any delay in the search for waste disposal solutions leads to a rise in the volume and size of the amounts stored on-site.

B.5 Radioactive waste management practices

B.5.1 Radioactive waste from the BNIs

B.5.1.1 Management by EDF of the waste from its nuclear power reactors

The waste resulting from operation of pressurised water reactors is primarily very low, low, or intermediate level, short-lived waste. It contains beta and gamma emitters and few or no alpha emitters. It can be placed in two categories:

- process waste resulting from purification of circuits and treatment of liquid or gaseous effluents, designed to reduce activity prior to discharge. This comprises ion exchanger resins, water filters, evaporator concentrates, liquid sludge, pre-filters, absolute filters and iodine traps;
- technological waste arising from maintenance operations. It can be solid (cloths, paper, cardboard, vinyl sheets or bags, pieces of wood or metal, rubble, gloves, protective clothing, etc.) or liquid (oil, decontamination effluents).

It should be noted that although, among the process waste, ion exchanger resins and water filters only account for about 5% of the total volume of waste produced, they account for more than 90% of the activity removed. The following table shows the breakdown of operating waste.

Annual production of operating waste from EDF nuclear power reactors

Low or intermediate level waste disposed of in the CS FMA (1)

2004 RESULTS (covering 58 PWRs)	Channel	Gross volume before conditioning (m^3)	Volume of packages disposed of in the CS FMA (m^3)	Activity (TBq)
- Process waste	CS FMA(1)/CTO(2)	990	2,680	200
- Technological waste	CS FMA/CTO	7,060	2,800	20
TOTAL		8,050	5,480	220

(1) CS FMA: Low and Intermediate level repository, or Aube Repository, managed by Andra.
(2) CTO (CENTRACO): Processing and Conditioning Plant operated by SOCODEI (subsidiary of EDF & COGEMA).

Very low level waste disposed of in the CS TFA (3)

2004 Results (covering 58 PWRs)	Channel	Mass of waste disposed of (tons)	Activity (TBq)
- Process waste	CS TFA(3)	430	0.002
- Technological waste	CS TFA	460	0.004
TOTAL		890	0.006

(3) CS TFA: Very low level repository, or Morvilliers repository, managed by Andra.

The technological waste, which represents the main stream (85 % of the total volume of gross waste) is:

- either shipped directly, after compacting on-site in 200 litre metal drums, to the Aube repository's press, for further compaction and then final disposal after encapsulation in 450 litre concrete drums. The most highly radioactive technological waste is conditioned on-site in concrete containers and directly disposed of in the same repository;
- or, when incinerable and low-level, shipped in metal or plastic drums to the CENTRACO incineration unit, while scrap is sent to the melting unit in the same plant. Waste resulting from incineration (ash and clinker) and melting (ingots) is also sent for final storage in the Aube repository.

The plant for low level waste processing and conditioning, CENTRACO, located in the commune of Codolet near the Marcoule site in the Gard *département*, and operated by SOCODEI (a subsidiary of EDF and COGEMA), is specialised in the treatment of low and very low level waste, either by melting of metal waste or incineration of incinerable or liquid waste (oils, solvents, evaporation concentrates, etc.). With this installation, part of the low or very low level metal waste can be recycled in the form of biological shielding for packaging other more radioactive wastes within concrete shells.

The process waste is packaged in concrete containers with a metal liner. The filters, evaporator concentrates and liquid sludge are encapsulated in a hydraulic binder in fixed facilities (in the nuclear auxiliaries building or the plant effluent treatment building).

For final packaging of ion exchanger resins, EDF uses the MERCURE process (encapsulation in an epoxy matrix) employing two identical mobile machines.

The packages produced by both machines are intended for surface disposal. The biological protection of the packages is provided by a concrete container reinforced with a leaktight steel liner. The steel biological shields inserted into the containers may be manufactured using the low-contamination steel recycled in the CENTRACO facility.

Maintenance of the nuclear power plants may make it necessary to replace certain large components such as reactor vessel heads, steam generators, racks (pool fuel storage racks), and so on. These special wastes are stored either on the site, or in the SOCATRI at Tricastin, or disposed of in the Aube repository.

During the course of the last 15 years, comparable progress has been made by the nuclear reactors, which mainly produce low and intermediate level, short-lived waste (it should be recalled that spent fuel is not waste).

The quantity of this type of waste, calculated on a per terawatt-hour basis, has considerably fallen in the space of twenty years, as the volume of packages concerned has dropped from about 80 m^3/TWhe in 1985 to just under 14 m^3/TWhe today. This volume corresponds to an average production of about 100m^3 of packages intended for surface disposal per PWR unit. Insofar as processing of the corresponding waste has been considered optimised since the melting and incineration units at CENTRACO were commissioned, this average volume per reactor constitutes a threshold of which the virtual stability since 1995 in fact indicates continuous progress when compared with the (rising) production of electricity. The decisive factors which contributed to the drop observed over the decade 85-95 are chiefly organisational - reduction of potential waste at source, sharing feedback, "good practices" - and technical - implementation of changes to the redraining of liquid effluent, denser packaging of certain waste by grouping and/or pre-compacting, etc. These improvements were effective for the waste resulting directly from reactor operation and that produced by reactor maintenance and the contributions today from each of the above-mentioned sources are almost identical.

It is important to stress that this reduction in solid waste was not offset by an increase in liquid discharge, far from it, as over the same period, the average activity (excluding tritium) of the liquid effluent discharged into the environment by the NPPs was divided by a factor of 50.

B.5.1.2 CEA management of waste from nuclear research facilities

CEA's radioactive waste management strategy can be summarised as follows:

- to resorb the stocks of old waste as soon as possible, by taking action to retrieve and characterise, along with the appropriate treatment and conditioning channels;
- to minimise the volumes of waste actually produced;
- to no longer produce waste without a specific management channel;
- to sort waste at the primary production site according to the management channels defined, in particular to avoid over-classification of waste or subsequent recovery operations;
- to evacuate the waste to the existing channels (Andra repositories or, failing which, the CEA's long-term storage facilities), ensuring that the disposal stream is equivalent to the production stream: this is to prevent experimental facilities or waste processing and packaging plants from becoming congested, as they are not designed for storage of large quantities of waste over long periods;
- to perform these actions in optimum conditions of safety and radioprotection, but also in the best technical and economic conditions.

B.5.1.2.1 Waste from treatment of radioactive liquid effluent

The CEA's radioactive aqueous effluent is treated in the facilities at the Cadarache, Saclay and Marcoule centres. The radioactive liquid effluent treatment plants are primarily designed to decontaminate the aqueous effluents, to package the residues and control their discharge into the environment within the framework of the release and discharge permits of each site.

In Cadarache, the beta-gamma emitting effluents are treated by evaporation. The concentrates are encapsulated in a concrete matrix for disposal in the Aube repository.

In Marcoule, the alpha and beta-gamma emitting effluent is treated by evaporation and/or precipitation-filtration; the resulting sludge is encapsulated in a bitumen matrix and then stored pending final disposal.

In Saclay, as of 2006, a new facility called STELLA will replace the old one and treat effluent by evaporation. The concentrates will be encapsulated in a concrete matrix for disposal in the Aube repository.

B.5.1.2.2 Solid radioactive waste

The CEA's very low level waste has since the end of 2003 been shipped to a dedicated disposal facility, Andra's VLLW repository.

The low and intermediate level waste is either incinerated, or compacted in the Cadarache and Saclay installations. The waste is incinerated in the SOCODEI CENTRACO plant. The compacted waste is then encapsulated or blocked in concrete. Depending on the activity of the packages, they are either shipped to the Aube repository or stored in Cadarache.

The Aube repository takes low and intermediate level, short-lived waste. For the other types of radioactive waste, the CEA has interim storage facilities the design of which, in particular with respect to safety, is tailored to its production estimates and the time Andra will need to build final disposal facilities.

Low and intermediate level, long-lived waste has been well anticipated by the CEA and in 1994 it planned to replace the existing dedicated storage facility in Cadarache (BNI 56), which was of an old design and nearing saturation, by the CEDRA project (see § H.3.2.2) pending a corresponding final disposal facility. This facility will be commissioned in early 2006.

It should be noted that at the beginning of 2005, the CEA took back management of the interim storage facilities on the Marcoule site, in particular the multipurpose interim storage installation (EIP) which also takes intermediate level, long-lived waste resulting from operation of the UP1 plant.

The other categories of waste produced by the CEA (specific waste) are also the subject of studies and actions with a view to their disposal. This primarily concerns:

- sodium waste from R&D work conducted on fast neutron reactors and the operation of experimental reactors or prototypes using this technology. A specific treatment facility is under study in Marcoule. After treatment and stabilisation, it will be possible to dispose of these wastes in the Aube Repository or Andra's VLLW repository;
- graphite waste from R&D on the natural-uranium-graphite-gas and heavy water reactors, as well as from operation of this reactor technology. Most of this waste, comprising graphite stacks taken from the reactors, is temporarily stored in the decommissioned reactors. Andra is examining solutions for final disposal;
- radium waste stored in Saclay and Cadarache, mainly on behalf of Andra and RHODIA-Terres rares. A final disposal project is also being under study by Andra;
- contaminated metal waste, such as lead and mercury, for which decontamination processes exist and have been used in Saclay (melting for lead and distillation for mercury). The disposal channel could be recycling in the nuclear industry (for lead) or disposal by Andra (after physical-chemical stabilisation of mercury).

Achieving the techno-economic optimum in waste management in particular presupposes:

- a network of service facilities and a transportation fleet;
- a range of packages suited to the characteristics of the CEA waste, but also to those of Andra repositories.

In this context, CEA policy is to use packagings which are suitable for storage on its sites and which can be directly accepted by Andra. This is why the CEA is an active participant in the discussions concerning Andra's various projects.

B.5.1.3 Management by COGEMA of waste from the fuel cycle facilities

In principle, since the end of the 1980s, the waste has been systematically packaged immediately (or temporarily deferred until the packaging facilities have been built).

COGEMA's type A and VLLW waste is currently disposed of in the corresponding operational channels. COGEMA produces virtually no graphite or radium-containing waste.

With regard to HLW-LL waste, management of which is being examined within the framework of the law, COGEMA's share is about 5% of the national inventory, representing less than 85,000 m^3 in total.

This waste is mainly waste from past practices, corresponding to operation of the previous generation of reprocessing plants in the 1960s to 1980s. This waste is stored at Marcoule and La Hague. Almost all the high level waste from the history of the French nuclear industry is today packaged in CSD-V containers (except for 250m^3 of "UMo" solutions, which will be processed in a cold crucible in the next few years). However, most medium-level waste from past practices has yet to be recovered and/or packaged. Large scale programmes are under way to attain this objective. HLW-LL waste from dismantling must also be considered. After packaging, it will represent several thousand cubic metres.

The wastes resulting from reprocessing of fuels belonging to customers outside France are returned to their owners as soon as technical and administrative conditions so allow. In this way, more than half the activity of the waste packaged under the "Service Agreement-UP3" contracts, which were the main reason for the construction and initial operation of the modern La Hague plant, has been shipped back to the customer countries.

With regard to the sizing of the repositories currently being planned, COGEMA's share is estimated on the basis of current stocks and the forecasts submitted by its customers. These forecasts constitute the basis for their financing contributions.

Finally, it is worth noting that the volume of COGEMA waste varies little as does its percentage of the national total. COGEMA type C waste is today mainly waste from past practices, the volume of which is therefore frozen. The volume of B waste packages from COGEMA, the CEA and EDF is well known and the forecasts have proven to be accurate. Among the factors used in producing these forecasts, we must mention the changes in the packaging methods for the waste still to be packaged, the La Hague operating scenario, future commercial agreements and the volumes of dismantling waste.

B.5.1.3.1 Fission products

Solutions of fission products (high level) are concentrated by evaporation before being stored in stainless steel tanks, equipped with permanent cooling and mixing systems, and a system for continuous sweeping of the hydrogen produced by radiolysis. After a period of desactivation, the fission product solutions are calcined then vitrified using a process developed by the CEA. The resulting molten glass, into which the fission products are incorporated, is then poured into stainless steel containers. After solidification of the glass, the containers are transferred to an interim storage facility where they are cooled by air.

B.5.1.3.2 Waste from treatment of radioactive effluents

Initially, the La Hague site had two radioactive effluent treatment plants (STE2 and STE3). The effluents are treated by co-precipitation and the resulting sludge is encapsulated in bitumen and then poured into stainless steel drums in the more recent of the installations (STE3). These drums are stored on the site. Production by these 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 buildings and the concentrates are sent for vitrification. Activity has been replaced by retrieval and packaging of the "legacy" sludges, in particular those from the seven STE2 silos which should lead to the production of 40,000 drums of bitumen over approximately the next 15 years.

COGEMA also has a facility for mineralisation of organic effluents by pyrolysis, in the MDSB building. This facility produces cemented packages suitable for surface storage.

The water in the fuel unloading and storage pools is continually purified through ion exchanger resins. Once used, these resins form process waste which is encapsulated in cement in the resins conditioning building (ACR).

B.5.1.3.3 Technological and structural solid wastes

Solid technological waste is sorted, compacted and then encapsulated or blocked in cement in the AD2 building. When they meet Andra's technical specifications for surface disposal, the packages are sent to the Aube repository. If not, they are stored pending a final disposal solution.

Some of the intermediate level long-lived waste (hulls and end-pieces) has been stored pending start-up of the compacting building (ACC) at the end of 2001. This compacting leads to the production of standard compacted waste packages (CSD-C) replacing and offering considerable volume savings over the cemented packages previously produced by COGEMA. This process also enables certain categories of technological waste to be packaged.

These CSD-C are stored in the compacted hulls and end-pieces storage building (ECC) which entered service in May 2002.

B.5.1.3.4 Recent progress and reduction in volumes of HLW and ILW-LL wastes

In this area of waste, important results have already been achieved under the terms of the 1991 law. This law comprises an important part (areas 1 to 3) dedicated to improving current industrial practices. We should mention the following areas:

- Progress with packaging of the streams from past practices: waste from former operations, shutdown of old facilities, etc.
- Optimisation of spent fuel reprocessing, upstream of packaging (recycling, etc.)
- Progress in packaging (including volume reduction)

In the field of HLW-LL waste, these actions as a whole have in particular ensured that the waste resulting directly from the spent fuel processed at La Hague is today packaged:

- in standard CSD-V containers for vitrified fission products and minor actinides
- in standard CSD-C containers for compacted metallic structures

The experience acquired has enabled bituminised waste to be eliminated from the latest generation of plants, by recycling effluent and sending the residual streams for vitrification. Compacting has also reduced the volume of structural waste by a factor of 4. Finally, actions to improve waste management (building zoning, sorting at source, recycling, measurement performance, etc.) have made a highly significant contribution to reducing the volumes of technological waste. In this way, the annual volume of HLW-LL waste has been reduced by a factor of more than 6 with respect to the design parameters of the reprocessing plants, down from an expected volume of about 3m^3 per ton of fuel processed, to less than 0.5 m^3 at present.

B.5.2 Radioactive waste from industrial, research or medical activities

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

For waste with a half-life in excess of 100 days but less than 30 years, the main disposal channel is the Aube repository. The part of waste produced by industrial, research or medical activities and received in this repository, is still however small when compared with the stream produced by the nuclear power generating sector. For sealed sources, the supplier is obliged to recover its sources (via the distributor). Should the supplier fail to do so, financial guarantees allow financing of recovery of the source by another supplier, who then manages the source as waste if it is not recycled. If no supplier agrees to take a source for which nobody claims responsibility, the public authorities - owing to their duty of public service - call on the CEA or Andra, depending on the origin of the source. As Andra has no interim storage facilities, it concludes agreements with the CEA, enabling it to take these sources for interim storage. The CEA uses the guarantee fund to obtain compensation for the service provided. This situation is however extremely rare (just a few cases in six years). At present, authorisation to dispose of sealed sources in the Aube repository has been given for a small number of low level, short-lived sources. All the other used sources are stored by their manufacturers.

As regards the use of unsealed sources, a collection system has been set up by Andra to recover the associated wastes. The volumes concerned are relatively small, apart from the waste resulting from clean-up of sites polluted by the radium industry or uranium ore processing residues. It is accepted that for very short half-life radionuclides (less than 100 days) the waste can be managed on-site through radioactive decay. Most of these wastes constitute a hazard owing to their chemical or biological content (GMO, etc.). Specific constraints are therefore required to deal with these multiple risks, which means that priority is given to reducing the biological risk, if possible, before managing radioactive decay.

As with the other areas of radioactive waste production, a number of disposal channels are as yet unavailable for wastes from certain industrial, research and medical activities, in particular used sealed sources. Depending on their type, these sources could eventually be disposed of in the Aube repository or in the various types of disposal facility being examined by Andra. The acceptance criteria are yet to be defined and are being debated as part of the process to draft the National Plan for Management of Radioactive Waste and Recoverable Material. However, in general, the high cost of long-term management of radioactive waste poses problems in this activity sector.

B.5.3 Management of mining residue

Waste from the working of uranium mines in France was the subject of a report produced on 9 June 1993 by the *Conseil Général des Ponts et Chaussées* (General Council of civil engineering) at the request of the Minister for the Environment. This report entitled "Low level waste - 1st part: disposal of uranium ore processing residues" begins as follows:

"The uranium ore mined in France, has a relatively low yield of only a few kilograms per ton of ore. By the end of 1990, all the mining work done by the CEA and COGEMA amounted to 52 Mt of ore extracted, containing 76,000 t of uranium, or an average yield of 0.15%.

"The lowest content in the ore extracted depends on the local conditions of the mine and above all on world uranium prices. At certain times when the price was high, we extracted relatively poor quality ore. The current low price of uranium however means that various mines in France have been shut down.

"When the mineralised zones are near the surface, open-cast mining is possible; the excavations are stepped, down to a depth of 30 to 40 m and sometimes even 100 m. The proportion of tailings rises with the depth of open-cast mining and this proportion is on average 9 t of tailings for 1 t of ore, but in certain cases this can reach 20 t. These tailings must not be confused with the ore processing residue. These tailings obviously contain a certain amount of uranium (generally less than 0.03%) and other than extraction have undergone no physical or chemical treatment (breaking, crushing, etc.)."

Mines are worked in accordance with the Mining Code, with the aims of safeguarding the general interests mentioned in its article 79 (health and safety of the personnel, public health and safety, essential characteristics of the environment, etc.) and ensuring that the operator employs mining methods such as to maximise the final efficiency of the field, provided of course that the first aim is met.

Administrative surveillance is carried out by the Prefect, with the support of the DRIRE's services.

Ore processing and disposal of the resulting residue are subject to regulations applicable to ICPEs. However, for historical reasons, some of these activities were authorised by legislation passed under the terms of the Mining Code.

However, the steps taken so far do not give a sufficiently clear picture of the real situation owing to a lack of investigations into the real impact of mining operations. It was in order to remedy this situation that the Directorate for Regional Action on Quality and Industrial Safety (regulatory authority with responsibility for mines) took part in a study entrusted to the IRSN by the Directorate for the Prevention of Pollution and Risks (regulatory authority with responsibility for ICPEs) in 2002. The purpose of this study, called MIMAUSA (history and impact of uranium mines: summary and archives) was initially to inventory knowledge of the existing situation by collecting data for each site and secondly to conduct specific studies designed to supplement the available information through additional investigations. This second point could lead to proposals for changes to the management and surveillance arrangements for the sites concerned.

B.5.4 Waste management by Andra

Andra operates three repositories for low and intermediate level, short-lived waste: the Manche repository, which is currently in the surveillance phase (see § D.3.3.1), the Aube repository (CSA), in the operational phase, and the Morvilliers repository for very low level waste. The principle of these repositories is to contain the radioactivity, protected from all damage (water circulation, human intrusion) until it has decayed sufficiently. (see § D.3.3.2 and § D.3.3.3)

In 2004 deliveries to the low/intermediate level waste repository were as follows:

EDF: 10,116 m^3

COGEMA: 3,860 m^3

CEA: 3,110 m^3

Others: 387 m^3

Andra is also involved in collecting waste produced outside the nuclear sector: small and medium industries, universities, hospitals, and so on. A collection guide was produced for these "small producers". It sets the conditions for collection of the waste, for which Andra possesses treatment channels allowing disposal or storage in the Aube repository. The waste is collected and then grouped in a basic nuclear installation belonging to the SOCATRI company, to which Andra subcontracts the sorting and reconditioning; the waste is then shipped to the processing installations: incineration in the CENTRACO plant in Codolet, compacting or injection in the Aube repository. Collection of this waste annually represents 3,000 to 4,000 packages for about 300 producers spread around the country. The total number of producers in Andra's customer base is about 700.

For waste from small producers without disposal channel, Andra is examining storage solutions. However, use is still made of the CEA's facilities for disused sealed sources or radium lightning arresters. Andra has asked for authorisation to use the storage areas of the SOCATRI company for the americium lightning arrester tips and the waste containing radium from small producers or from clean-up of polluted sites.

Section C – SCOPE OF APPLICATION (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 spent fuel reprocessing facilities as part of a processing activity is not covered in the scope of this Convention unless the Contracting Party declares spent fuel reprocessing to be part of spent fuel management.*
2. *This Convention shall also apply to the safety of radioactive waste management when the radioactive waste 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 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 for in Articles 4, 7, 11, 14, 24 and 26.*

C.1 The place of reprocessing in spent fuel management

On the occasion of the diplomatic conference to adopt this Convention, held from 1 to 5 September 1997 in the IAEA headquarters, France, Japan and the United Kingdom, made the following declaration (Final proceedings §12 – Analytical report of the 4th 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, France uses this document to report on the measures taken to ensure the safety of the spent fuel reprocessing facilities, which it considers to be spent fuel management facilities for the purposes of the convention, that is corresponding to the definition of spent fuel management facilities expressed in article 2 of the Convention.

C.2 Naturally occurring radioactive materials

Concerning wastes which contain only naturally occurring radioactive materials and which do not originate from the fuel cycle, France applies the same safety and radioprotection principles as for radioactive materials of artificial origin.

For application of the regulations regarding disposal, wastes containing naturally occurring radionuclides and originating from the non-nuclear industries are considered as being satisfactorily disposed of when a radiological impact assessment can demonstrate that the doses received by the persons most heavily exposed do not exceed 1 mSv/year and when an optimisation study has been performed as necessary. This provision is founded on the definition of a radioactive substance as employed by the French regulations and on the "Radioprotection n°88" recommendation from the European Commission concerning significant increases in radiation from natural sources of radiation.

The radioactive nature of a waste is estimated in accordance with European directive Euratom 96/29 transposed into French law (decree 2002-460) whereby a radioactive substance is "any substance that contains one or more radionuclides the activity or concentration of which cannot be disregarded as far as radiation protection is concerned".

In general, waste with a concentration of enhanced natural radioactivity will only be accepted by a site if its characteristics are in conformity with the specifications for operation of the site, if necessary, once its radiological impact has been considered as acceptable.

Uranium mining residue disposal facilities are dedicated to waste from plants manufacturing uranium concentrates during the operational period and possibly during their dismantling. No waste which does not stem from mining activities may be disposed of in the uranium mines. However, the residue from the mines and from dismantling may be disposed of there.

C.3 Other spent fuels and radioactive wastes treated in civilian programmes

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

All storage facilities are civil. Andra therefore has complete freedom in determining the quality of the waste packages intended for its facilities, even if the waste comes from military or secret installations. The ASN also conducts a secondary check on the quality of these packages at Andra. Inspections are jointly conducted by the ASN and the military safety authority.

Any transfer of nuclear material or waste between civil and military installations must be duly authorised by both authorities. This is a guarantee of transparency in this field.

C.4 Effluent discharges

Discharges are subject to procedures in particular laid down in the water law (92-3 of 3 January 1992) and the law on the reduction of atmospheric pollution of 2 August 1961. In particular, all chemical and radioactive liquid and gaseous discharges from basic nuclear installations require a specific inter-ministerial authorisation. The corresponding regime is described in the pertinent sections of the report.

Radioactive discharges from ICPEs are regulated by a specific order from the Prefect or by an "standard" ministerial order, depending on the size of the installation.

Discharges from other installations are covered by the general regime. They may in particular require a permit as stipulated by the water law.

The aim of amended law n°92-3 of 3 January 1992, which is today part of the Environment Code, is to ensure protection, valorisation and development of water as a usable resource, while ensuring that natural balances are respected. This law covers the general principle and planning of management of the water resources, the associated administrative and financial structures, the procedures to be followed for the installations and activities with an influence on water and the penalties to be applied in the event of pollution or failure to abide by the stipulated procedures.

For discharges from medical or biomedical activities, in particular those from hospitals, and for those from establishments other than BNI, ICPE or mines, decree n°2002-460 of 4 April 2002 (article R.43-7 of the Public Health Code) creates a new regulatory framework for setting the technical rules applicable to the collection, treatment and discharge of effluents likely to contain radionuclides. In the meantime, for management of effluent from facilities likely to contain radionuclides, reference should be made to the basic principles given in circular DGS/DHOS of 9 July 2001. These principles are based on decay management of the effluent collected (effluent containing radionuclides with a half-life of less than 100 days) and control of activity prior to disposal into the sewerage system. If radionuclides with a half life of more than 100 days are present in significant quantities, the liquids are recovered and sent to authorised facilities.

Section D – INVENTORIES AND LISTS (Article 32 §2)

This report shall also include:

i) a list of the 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;

v) a list of nuclear facilities in the process of being decommissioned and the status of decommissioning activities at those facilities.

The map showing the locations of the main installations concerned is presented at the beginning of section L containing the appendices to the report.

D.1 Spent fuel management facilities

D.1.1 Facilities producing spent fuel

Most spent fuel is produced in France by the 58 pressurised water nuclear power reactors, with power ranging from 900 MWe to 1,450 MWe, commissioned between 1977 and 1999 and distributed over 19 EDF centres. The fuel used in these reactors is either based on uranium oxide slightly enriched with uranium 235, or a mixture of depleted uranium oxide and plutonium originating from reprocessing of spent fuel (MOX).

The other spent fuel originates from the 11 active research reactors of various types, with a thermal power of between 100 kW and 350 MW, and commissioned between 1964 and 1978. 10 of them are located in the CEA's centres in Cadarache, Marcoule and Saclay with the 11th located in the Institut Laue-Langevin near the CEA centre in Grenoble.

The inventory of the facilities is appended (see § L.1.1).

D.1.2 Spent fuel storage or reprocessing facilities

Certain basic nuclear installations play a role in spent fuel management. These are the spent fuel experimentation laboratories, the spent fuel storage facilities and the spent fuel reprocessing facilities. The inventory of these facilities, managed by EDF, CEA or COGEMA, is appended (see § L.1.2).

D.1.2.1 COGEMA facilities

D.1.2.1.1 General presentation

All the COGEMA spent fuel management facilities currently in service are located in the La Hague establishment, situated on the north-west tip of the Cotentin peninsula, 20 km to the west of Cherbourg.

In 1959, the French Atomic Energy Commission (CEA) decided to build the UP2 plant to reprocess the spent fuel from the natural uranium-graphite-gas reactor (GGR) series; the CEA was authorised in 1974 to expand plant UP2 with a building for reprocessing of fuel from light water reactors: the high activity oxide (HAO) building.

Plant UP2 and the HAO building entered service in 1978, forming plant UP2-400, with an annual spent fuel reprocessing capacity of 400 tons.

Responsibility for operating the site was transferred to COGEMA in 1978. By three decrees of 12 May 1981, COGEMA was also authorised to build the following plants:

- UP3-A, with a practical annual capacity of about 850 tons of fuel from the light water reactor series;
- UP2-800, with the same purpose and capacity;
- STE3, designed to purify effluent from the above two units before discharge into the sea.

Plant UP2-400 can be used for particular operations.

The various buildings in plants UP3-A, UP2-800 and STE3 entered service from 1986 (reception and storage of the spent fuel) to 1992 (vitrification building), with most process buildings coming on-line in 1989/90, and ended with commissioning of the ACC (hull compacting) and R4 (end of the plutonium line in unit UP2-800) buildings in 2001.

The primary chain in these facilities comprises reception and interim storage of the spent fuel, shearing and dissolution of it, chemical separation of the fission products, final purification of the uranium and plutonium and treatment of the effluent.

The decrees of 10 January 2003 increased the reprocessing capacity of each plant to 1,000 ton per year, the site capacity remaining administratively limited to 1,700 tons. This capacity can also be technically expressed in terms of TWh output of the treated fuels, with technical limitations depending on the burn up fraction. This capacity is between 400 and 450 TWh per year.

D.1.2.1.2 The future: consolidation of the site into a single optimised plant

The two plants have reached maturity. The contracts helping to finance the plants are completed (7,000 tons reprocessed for foreign customers). A new organisation has been gradually set up since the end of 2001, to optimise use of the site's industrial and human resources. This new organisation is the subject of the SITOP (for "site optimisation") project.

At the same time, the site's capacity is increasingly diverse, and it can now receive and process fuel from various French and foreign research reactors.

At the request of the ASN, COGEMA submitted a file corresponding to the SITOP project, which in particular ensures that the operator takes account of the human factors aspect of this project.

D.1.2.1.3 Reception facilities

Reception of the shipment packagings and interim storage of the spent fuel are the first operations performed in the plant. On arrival in the reprocessing plant, the packagings are unloaded either under water in the deep pool, or dry, in a sealed shielded cell. The fuel is then stored in pools in which it will spend at least two to three years.

Three unloading facilities are available, the HAO North, which is the oldest building, operating underwater, the NPH pool, also underwater, used to unload packagings with a heating power of up to 85 kW, and finally T0, the most recent and operating dry. Dry unloading minimises operator exposure during preparation of the packagings and during decontamination of them after unloading. As the packagings are not immersed they are simpler to prepare and this can be done almost totally remotely. Furthermore, they are not contaminated by the pool water, which obviates the need for most of the decontamination operations.

The capacity of the NPH and T0 buildings is about 1,400 tons each per year.

D.1.2.1.4 Interim storage facilities

After reception, the fuel elements are placed in racks with a cross-section of about 1 m^2 and able to take between 9 and 25 of them, depending on their size. These racks are placed in pools about 8.5 m deep, ensuring a depth of water above the fuel such that the dose rate on the surface enables the personnel to access the edges of the pool.

The Establishment comprises five interconnected fuel pools, with a total capacity in the current configuration of 14,400 tons of initial uranium.

Three of these pools contain installations for recovering fuel elements, sent to the UP2-400, UP2-800 and UP 3-A spent fuel reprocessing facilities respectively.

D.1.2.1.5 Reprocessing installations

After shearing, the spent fuel is separated from its metal cladding during dissolution with nitric acid. The pieces of cladding, which are insoluble in the nitric acid, are removed from the dissolver, rinsed in acid then water, and transferred to a conditioning unit. The solutions taken from the dissolver are then clarified in a centrifuge.

The elements separation phase consists in separating out the fission products and actinides from the uranium and plutonium and then the uranium from the plutonium.

After purification, the uranium in the form of uranyl nitrate is concentrated and stored. This uranyl nitrate is intended for conversion into a solid compound containing uranium (oxide), and then recycled or, for the remaining part, stored to constitute a strategic stock.

After purification and concentration, the plutonium is precipitated by oxalic acid, dried, calcined into plutonium oxide, conditioned in sealed boxes and stored. The plutonium is used in the fabrication of MOX fuel. The plutonium originating from fuels belonging to customers outside France is returned to the country of origin as MOX fuel.

Treatment of the effluents and control of discharges into the environment is essential, because the sequence of production operations, from shearing to the finished products, uses chemical processes generating gaseous and liquid effluents.

A large part of the gaseous effluent is released during shearing of the cladding and during dissolution through boiling. These discharges are treated by washing in a gas treatment unit. Some residual radioactive gases, in particular krypton, an inert gas with an extremely low radioactive impact, are simply controlled before being discharged into the atmosphere.

The liquid effluents are treated according to their activity and chemical composition, undergoing various evaporation and concentration cycles.

The final conditioning and storage of the radioactive waste packaged in the primary spent fuel reprocessing chain and the liquid and gaseous effluent treatment facilities take place on the plant site. Three on-line methods are used: vitrification, compacting and encapsulation in cement.

Two main spent fuel reprocessing facilities are in service in the La Hague establishment, the UP2-800 plant and the UP 3-A plant, each of which has a technical capacity of about 1,000 tons/year.

The HAO building (shearing, dissolution, clarification) of the UP2-400 plant, in which all the other buildings have been replaced by those of UP2-800, will soon be shut down. Its batch dissolver, which is more flexible than the continuous dissolvers used in UP 2-800 and UP 3-A will in 2005 be replaced by a flexible batch dissolution capacity able to reprocess fuel from research reactors.

D.1.2.1.6 Return of foreign waste

In accordance with article L.542 of the Environment Code concerning radioactive waste management, imported radioactive waste cannot be disposed of in France, even if processed there. Consequently, the waste belonging to customers outside France is gradually shipped back to them. The radioactive waste belonging to domestic customers is either sent to the national surface repository, or stored pending implementation of a solution for its disposal.

The process to ship residue to foreign customers began in 1995 with standard containers of vitrified waste (CSD-V), in which most of the activity of the ultimate waste contained in the spent fuels is conditioned.

As at 31 December 2003, 2,132 CSD-V containers had been shipped:

- 760 CSD-V had been delivered to Japan by sea (or 32 packages delivered in 8 shipments);
- 1,092 CSD-V had been delivered to Germany (or 39 packages in 6 shipments);
- 168 CSD-V had been delivered to Belgium (6 packages in 6 shipments);
- 112 CSD-V had been delivered to Switzerland (4 packages in 4 shipments);

For fuels processed before 31 December 2003, CSD-V deliveries should continue until about 2010 (including deliveries to the Dutch customer).

D.1.2.1.7 Storage capacity at La Hague

Once packaged, the waste is stored at La Hague in specially designed facilities. By guaranteeing confinement of the packages at all times, operation of these facilities protects man and the environment against radiation. The steps taken also ensure that the packages can be recovered for subsequent routing to a long-term management channel.

Packages of long-lived waste resulting from fuel reprocessing occupy a small area, owing to the small volume of packages and the compact design of the buildings. As an example, the waste packages corresponding to 40 years of production from the current power plants could be stored in buildings covering a surface area of no more than 7,000 m2, or the equivalent of a single football pitch.

The La Hague storage facilities were initially designed for a period of about 50 years. According to the studies conducted as required by the law of 30 December 1991, the most modern ones could be operated for longer periods of up to 100 years.

Furthermore, new facilities with an even longer life could be designed using the latest available techniques, benefiting from recent advances in research and industrial experience. This type of facility could be built close to the existing infrastructures if necessary.

Industrial storage is thus a medium-term management solution, which it appears technically possible to supplement industrially and economically by defining and developing a long-term management process. This is one of the issues of the fifteen years of research conducted under the terms of the law of 30 December 1991.

D.1.2.2 The other interim storage facilities

The fuel disposal building (APEC) for the Superphénix fast neutron reactor, a sodium-cooled industrial prototype with a thermal power of 3,000 MWe and which was finally decommissioned in 1998, mainly comprises an interim storage pool on the Creys-Malville site, and was commissioned on 25 July 2000. The irradiated assemblies were extracted from the reactor from 1999 to 2002, washed and then stored in the facility's pool.

The unused fuel from CEA civilian programmes is stored, pending final disposal (reprocessing or disposal) either dry (in a pit), in the CASCAD facility, or under water (pool storage) in the PEGASE facility in the Cadarache centre, which is scheduled to continue operating until 2010.

Owing to the capacity and heat dissipation limits of the CASCAD facility in the Cadarache Centre, the CEA intends to build a facility called ECUME, the characteristics of which would enable it to take fuel classes which cannot be accepted by CASCAD (see B.2.2). ECUME is scheduled to enter service in 2008.

D.2 Inventory of stored spent fuel

The spent fuel stored in France mainly comes from PWR (pressurised water reactor) or BWR (boiling water reactor) nuclear power reactors, and is then of the uranium oxide or MOX type, or comes from research reactors. It is stored in the various installations mentioned in the previous paragraph.

At the end of 2004, about 7,200 tons of French spent fuel was stored at La Hague, 3,600 tons in EDF's nuclear power plants and 120 tons in the CEA's centres.

Apart from French fuel, the pools at La Hague contained about 450 tons of fuel from the following foreign nuclear power reactors: Germany (347 t), Switzerland (95 t) and the Netherlands (4 t).

Finally, as at 30 September 2002, they contained fuel from research reactors, originating in France (0.5 t), Belgium (0.3 t) and Australia (0.2 t).

D.3 Radioactive waste management facilities

The spent fuel management facilities, which are listed in the appendix (see § L.1), by their very nature also have to manage radioactive waste. The inventory of the other radioactive waste management facilities is appended (see § L.2).

D.3.1 Installations producing radioactive waste

D.3.1.1 The active BNI

Radioactive waste is produced in all active BNI, the list of which is appended for spent fuel management facilities (see § L.1 already mentioned) and for the other BNI (see § L.2.1) producing radioactive waste (decommissioned reactors, laboratories, plants and storage buildings).

D.3.1.2 BNI being dismantled

Radioactive waste is also produced in BNI being dismantled (old reactors, old laboratories and old plants), the list of which is appended (see § L.3).

D.3.1.3 Installations classified on environmental protection grounds (ICPE)

As mentioned earlier, in France there are about 800 ICPEs because of the radioactive substances they hold and use. They are spread around the country. These are in particular research laboratories, industrial facilities (manufacturers of sealed radioactive sources, manufacturers of lightning arresters, plants using naturally radioactive ores, irradiators) or health establishments (hospitals, clinics, medical analysis laboratories).

D.3.1.4 Polluted sites

French regulations provide for treatment and clean-up operations if a site uses or stores naturally occurring or artificial radioactive substances in conditions such that the site presents health and environment hazards.

The treatment and clean-up operations on these polluted sites can produce radioactive waste.

In France, a large proportion of the polluted sites dates from the days of the radium industry, which was extensively developed in the first half of the 20th century, or the mining industry in the second half of the century; however, there are also other cases coming from past industrial activities: phosphated fertiliser, rare earth…

As part of its public service duties, Andra keeps an up to date inventory of all these sites, in its "national inventory of radioactive waste and recoverable materials" the latest edition of which was published in November 2004 (can be ordered free of charge from the website: http://www.andra.fr/). In addition to the inventory of sites polluted by other industrial activities in France, the data bank is created of former industrial sites and service activities (BASIAS – consultable on the website: http://basias.brgm.fr)

These clean-up operations generally produce a large volume of waste with low specific activity. Some long-lived radionuclides and waste containing radium constitute a hazard owing to the radon they emit and must be controlled. Management solutions for these latter are not yet available, so this waste must be stored pending completion of current studies into the subject.

A certain number of sites contain waste that is contaminated both by chemical substances and by radioactive substances, which makes them particularly delicate to deal with. Clean-up of historical sites also poses financing problems, which are only partially resolved by the funding mechanisms put in place, particularly owing to the high cost of clean-up work and recovery of the waste, inherent in any nuclear activity.

Andra coordinates clean-up of polluted sites, either under authorisation from the regional prefects responsible for these sites, or at the request of the owners of the sites. In any case, the health objectives of the clean-up process are defined by the ASN and the site is evaluated after decontamination.

D.3.2 Radioactive waste treatment installations

The radioactive waste treatment facilities are placed in two categories: treatment facilities and storage facilities.

The list of treatment facilities operated by the CEA, COGEMA, EDF or SOCODEI is appended (see § L.2.2).

The list of storage facilities operated by Andra, CEA, COGEMA, EDF or SOCODEI is also given in the same appendix (see § L.2.2).

D.3.3 Waste disposal facilities

D.3.3.1 The Manche repository

The Manche repository, managed by Andra, entered service in 1969. It is located in Digulleville, on the Cotentin peninsular, in the immediate vicinity of the spent fuel reprocessing plant at La Hague. 527,000 m^3 of waste packages were stored in it until it ceased operations on 30 June 1994.

In 25 years, the design of disposal structures has changed. The general design principle used to be to separate, collect and control water likely to have been in contact with the packages. The structures consist of concrete slabs on which the packages are either directly stacked or stored in concrete bunkers built on these slabs. The structures were loaded in the open air and the rainwater collected from the slabs is fed to a piping network running through underground galleries.

The repository occupies a fifteen hectare site and since 1997 has been covered by a bituminous layer within a system of draining or impermeable layers, constituting an assembly designed to prevent water infiltration. The covering layer is grassed over.

The Manche repository officially entered its surveillance phase of no more than 300 years in January 2003 but has been under particularly active supervision since 1997. The transition from operation to surveillance was the subject of a process of the same type as that applied for creation of a nuclear facility, including a public inquiry. This phase will comprise two parts of which one, known as active surveillance, will last 10 years. Since 1997, the active surveillance phase consists of:

- checking the correct functioning of the repository:
  stability of the covering layer;
  impermeability of the covering layer;
  estimation of water infiltrating the covering layer and at the base of the structures.
- detecting or any abnormal situation or altered evolution:
  radiological and chemical surveillance of the water table;
  irradiation checks;
  atmospheric contamination checks.
- monitoring of the radiological and chemical impact of the facility.

The surveillance phase authorisation decree requires an updated safety analysis report and a file about the interest of a more durable cover onto 10 January 2009. Andra implements provisions allowing the site memory preservation. Files related to Manche repository are delivered to the National Archives.

D.3.3.2 The Aube repository

The Aube repository, managed by Andra, entered service in January 1992. It has taken over from the Manche repository and its design benefited considerably from feedback from it. It is located in eastern France and comprises conditioning buildings and a disposal area covering about thirty hectares. It is authorised to dispose of a volume of one million cubic metres of waste packages.

The repository consists of bunkers (25m x 25m x 8m) in which the packages are placed. The slab is made of watertight concrete, covered by a sealing polymer. It has a hole to recover any water infiltration, which is sent to a pipe running through an underground gallery under the structures (separate free-falling subsurface system). Loading takes place sheltered from rainwater under a mobile roof. The metal envelope packages are concreted in the structure, whereas the concrete envelope packages are stabilised in the structure with gravel. Once the structure is full and the packages immobilised, a closure slab is poured over its upper surface and then covered with a provisional sealing layer pending final coverage of the facility.

On 31 December 2003, the volume stored stood at 151,132 m^3. 64 structures had been closed since the repository was commissioned, out of a planned total of about 400. Given the rate of deliveries, between 10 and 15,000 m^3 per year, and the fact that the repository was designed for an annual intake of 30,000 m^3, the facility could be operated for more than fifty years.

The conditioning buildings can compact 200 litre drums or inject metal containers of 5 or 10 m^3.

The repository acceptance criteria are derived from the safety analysis which demonstrates the absence of any significant impact in the event of any drilling through the repository within a period of 300 years, corresponding to the post-closure surveillance phase. Maximum radiological capacities are defined for a certain number of radionuclides in the CSA's authorisation decree:

tritium: 4000 TBq;

cobalt 60: 400,000 TBq;

strontium 90: 40,000 TBq;

caesium 137: 200,000 TBq;

nickel 63: 40,000 TBq;

alpha emitters: 750 TBq (assumption after 300 years)

Other limits were set in 1999 in the technical specifications of the repository, for 14 other radionuclides, including chlorine 36, niobium 94, technetium 99, silver 108m, and iodine 129.

D.3.3.3 The Morvilliers VLL waste repository

This 650,000 m^3 capacity repository managed by Andra is located a few kilometres from the Aube repository. Since it opened in August 2003, it has received 16,644 m^3. Given the radiological activity it is to contain, the facility is not covered by the regulations applicable to basic nuclear installations (BNI) but the regulations for installations classified on environmental protection grounds (ICPE). It covers an area of 45 hectares.

Given the activity level of the wastes, their packaging is not designed for long-term containment, but to prevent any dispersal of radioactive material while they are being transported and placed in the repository. The waste must however be solid and inert. Under a mobile roof protecting it from any rain, it is placed in cells hollowed out from the clay. A membrane at the bottom of the cell seals the arrangement. The cells are then filled with sand, then covered with another membrane and a layer of clay. An inspection shaft is used to check for any water infiltration.

The repository acceptance criteria are based on an impact indicator called IRAS. The value of this indicator should not exceed 1 for the entire batch of waste received and should not exceed 10 for the waste.

In practice, this limit on the specific activity of the VLL waste depends on the classification of the radionuclide in one of the 4 classes of radio-toxicity:

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

To determine the acceptability of a batch of waste, the repository radiological acceptance index (IRAS) is defined as follows:

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

where: Am_i is the specific activity of radionuclide i (in Bq/g) in the mass of waste considered class i is the class N° of the radionuclide i considered (0, 1, 2 or 3).

In order to be accepted in the LLW-LL waste repository, the waste must have an IRAS index of 1 or less for each batch. A waste package in this batch may have an IRAS index of 10 or less, provided that the average index for the batch remains 1 or lower.

The following table provides the corresponding classes for prominent radionuclides:

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

The reference activity for cobalt 60 and caesium 137 is 10 Bq/g, while it is 100 Bq/g for the isotopes of uranium and 1,000 Bq/g for tritium.

D.3.4 Mining residue repositories

The mining residue generated by the uranium mining industry, today no longer active in France, is currently distributed among 17 surface repositories of different sizes, corresponding to the old mine works (see table § D.4.2).

Based on economic criteria, the poorest ore was routed to static processing and the others to dynamic processing. Depending on the nature of the ore, processing was based on either acids or bases. On most French sites, uranium was leached using sulphuric acid, plus sodium chlorate as an oxidiser if necessary.

These processes left virtually all the components of the ore intact after the uranium was placed in solution. The uranium remaining in the residue was about 0.1 kg per ton and it could not be extracted owing to its low solubility or its inaccessibility to the acid. However, all the highly insoluble radium remained in the solid residue.

The only facilities put in place by the mine operators are facilities to treat the water overflowing from the reservoirs created by the mine works and shafts, such as the treatment facilities on the former Bois Noirs mine at Saint-Priest-la-Prugne.

After rehabilitation of the sites, drainage and/or residue washing water treatment facilities need to be maintained on some of the sites. They can be used to reduce the uranium and radium concentrations of the water before it is discharged.

D.4 Inventory of radioactive waste

D.4.1 Annual production of radioactive waste

The annual production of waste according to the classification defined in paragraph B.3, and its origin, is summarised in the following table:

Type of waste	Volume	Fuel cycle and electricity production	Nuclear research	Others
LILW-SL	12,000 m^3	75 %	23 %	2 %
ILW-LL	930 m^3	80 %	20 %	0
HLW	155 m^3	~100 %	low	0

The ILW-LL and HLW here comprise all the waste conditioned through reprocessing of spent fuel produced in France, and therefore include production for all COGEMA customers.

The percentages were calculated on the basis of the waste conditioned into packages. These figures are approximate and deal with past production rather than production of a given year. The percentages are calculated excluding VLLW, LLW-LL (the production of LLW-LL is low), and excludes disused sealed sources. Stored spent fuel is also ignored when calculating the percentage. The "others" category only includes medical waste and waste from the non-nuclear research industries.

D.4.2 Waste present in the interim storage facilities

The treated volumes given for the LLW-LL, ILW-LL and HLW waste only shows the French share of the waste generated by this activity. The total volume of radioactive waste in the interim storage facilities as at the end of 2002 can be broken down as follows, according to the international categories:

- ILW-SL - Intermediate level waste, short-lived (tritiated waste): 1,800 m^3
- ILW-LL - Intermediate level waste, long-lived: 46,000 m^3
- HLW High level waste (vitrified waste): 1,639 m^3

Low level, long-lived waste (waste containing radium and graphite waste), or LLW-LL, are not included in the above volumes.

The volume of waste containing radium, a large part of which comes from industrial ore processing (extraction of rare earths, zirconium industry), is currently about 35,717 m^3. The mass of graphite containing radioactivity is about 52,200 m^3, most of which is still in the cores of the natural uranium-graphite-gas reactors, meaning that it does not as yet have official waste status. Only 8,842 m^3 of graphite sleeves are temporarily stored on the site, outside the reactors: several disposal options are being examined, also in the LLW-LL category. (data taken from the "2004 national inventory").

Very low level waste (VLLW) represents a volume of 110.000 m^3 at the end of 2002. For France's own reasons, this waste will be stored in a dedicated facility (Morvilliers surface repository). It cannot in any case be placed in the LILW-SL category and the total volume of this LLW stored in France currently stands at about 108,219m^3 (data from the "2004 national inventory"). The buffer stocks of LILW-SL waste on the production sites, pending shipment to the Aube repository, correspond to an average of one year of production for those packaged in concrete containers and half a year for those packaged in metal or plastic drums, i.e. a total of about 4800 m^3.

For certain categories of very low and low level waste which have been without a disposal channel for a long time (oils, resins, scrap, etc.) EDF has created dedicated, regulated areas (VLLW areas) in which this waste is stored pending removal to the SOCODEI CENTRACO plant or to Andra's VLLW repository.

Disused radioactive sources are not included in the above figures. About 100,000 of them are currently being stored.

The volume of waste currently unpackaged is included, taking account of the future packaging of this waste.

Finally, it should be noted that the mining residue generated by the uranium extraction industry, represents about 50 million tons. This is a particular category of VLLW waste that is managed separately.

Inventory of uranium mines and mining waste in millions of tons

Region	Site	Quantity
Limousin	Bellezane	1.552
	Montmassacrot	0.740
	Brugeaud	12.530

Region	Site	Quantity
	Lavaugrasse	7.480
	Bernardan (Jouac)	1.810
	La Ribière	0.200
Pays de Loire	Ecarpière	11.340
	Commanderie	0.250
Rhône-Alpes	Bois Noirs	1.300
Bourgogne	Gueugnon	0.220
	Bauzot	0.016
Auvergne	Rophin	0.030
	St-Pierre-du Cantal	0.600
Languedoc	Lodève	4.960
Roussillon	Le Cellier	5.940
Midi-Pyrénées	Bertholène	0.470
Alsace	Teufelsloch	0.004
TOTAL	(million tons)	**~50**

D.4.3 Waste in final storage

The volume and total activity of low level radioactive waste (LLW) and intermediate level (ILW) short-lived waste, in final storage at the end of 2002 (data from the "2004 national inventory") amounts to about 673,462 m^3 with the location broken down as follows:

	Volume	Beta Gamma Activity	Alpha Activity
deep-sea disposal of 14,300 tonnes (1967 and 1969)	9,900 m^3		
Manche repository	527,000 m^3	19.6 PBq	629 TBq
Aube repository	136,562 m^3	1.7 PBq	54.6 TBq

At the end of 2002 there was no intermediate level long lived waste (ILW-LL) nor high level waste (HLW) in repositories in France.

D.5 Nuclear facilities being dismantled

The nuclear facilities dismantled or being decommissioned as at the end of 2004 comprise 15 old reactors (9 power reactors and 6 experimental reactors) and 8 disused laboratories or plants, inventoried in the appendix (see § L.3). To this inventory should be added 3 former small nuclear power reactors (Marcoule) which were part of defence programmes but from which the dismantling waste has been transferred to the civil programme.

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

E.1 Implementing measures (Article 18)

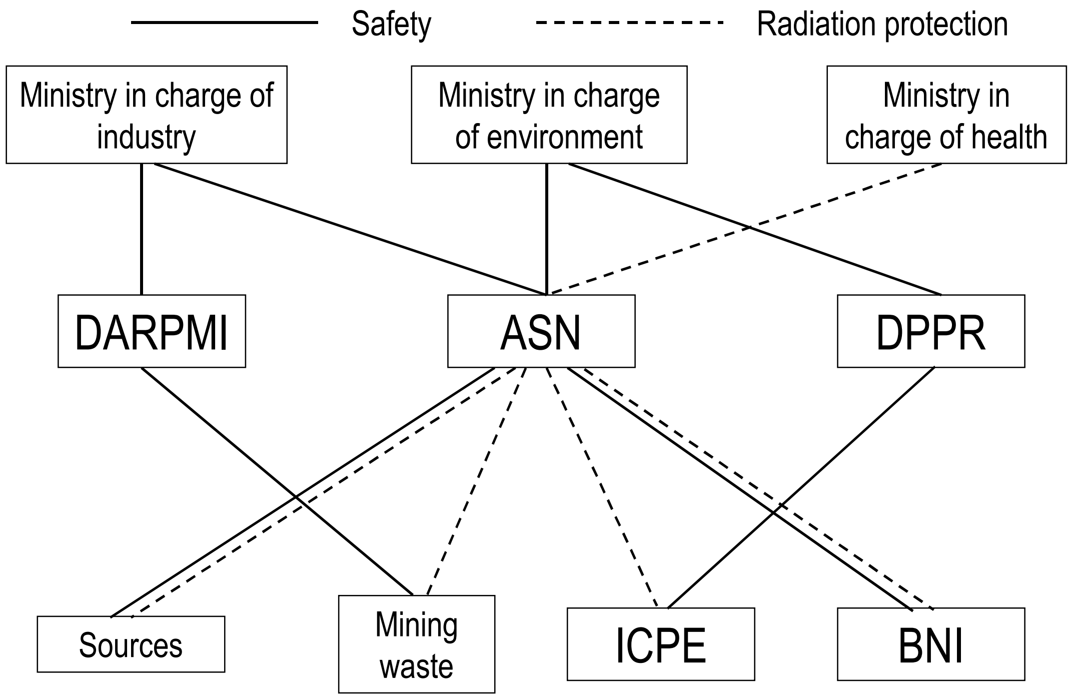
Each Contracting Party shall take, within the framework of its national law, the legislative, regulatory and administrative measures and other steps necessary for implementing its obligations under this Convention.

E.1.1 The general regulatory framework of nuclear activities

The French nuclear safety and radiation protection organisation is based mainly on the principle of the prime responsibility of the operators, stating that responsibility for an activity entailing risks lies in the first place with whoever is carrying out this activity (BNI operator – CEA, COGEMA, EDF, etc.-, radioactive materials consignor, user of sources, etc.) rather than with the public authorities or other parties. In this respect, decree 63-1228 of 11 December 1963 as amended concerning nuclear installations, constitutes the basis for nuclear safety regulations. Article 2 of this text defines the basic nuclear installations (BNI) which are subject to said regulations and which in particular comprise all civil nuclear reactors, whether intended for energy production or for research. Its article 3 defines the necessary authorisations (creation, operation, shutdown, dismantling) and article 4 specifies the conditions for issue of a creation authorisation (provision of safety analysis reports, general operating rules and emergency plan). Article 5 defines the modification conditions, provides for the periodic safety reviews and requires declaration of incidents and accidents. Article 6 specifies the cases in which a new authorisation is required. Articles 7 to 10 define the role and composition of the Interministerial Commission for basic nuclear installations, which gives its opinion on BNI creation or modification applications and on the requirements specific to each type of installation. This Commission also gives its opinion and makes proposals regarding the drafting and application of the regulations concerning these installations. Article 11 defines the conditions for monitoring and inspecting the safety of these installations. Article 12 describes the sanctions applicable to anyone who operates a BNI without authorisation, is in breach of the technical specifications notified to the public authorities, modifies the installation without authorisation or omits to declare accidents or incidents to the authorities.

With respect to radiation protection, the regulation and supervision of all nuclear activities were unified in February 2002: the responsible authority is the Nuclear Safety Authority, under the joint authority of the Ministers for Industry, Health and the Environment. With respect to the safety of nuclear activities, the supervision organisation differs according to the hazards involved in the use of the radioactivity, as illustrated in the following diagram.

Schematic overview of nuclear activities supervision in France



The consistency of safety supervision is guaranteed by constant interaction between the regulatory authorities who meet frequently at a high level. General regulations which can apply to several types of installation are drafted by joint working groups. Although informal, these relations are highly effective.

Sealed sources are regulated once they exceed the exemption threshold per radionuclide set by decree 2002-460 of 4 April 2002 at a very low level. They require that a possession licence be held by someone designated in person and must be returned to the manufacturer once they are no longer needed or if their age means that the seal can no longer be guaranteed without a check. Source possession licences are mainly based on radiation protection and physical protection considerations to prevent inappropriate use. The responsible authority is the Nuclear Safety Authority.

Above a certain threshold for unsealed sources and another higher threshold for sealed sources, their use is considered as constituting a risk outside the facility in which they are used. These thresholds, defined by the ICPE nomenclature - decree 53-578 of 20 May 1953 amended - also depend on the potential hazard from the radionuclide employed. Beyond these thresholds, the regulations concerning installations classified on environmental protection grounds (ICPE) then apply.

These regulations generally apply to any activity that is likely to be dangerous or harmful. The responsible authority is generally the Prefect, as the State's representative in the *département*. He is assisted up by a number of State inspectors and the ICPE inspectorate, the activities of which are co-ordinated nationally by the DPPR (Directorate for the Prevention of Pollution and Risks), central directorate of the Ministry for the Environment. With regard to mining residue, coordination is the responsibility of the Directorate for Regional Action on Quality and Industrial Safety (DARQSI), central directorate of the Ministry for Industry.

When a second threshold is crossed (this threshold depends on whether the source is unsealed or sealed, and on the hazards involved in using the radionuclide and defined in the ministerial order of 11 March 1996) or if the fissile materials are used in quantities which imply the possibility of a chain reaction, or for very powerful accelerators, the French legislators has estimated that the installation concerned is of national importance. It is then designated a basic nuclear installation (BNI), its construction is subject to a national decision (government decree) and it is supervised by the Nuclear Safety Authority.

It should be noted that installations concerning national defence are subject to the same system of activity classification. The responsible authorities are specific authorities reporting to the Ministry for Industry and/or the Ministry for Defence. However, the radioactive waste produced by these installations is disposed of in civilian waste disposal facilities and the Nuclear Safety Authority therefore takes part in inspection of the waste in these facilities.

For information, supervision of physical protection of the radioactive materials (nuclear security) is performed by another authority, the Defence High Official (HFD) at the Ministry of industry.

E.1.2 The regulatory frameworks governing ICPEs and mines

The legislation applicable to installations classified on environmental protection grounds covers industrial activities, intensive livestock breeding installations and waste treatment activities outside nuclear installations and mines (covered by other legislation).

ICPE regulations are set by the Prefects who, in France, are the State's representatives although they are not elected. Their role is to apply the Government's regulations and general directives. For each section in the nomenclature, standard technical specifications are established at a national level. These specifications form the general framework used by the ICPE inspectors to apply the Prefects' directives, while taking account of the specificities of the installations and their environment.

The DPPR at the Ministry for the Environment contributes to development of these specifications and to national harmonisation of the actions taken by the ICPE inspectors.

Regulations concerning the ICPEs are based on an integrated approach, which means that:

- a single environment protection licence is issued for an 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;
- a single authority is competent to apply this legislation. In France, only the State has competence regarding ICPE legislation. It acts through the Prefect (State's representative in each *département*) assisted by technical support organisations.

The industrial activities covered by legislation on ICPEs are listed in a nomenclature. They are subject to the need for declaration, or the need for a licence. The regulations for ICPEs concern about 500,000 installations subject to declaration and 64,600 installations requiring a licence, i.e. a total of nearly 600,000 installations. As previously mentioned, about 800 installations are classified because of the radioactive substances they possess or use.

Facilities with little impact on the environment are subject to a simple declaration procedure. The operator sends the local Prefect a declaration file which in particular stipulates the nature of the activity it intends to perform. The Prefect examines the compliance of the file and issues a receipt along with general stipulations applicable to the activity category concerned.

The licence concerns the more polluting or more hazardous activities. The licence procedure begins with compilation of a licence application file, containing impact and hazards assessments. These assessments must be commensurate with the size of the planned facility and its foreseeable impact on the environment.

The file is then examined by the ICPE inspectorate, under the authority of the Prefect. It leads to various consultations, particularly consultation with the local authorities, and to a public inquiry. The procedure ends with issue (or refusal) of the licence in the form of an order from the Prefect containing the stipulations (for example for discharges: the maximum concentration and flow levels for the various pollutants) to be followed by the industrial operator.

The Prefect has a range of administrative penalties (formal notice, deposit of funds, automatic execution, suspension of licence, closure) in the event of failure to comply with these stipulations.

The ICPE inspectorate monitors compliance with the technical specifications to which the installation is subject. It also intervenes in the event of any complaint, accident or incident. If it observes that the provisions are inappropriate, the inspectorate may propose that the Prefect issue an order stipulating additional provisions. If the operator fails to abide by the provisions by which it is bound, it runs the risk of administrative and criminal penalties. The law provides for considerable penalties should these provisions be breached.

The general regulations are drawn up by the Ministry for the Environment, in compliance with European community directives. It ensures that these regulations are applicable and applied. The Directorate for the Prevention of Pollution and Risks co-ordinates the inspection and provides technical, methodological, legal and regulatory management at a national level.

Mines regulations are different from those covering the ICPEs, primarily for historical reasons and also because, apart from their strategic nature, mine workings pose particular technical problems. The departmental Prefect, as the local government representative, is the supervisory Authority. However, the mining permits (concessions or operating licences) and the subsequent mine working permits are issued nationally after recommendation by the General Mining Council.

Mine regulations cover mining work proper and the facilities legally dependent on the mines; most ore treatment plants and residue 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. 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;

vi) a clear allocation of responsibilities of the bodies involved in the different steps of spent fuel and of radioactive waste management.

3. When considering whether to regulate radioactive materials as radioactive waste, Contracting Parties shall take due account of the objectives of this Convention.

Safe management of activities involving radioactive materials comprises two inseparable aspects: radiological protection and nuclear safety.

In terms of radiological protection or radiation protection there is a single set of regulations in France and a single regulatory body in charge of implementing it: the Nuclear Safety Authority (ASN).

However, in terms of nuclear safety, as mentioned in the introduction and specified in paragraph E.1.1, the facilities and radioactive materials covered by this Convention are of very different natures and in France are subject to different regulatory frameworks.

Above a certain threshold, which according to the type of facility and the radionuclide in question, is set by joint order of the Ministers with responsibility for Industry, Health and the Environment, a facility is called a "basic nuclear installation" (BNI) and placed under the supervision of the above-mentioned Nuclear Safety Authority. This category in particular includes all facilities receiving spent fuel (reactors, reprocessing plants, interim storage facilities, etc.), all facilities "whose primary purpose is radioactive waste management" as defined by this Convention, and a large number of facilities containing radioactive waste, even if their management is not the main purpose of these installations: all told, there are about 125 BNIs.

Below this threshold, an installation containing radioactive materials can be an "installation classified on environmental protection grounds" (ICPEs) and is placed under the supervision of the Ministry for the Environment. This category includes the other facilities using radioactive materials for industrial or medical purposes and which are distributed around the entire country. There are about 800 of these.

Finally, radioactive sources are specifically regulated and since April 2002 have been under the supervision of the Nuclear Safety Authority (ASN).

Euratom is one of the treaties of the European Union. The EU directives must be transposed into individual national legislations within an allotted time following acceptance by the European Council. Once transposed into national legislation, the law makes the country concerned responsible for application of the regulations (principle of subsidiarity). The law may be more strict than the European directive, but never less so.

This chapter in turn describes the radiation protection regulations, then the regulations applicable to the three nuclear activity categories listed above.

E.2.1 The general radiation protection regulatory framework

The regulatory framework for radiation protection, which was recently updated with the transposition of directives Euratom 96/29 and 97/43, is presented with the corresponding regulations in chapter F.4

E.2.2 The regulatory framework for the safety of basic nuclear installations

Apart from the general regulations such as those concerning labour law and the protection of nature, basic nuclear installations (BNIs) are subject to two types of specific regulations: licensing procedures and technical rules.

Supervision by the ASN is designed to ensure that the operator of a nuclear facility respects in full its safety responsibilities and obligations. This external supervision in no way relieves the operator of its responsibility for organising its own monitoring of its activities, in particular those contributing to safety.

E.2.2.1 BNI licensing procedures

French legislation and regulations prohibit the operation of a nuclear facility without a licence. BNIs are thus regulated by decree 63-1228 of 11 December 1963, as modified, implementing amended law 61-842 of 2 August 1961 concerning the prevention of atmospheric pollution and odours. This decree in particular provides for a plant authorisation procedure followed by a further series of licences issued to mark the main steps in the life of these installations: choice of site, design, pre-commissioning, commissioning, final shutdown, dismantling. Its article 5 also enables the ministers in charge of nuclear safety to ask the operator at any time to review the safety of the installation.

An operator who runs an installation without the necessary licences, or in breach of these licences, may be subject to administrative and criminal penalties. These are mainly laid down in articles 12 and 13 of the decree of 11 December 1963 mentioned above, regarding the authorisation, and in articles 22 to 30 of the water law of 3 January 1992, regarding the discharge of effluents and intake of water.

Implementation of the various licence procedures runs from the choice of site and the design phase up to final dismantling.

E.2.2.2 BNI site selection procedures

Well before requesting an authorisation, the operator informs the administration of the site(s) on which it envisages building a BNI. It is then possible to examine the main characteristics of the future sites at a very early stage.

This examination covers the socio-economic and safety aspects. If the BNI project is to produce energy, the General Directorate for Energy and Raw Materials at the Ministry for Industry is closely associated with it. For its part, the ASN analyses the characteristics of the sites from the safety viewpoint: seismic activity, hydrogeology, industrial environment, sources of cold water, etc.

An additional decree of 22 October 2002 concerning the organisation of a public debate and the national public debate commission, stipulates that construction of a BNI must be referred to the public debate commission, so that the debate can be organised, whenever it concerns any new nuclear power production site or any new nuclear site not producing electricity and corresponding to an investment of more than 300 million euros. If the investment is between 150 and 300 million euros, the objectives and characteristics of the project must be made public, with a view to the possible organisation of a public debate.

Finally, neighbouring countries are informed by the French government in accordance with treaties in force, in particular the Euratom treaty.

E.2.2.3 Procedures concerning the design, construction and safety evaluation of a BNI

E.2.2.3.1 Safety evaluation

E.2.2.3.1.1 The safety options

When an operator intends to build a new BNI, it is normal although not mandatory for it to present the safety objectives and main characteristics as early as possible, and well before submitting a licence application.

The ASN asks the IRSN for its opinion on these proposals and then informs the operator of the questions to which it will have to provide answers in its authorisation application.

This preparatory procedure does not replace the subsequent regulatory examinations, but aims to make them easier.

E.2.2.3.1.2 Safety reviews and re-assessments

To take account of both the effect of time on the facilities and changes in safety requirements, the ASN asks the operators to conduct a BNI safety review at regular intervals (about every ten years), based on permanent analysis of experience feedback.

This provision is laid down in the regulatory texts. Article 4 of the decree of 19 July 1990, amending the initial decree of 11 December 1963, introduced an article 5 which in particular stipulates that the Ministers for the Environment and Industry "may jointly and at any time ask the operator to re-examine the safety of the facility".

If new data concerning the sites (earthquakes, flooding, etc.) or data from national or international experience feedback is likely to compromise the safety of the facility, a safety re-assessment is conducted. In any case, each BNI regularly undergoes a safety review.

A safety review of a facility comprises two stages:

- a conformity examination which systematically checks that the facility is in conformity with its design assumptions;
- a safety re-assessment which comprises a study phase, the aim of which is to review the BNI's safety analysis, with the benefit of experience feedback and using new analysis methods and tools (codes, probabilistic safety studies). This study phase leads to modifications to be implemented during scheduled outages, such as to improve the level of safety of the BNIs, in particular the older ones.

Each safety review ends with updating of the installation's safety analysis report.

E.2.2.3.2 Plant authorisation licence

E.2.2.3.2.1 Submission of the authorisation application

The application for BNI authorisation is submitted to the ministers in charge of nuclear safety, that is the Minister for the Environment and the Minister for Industry, who forward it to the other Ministers concerned for their recommendation (Interior, Health, Agriculture, Town Planning, Transport, Labour, etc.). It comprises a preliminary safety analysis report.

Examination of this application includes a public and administrative inquiry and a technical examination.

E.2.2.3.2.2 Consultation of the public and local authorities

The public inquiry is opened by the Prefect of the *département* in which the installation is to be located. The documents submitted to the inquiry must in particular specify the identity of the applicant, the subject of the inquiry, the nature and essential characteristics of the installation, and include a drawing of it, a map of the region, an assessment of the hazards and an environmental impact assessment.

In accordance with the relevant general provisions, the length of the public inquiry is between a minimum of one month and a maximum of two months, although it can be extended by a further two weeks if the Inquiry Commission so decides for good reason. Furthermore, in the case of BNIs, a specific provision introduced by a decree of 12 May 1993, enables the government to extend the inquiry period by a maximum of one month.

The subject of the inquiry is to inform the public and receive its perceptions, suggestions and counter-proposals, to enable the competent authority to obtain all the information it needs. Thus any interested person, wherever he lives, and of whatever nationality, is invited to express himself.

An Inquiry Commissioner (or an Inquiry Committee, depending on the nature or scale of the operations) is appointed by the president of the competent administrative court. He can receive all documents, visit premises, interview all persons, organise public meetings and request extension of the inquiry.

At the end of the inquiry, he examines the public's comments recorded in the planning inquiry registers or sent to him directly. He forwards a report and his recommendation to the Prefect within one month following closure of the inquiry.

The departmental or regional administrative services of the ministries concerned by the project are also consulted by the Prefect during an administrative conference.

At the end of this process, the Prefect forwards his recommendation along with the report and conclusions of the planning inspector and the results of the administrative conference, to the ministers with responsibility for nuclear safety.

The public inquiry organised prior to a possible public interest statement may in some cases replace the public inquiry required for a plant authorisation application.

E.2.2.3.2.3 Consultation of technical organisations

The preliminary safety analysis report appended to the plant authorisation application is subject to examination by one of the Advisory Committees reporting to the ASN, on the basis of an analysis report prepared by the IRSN.

After recommendations are received from the expert Advisory Committee, and taking account of the results of the public inquiry and any observations from the other ministers the ASN will, if there is no obstacle, prepare a draft decree authorising construction of the installation.

This draft is then forwarded to an inter-ministerial advisory commission, the CIINB (see § E.3.3.2.2), which is required to submit its recommendation within two months. The draft decree, possibly amended, is then submitted to the Minister for Health, who is required to issue his recommendation within three months.

E.2.2.3.2.4 The authorisation decree

The authorisation decree, implemented after a report by the Ministers for the Environment and Industry, sets the perimeter and characteristics of the facility, along with any special provisions with which the operator has to comply. It also specifies the justifications the operator will be required to present for pre-commissioning and then commissioning of its facility and later, for its final shutdown.

The provisions specific to the facility are applicable without prejudice to implementation of the general technical regulations, the regulations covering effluent discharges and the other texts applicable to environmental protection or worker health and safety.

E.2.2.4 Procedures concerning BNI operations

E.2.2.4.1 Operating licences for power reactors

The first load of new fuel elements may only arrive in the reactor storage building after authorisation by the Ministers for the Environment and Industry . This authorisation is issued after the ASN has examined the storage conditions provided for by the operator and presented to the ASN at least three months beforehand, along with the conclusions of an inspection conducted shortly before the scheduled date of arrival of the fuel elements.

In addition, six months before the reactor is loaded, the operator must send the Ministers for the Environment and Industry a provisional safety analysis report together with provisional general operating rules and an on-site emergency plan (PUI) specifying the organisation and the resources to be implemented on the site in the event of an accident. The ASN consults its technical bodies, in particular the Advisory Committee for nuclear reactors (see § E.3.1.5), about these documents, and then drafts its own recommendation. It is on the basis of this recommendation that the ministers can authorise fuel loading and pre-commissioning testing.

For pressurised water reactors, at least four successive licences are required during the start-up phase: the loading licence, the pre-critical hot testing licence, the licence for first criticality and power build-up to 90% of planned nominal power and the licence for build-up to 100% of planned nominal power.

After first start-up, within a time limit stipulated in the authorisation decree, the operator requests the issue of a commissioning licence from the Ministers for the Environment and Industry. Its request is substantiated by a final safety analysis report, the final general operating rules (RGE) and a new version of the PUI. These documents must take account of lessons learned during the period of operation since first start-up.

E.2.2.4.2 Operating licences for BNIs other than power reactors

The authorisation decrees for BNIs other than power reactors stipulate that start-up is subject to authorisation by the Ministers for the Environment and Industry.

This so-called "pre-commissioning" licence, which corresponds to introduction of radioactive material into the facility, requires notification of technical requirements. It is preceded by an examination by the ASN and its technical support organisations, in particular the relevant Advisory Committee, of the documents submitted by the operator. These documents include the provisional safety analysis report, the general operating rules (RGE) for the facility and the on-site emergency plan (PUI).

Furthermore, before final commissioning of the installation, which must take place within a time limit stipulated in the authorisation decree, the operator must submit a final safety analysis report to the Ministers for the Environment and Industry. Commissioning is subject to ministerial authorisation plus, as necessary, an update of the technical requirements and the general operating rules, using a procedure similar to that employed for power reactors.

E.2.2.4.3 Effluent discharge and water intake licences

The effluent discharge and water intake regulations are presented in paragraph F.4.1. The process for examining the licence applications is described below.

E.2.2.4.3.1 Submission of the licence application

The application concerning effluent discharge and water intake concerns all operations for which a licence is requested. It is sent to the Ministers for Industry and the Environment. This application includes various drawings, maps and information, a description of the operations or activities envisaged along with a study of their impact on the environment, comprising the proposed compensatory measures and the intended monitoring resources.

E.2.2.4.3.2 Recommendation by the ministers concerned

The application is forwarded to the Ministers for Health and Civil Safety for their opinion, as well as to the Directorate for the Prevention of Pollution and Risks of the Ministry for the Environment.

E.2.2.4.3.3 Consultation of the public and the local authorities and organisations

After asking the operator for any necessary additions or modifications to the file, the Ministers for Industry and the Environment transmit the application along with the recommendations of the ministers to the Prefect of the *département* concerned.

The Prefect calls an administrative conference between the devolved general government departments he feels that it would be useful to consult and subjects the licence application to a public inquiry in conditions similar to those described earlier for plant authorisations.

However, in this procedure, the inquiry is opened in the city in which the operation is to take place, as well as in the other communes to which its effect could spread, in particular communes along the rivers and waterways located downstream. Whenever possible, this inquiry should be combined with that opened for the creation authorisation procedure.

In addition, the Prefect consults the municipal councils concerned as well as various organisations such as the departmental health council (local debating structure) and, if necessary, the local river authority (*Mission déléguée de bassin*) or the government representative managing the public domain. Finally, he forwards the application file to the local water commission for information.

At the end of these consultations, the Prefect forwards the results of the administrative conferences, the consultations and the inquiry, with his recommendations, to the Ministers for Industry and the Environment.

E.2.2.4.3.4 Consultation of technical experts

The opinion of the technical support organisation (IRSN) is generally required by the Nuclear Safety Authority. This opinion completes the ASN's analysis and helps it reach its conclusions and define the discharge and monitoring conditions.

E.2.2.4.3.5 The inter-ministerial licensing order

The licence is granted by joint order of the Ministers for Health, Industry and the Environment.

Within the framework of the general technical rules defined by regulatory order of 26 November 1999, this order sets:

a) limits for the intake and discharges the operator is authorised to carry out;
b) the means of analysing, measuring and monitoring the structure, installation, works or activity, and of monitoring their effects on the environment, in particular with respect to discharges;
c) the conditions in which the operator reports to the Ministers for Health and for the Environment and the Prefect on water intake and discharges it has carried out, as well as the results of the monitoring of their effects on the environment;
d) how the public is informed.

Finally, any modification made by the operator to the installation or its operation, and such as to entail consequences on effluent discharges or water intake must, prior to implementation, be made known to the Ministers for Industry and the Environment, who consult the Minister for Health. If they estimate that the modification is likely to prove dangerous or harmful for the environment, they may demand submission of a new licensing application.

At the request of the licence holder or at their own initiative, the Ministers for Health, Industry and the Environment may, after consulting the local health council, issue an order to modify the conditions stipulated in the licensing order. This simplified method for modifying technical rules is however limited to aspects which do not appreciably alter the impact of the facility.

E.2.2.4.4 Operating documents

For operation of nuclear installations, the personnel refer to various documents, among which the ASN pays particular attention to those concerning safety.

These are primarily general operating rules (RGE) which present the steps taken during normal and incident status operation of the BNIs; they supplement the safety analysis report, which mainly deals with the steps taken at design of the installation. Decree 63-1228 of 11 December 1963, as modified, in particular stipulates that the operator must provide these two documents to support its application for pre-commissioning of a basic nuclear installation.

E.2.2.4.5 Incident monitoring

Articles 12 and 13 of the "quality" order of 10 August 1984 stipulate the provisions concerning anomalies and incidents. Any deviation from a requirement defined for performance of or the result of an activity concerned by quality, any situation likely to prejudice the defined quality or any situation which, from a safety viewpoint, warrants corrective action, is referred to in this order as "anomalies or incidents", as applicable.

Action to correct an anomaly or incident thus defined is considered to be an activity concerned by quality. An up to date record of anomalies or incidents is kept.

Safety-related anomalies or incidents must be identified. These anomalies or incidents are designated "significant anomalies or incidents" in this order. The ASN defines the criteria on the basis of which an event is to be considered significant.

For this purpose, a procedure must - for each activity concerned by quality, and taking account of pre-determined criteria whenever possible – allow identification of which incidents or anomalies are to be considered significant. It specifies the functions of the persons responsible for this identification.

Incidents are declared to the Nuclear Safety Authority within 24 hours and are systematically rated on the INES scale. An incident report comprising an initial analysis must be sent by the operator to the Nuclear Safety Authority within 2 months.

An equivalent system is in place for events involving radiation protection.

E.2.2.4.6 Final shutdown and dismantling licences

Article 6 ter of decree 63-1228 of 11 December 1963 states that when, for whatever reason, the operator intends to carry out final shutdown of its installation, it must inform the ministers responsible for nuclear safety, by sending them:

- a document explaining the chosen status of the installation after final shutdown and specifying the steps involved in its subsequent dismantling, including the target final status of the site;
- a safety analysis report applicable to the final shutdown operations and the steps ensuring the safety of the installation;
- the general surveillance and maintenance rules to be observed to maintain a satisfactory level of safety;
- an update on the on-site emergency plan for the installation concerned.

In accordance with the general regulations for the protection of nature, the operator must also enclose with its documents an environmental impact assessment for the measures proposed.

Implementation of these various provisions is dependent on their being approved by a decree signed by the Ministers for the Environment and Industry, after approval by the Minister for Health, further to consultation of the CIINB (see § E.3.3.2.2).

All the operations included in normal operation of the installation and its authorisation decree (for example, unloading and shipment of nuclear fuel, dismantling of glove boxes, etc.) can be carried out during the final cessation of activity phase, before the final shutdown and dismantling decree. However, this decree is a prerequisite to the other operations not involved in normal operation, such as destruction of civil engineering structures.

The final shutdown and dismantling decree authorises the works corresponding to the operator's application and specifies how the installation must be administratively managed at the end of the dismantling work. This decree is implemented after examination of the operator's justification that the risks linked to this dismantling work have been evaluated and that the appropriate steps have been taken for all stages of dismantling.

When the final status targeted by the operator following the work authorised by the final shutdown and dismantling decree still requires classification of the facility as a basic nuclear installation, a new decree implemented following public inquiry must authorise this new facility. If not, following the dismantling work and depending on the radioactivity and remaining chemical products, the facility becomes an installation classified on environmental protection grounds or may even no longer be regulated.

In most cases, the ASN attempts to ensure that a trace of the past use of the land is preserved in the town planning records to ensure that a future buyer of the land is informed of its history.

In February 2003, the ASN issued an instruction concerning the various technical and administrative aspects of final shutdown and dismantling of BNIs. This text for example takes account of the experience acquired on the subject since January 1990, date on which the above-mentioned decree of 11 December 1963 concerning nuclear facilities was completed on this point.

E.2.2.5 Technical rules concerning BNIs

A hierarchical series of texts sets the rules and technical practices in terms of nuclear safety. They are summarised below, in ascending order of detail. Initially these texts, which have regulatory status, are relatively general, covering a broad scope but usually not going into too much technical detail. The later ones however, deal with subjects in precise detail. Their legal format is more flexible.

E.2.2.5.1 General technical regulations

The general technical regulations, based on article 10 bis of the decree of 11 December 1963 mentioned above, currently deal with four major subjects: pressure vessels (subject not relevant to the installations within the scope of the convention), the quality organisation (see section F.3, article 23), BNI water intake and effluent discharges (see section F.4, article 24), detrimental effects and external risks resulting from BNI operation (see § E.2.2.6.3).

E.2.2.5.2 Basic safety rules

On various technical subjects, concerning both power reactors and other BNIs, the ASN issues basic safety rules (RFS). These are recommendations which define safety objectives and describe practices that the ASN feels to be satisfactory to ensure that they are met.

These are not regulatory texts as such and an operator may choose not to follow the provisions of a basic safety rule if it can prove that the alternatives it proposes enables the safety objectives it has set to be attained.

Through its flexibility, this type of text enables the technical requirements to be updated according to technical progress and new knowledge.

There are currently about forty RFS and other technical rules issued by the ASN which can be consulted in brochure no. 1606 published by the Official Gazette and the Nuclear Safety Authority, under the title "The safety of nuclear installations in France – laws and regulations". The list of RFS that more particularly concern the facilities within the scope of the convention is given in appendix L.4. They cover the following areas:

- determination of seismic movements to be taken into account in the safety of facilities and installations;
- criticality risks;
- fire protection;
- design and operation of ventilation systems;
- incorporation of risks linked to aircraft crashes;
- incorporation of risks linked to the industrial environment and thoroughfares.

E.2.2.6 The scope of supervision of the BNIs

ASN supervision also aims to check that any user of ionising radiation assumes full responsibility for its radiation protection obligations. In the case of BNIs, this check – which also covers nuclear safety – involves both inspections of all or part of a facility, and examination of files, documents and information supplied by the operator to justify its actions. This supervision is applicable at all stages in the life of an installation: design, construction, commissioning, operation, final shutdown, dismantling. In other areas, the ASN is gradually setting up supervision based on the one hand on examination of the files concerning the procedures stipulated by the regulations and on the other on a system of radiation protection inspections in the nuclear activities.

E.2.2.6.1 Supervision of nuclear safety

As part of its supervision activities, the ASN looks at all elements contributing to the safety of the installations. Supervision thus concerns both the actual equipment constituting the installations and those responsible for their operation, together with the related working methods and the organisational arrangements.

The scope of ASN supervision also extends to the entire life of a nuclear facility, from the initial design phases up to dismantling, covering its construction, commissioning, operation, modifications, final shutdown and dismantling.

At the design and construction stage, the ASN reviews the safety analysis reports describing and justifying the design principles, the equipment sizing calculations, their operating and test rules, and the quality organisation set up by the prime contractor and its suppliers.

During operation of such a nuclear facility, all safety-related modifications made by the operator must be authorised by the ASN. Furthermore, the ASN regularly requires that the operator conduct safety reviews, as described in § E.2.2.3.1.2

Nuclear operator compliance with the safety reference system is monitored through regular inspections. These mainly take the form of inspections on the nuclear sites, but also whenever necessary at the Head Office department of the large nuclear operators or at the premises of their suppliers, in order to check concrete implementation of the safety provisions.

When the supervisory actions conducted by the ASN reveal breaches of compliance with safety requirements, penalties can be imposed on the operators, if necessary after formal notice to comply. These can in particular consist in a ban on restart or suspension of operation of a nuclear installation until such time as corrective steps are taken.

Finally, the ASN is kept informed of unforeseen safety-related events, such as equipment failures or errors in implementation of operating rules. The ASN ensures that the operator has conducted a relevant analysis of the event and has taken appropriate steps to correct the situation and prevent it happening again.

Nuclear safety supervision assignments are split within the ASN between the General Directorate for Nuclear Safety and Radiation Protection (DGSNR) and the nuclear safety and radiation protection departments (DSNR) of the regional directorates for industry, research and the environment (DRIRE). The DSNR are entrusted with on the spot supervision. They are in permanent contact with the nuclear operators, co-ordinate most of the inspections performed on the nuclear sites, and supervise maintenance outages, following which the ASN is required to decide whether to authorise restart of the facility. The DSNR also examine certain authorisation and waiver applications and conduct an initial examination of the incident reports. The DGSNR co-ordinates and guides the DSNR in these fields, deals with generic events, and defines and implements national nuclear safety policy.

E.2.2.6.2 Radiation protection

Since 22 February 2002, supervision of implementation of radiation protection rules has been the responsibility of the ASN, placed for this purpose under the authority of the Ministry for Health.

This responsibility for radiation protection was anticipated by the ASN, which had already included radiation protection concerns in its BNI supervision. There is indeed a strong link between safety, which aims to prevent the accidental dispersal of radioactivity, and the practical steps taken by the operator to control radioactive materials transfer, detect any contamination, and more generally to monitor and limit the doses received by persons working in the facilities, in particular during safety checks. This final aspect coincides with the scope of action of the DRIRE, regarding inspection of work in nuclear facilities (see § E.2.2.6.4).

E.2.2.6.3 Environmental protection

The prevention and limitation of detrimental effects and risks for the environment as a result of BNI operations, are ensured through implementation of:

- the decree of 11 December 1963 concerning BNIs, in conjunction with an implementation order of 31 December 1999 which sets out the general provisions concerning the prevention of environmental risks (in particular accidental contamination) and noise pollution, as well as waste management in the BNIs;
- legislation on those installations classified on environmental protection grounds (ICPEs) which fall within the scope of the BNIs;
- the decree of 4 May 1995 concerning discharge of liquid and gaseous effluents from and intake of water into BNIs, together with an implementation order of 26 November 1999 and the circular of 20 January 2002;
- the order of 31 December 1999 stipulating the general technical regulations designed to prevent and limit detrimental effects and external risks arising from operation of the BNIs.

More generally, the policy followed by the ASN in terms of environmental protection tends towards the policy applied to conventional industrial activities. For example, the order of 26 November 1999, laying down the general technical provisions concerning the limits and procedures for intake and discharges performed by the BNIs and subject to authorisation, requires that a BNI's discharge limits be set on the basis of the use of the best available technologies at an economically acceptable cost, taking account of the specific characteristics of the site environment. This approach leads to clarification and strengthening of the limits concerning discharge of chemical substances, as well as to a reduction of the authorised limits for discharge of radioactive and chemical substances. The previous regulations provided for discharge licences of limited duration. As these licences expire, they are renewed according to the above provisions. This renewal process is an opportunity to examine the possible reduction of discharges from the facility and improve the monitoring conditions.

In parallel with this approach, the ASN has in recent years developed inspections concerning effluent and waste management, the prevention of accidental pollution and the implementation of rules applicable to the ICPEs. This action has been strengthened through new inspection procedures involving sampling, which have been in force since 1 January 2000.

E.2.2.6.4 Working conditions in the BNIs

In a BNI as in any company, monitoring of compliance with health and safety at work regulations is the responsibility of the work and safety inspectors. In the case of EDF nuclear power plants, this monitoring is performed by DRIRE personnel under the authority of the Directorate for Energy Demand and Energy markets (DIDEME) of the Ministry of the Economy, Finance and Industry, acting on behalf of the Ministry for Labour. The DRIRE personnel who carry out this activity may also be BNI inspectors.

Nuclear safety supervision, radiation protection and work and safety inspections share a number of concerns, in particular the organisation of work sites and the conditions for use of subcontractors. The ASN, the DIDEME and the work and safety inspectors therefore pay particular attention to co-ordinating their respective actions.

Finally, exchanges with the work and safety inspectors can also be a valuable source of information about the status of labour relations, within a more general nuclear safety picture which pays more attention to the importance of people and organisations.

E.2.2.7 BNI supervision procedures

There are many ASN supervision procedures, chiefly consisting of:

- inspections on-site or in departments linked to the operators;
- work-site inspections during installation maintenance outages;
- technical meetings on site with the BNI operators or the manufacturers of equipment used in the installations;
- examination of supporting documents submitted by the operators.

E.2.2.7.1 Inspection

E.2.2.7.1.1 Principles and objectives

Inspection by the ASN consists in checking that the operator is complying with the provisions it is required to implement regarding safety and radiation protection. Without being systematic or exhaustive, the aim of inspections is to detect occasional discrepancies or nonconformances, as well as any drift indicating a possible deterioration in the safety of the installations.

The ASN draws up an annual programme of inspections, taking account of the inspections already conducted, its knowledge of the installations and the progress made on technical subjects under discussion between the ASN and the operators. The programme is drawn up jointly by the DGSNR, the nuclear safety and radiation protection departments of the DRIRE and the IRSN, using a methodical approach defining priority national topics and an adequate distribution among the sites. This programme is not made known to the operators of the nuclear installations and facilities.

The inspections are either announced to the operator a few weeks before the visit, or are unannounced.

They mainly take place on the nuclear sites, but can also be in the operators' engineering offices, the workshops and design offices of the subcontractors, as well as on the construction sites or in the manufacturing plants or buildings producing various safety-related components. Even when the inspection does not take place on the nuclear site, it is the BNI operator who is responsible for the results, in particular concerning the quality of the work performed and the efficiency of its own surveillance at its subcontractor's or supplier's works.

The inspections are generally performed by two inspectors, one of whom is more particularly in charge of co-ordination, with the assistance of an IRSN representative specialised in the installation to be inspected or the technical topic of the inspection.

The BNI inspectors are ASN engineers, appointed from among the inspectors for installations classified on environmental protection grounds by joint order of the Ministers for the Environment and Industry. They carry out their inspection functions under the authority of the Director General for Nuclear Safety and Radiation Protection. The inspectors take an oath and are bound to professional secrecy when legal proceedings are initiated.

During the inspections, the operator is informed of any factual findings concerning:

- nonconformances regarding safety or radiation protection in the facility, or safety-related points requiring further explanation in the opinion of the inspectors;
- discrepancies between the situation observed during the inspection and the regulatory texts or documents produced by the operator in accordance with the regulations, with regard both to safety and radiation protection and to the related fields under ASN supervision (waste management, effluent discharges, installations classified on environmental protection grounds).

Following the inspection, the ASN sends a follow-up letter to the operator, summarising the inspection and listing its requests for corrective action, along with change requests and any observations from the inspectors. The operator must reply to these requests within two months.

The inspection follow-up letters are published on the ASN's website (www.asn.gouv.fr) and indicate any discrepancy or nonconformity, giving an overall picture of the operation of the facility.

E.2.2.7.1.2 Inspection practices

The ASN uses six types of inspections:

- routine inspections dealing with general subjects;
- reinforced inspections, on topics involving particular technical difficulties and normally conducted by experienced inspectors;
- review inspections, which take place over several days and mobilise an entire team of inspectors, to carry out in-depth examination of pre-determined subjects;
- inspections involving sampling and measurements, allowing spot checking of discharge levels independently of that performed by the operator;
- reactive inspections conducted following an incident or particularly significant event;
- work-site inspections, ensuring a significant ASN presence on the sites during scheduled outages or specific work-sites.

The ASN has also set up a system of inspector qualification taking account of their experience and their training. This system means that responsibility for the more complex inspections is entrusted to the more experienced inspectors.

Annually, the ASN carries out about 700 inspections in basic nuclear installations, half of which concern the power reactors and the other half the other installations. The number of unannounced inspections has risen in recent years and now accounts for 30 %, as shown in the following table.

Number of inspections conducted by the ASN

Year	total	reactors	other installations	unannounced inspections
1998	674	350	324	68
1999	667	326	341	87
2000	678	360	318	118
2001	674	338	336	132
2002	666	335	331	158
2003	670	326	344	176
2004	757	374	383	215

E.2.2.7.2 Technical examination of the documents supplied by the operator

The operator is required to provide the ASN with the information needed for its supervision. The contents and quality of this information should enable the inspections to be targeted and the technical demonstrations presented by the operator to be analysed. It should also allow identification and monitoring of the significant events during the operation of a BNI.

E.2.2.7.2.1 Significant incidents

For all the facilities, the ASN has defined a category of "significant incidents", which have nuclear safety implications such as to justify that they be immediately reported. The ASN would subsequently receive a more complete report stating the conclusions the operators have drawn from their analysis of the incidents and the measures they are taking to improve safety. This for example includes excursions outside an installation's normal operating range, malfunction of certain safety systems or unscheduled radioactive discharges.

The DRIREs are responsible for immediately investigating significant incidents in all basic nuclear installations, as well as incidents concerning radioactive material transports, to check implementation of immediate corrective measures and where necessary to prepare information to be released to the public. The ASN co-ordinates the actions of the DRIRE in this respect and every year provides training for the engineers concerned.

Investigation of a significant incident by the DRIRE consists in examining compliance with current rules regarding detection and reporting of significant incidents, the immediate technical steps taken by the operator to keep the facility in or bring it to a safe condition, and finally the relevance of the significant incident reports supplied by the operator.

A deferred examination of experience feedback on nonconformances and incidents is performed by the ASN and its technical support organisations, in particular the IRSN. The information received from the DRIRE and analysis of the significant incident reports and periodic summaries sent in by the operators constitute the basis for the ASN experience feedback organisation. This experience feedback is in particular taken into account during the periodic safety reviews of installations and can lead to requests for improvement of the condition of the installations and of the organisation adopted by the operator, or transmission of information to other operators who may be concerned.

E.2.2.7.2.2 The other information presented by the operators

The operator periodically submits activity reports and summary reports regarding liquid and gaseous discharges and the waste produced.

Similarly, a large amount of information concerns specific subjects such as the earthquake resistance of the facilities, fire protection, contractor relations, and so on, and is forwarded by the operator.

E.2.2.7.2.3 Assessment of the information supplied

The purpose of much of the information submitted by a BNI operator is to demonstrate that the goals set by the general technical regulations or those set by the operator itself are met. The ASN and DRIRE are required to check the completeness of the file and the quality of the demonstration.

Whenever it feels it to be necessary, the ASN calls on its technical support organisations, primarily the IRSN, for advice. The safety assessment requires cooperation by a large number of specialists and effective co-ordination in order to identify the key safety-related aspects. The IRSN assessment relies on studies and R&D programmes focused on risk prevention and improving knowledge about accidents. It is also based on in-depth technical exchanges with the operating teams who design and run the facilities.

For a number of years, the ASN has been diversifying its technical support organisations by calling on both French and foreign organisations.

The way in which the ASN requests advice from a technical support organisation and, as applicable, an Advisory Committee, is described in § E.3.1.5. For more important matters, the ASN requests the opinion of the competent Advisory Committee to which the IRSN presents its analyses; for the other matters, the safety analyses are the subject of a recommendation sent directly to the ASN by the IRSN.

E.2.3 The regulatory framework of the ICPEs and mines

E.2.3.1 Regulatory framework of ICPEs

In France, the State is responsible for prevention of industrial and agricultural pollution and risks. The State lays down policy for controlling the risks and detrimental effects generated by industry. The Directorate for the Prevention of Pollution and Risks within the Ministry for the Environment is in charge of this task. Legislation applicable to ICPEs, codified in part 1 of Book V of the Environment Code, is the legal basis for the industrial environment policy in France. This legislation superseded a law of 1917, which itself replaced a decree of 1810.

These texts provide a general definition of the principles applicable to any facility which can constitute a hazard or inconvenience either for the peace and quiet of the neighbourhood, or for public well-being, safety and health, or for agriculture, or for protection of nature and the environment, or for conservation of historic sites and monuments.

Regulation of the ICPEs covers activities as varied as livestock breeding, large oil refineries, quarries or use of radioactive materials.

The legislation for ICPEs uses a simple system. Industrial activities covered by this legislation are listed in a nomenclature which subjects them either to a licensing system, or a declaration system, depending on the activity performed and the quantity of hazardous products used.

Below the declaration threshold, the facility owner is not required to follow administrative procedures for prevention of detrimental effects and risks. Between the declaration and licence thresholds, a declaration to the departmental Prefect is required. General requirements must be met and the facility can be inspected. Above the licence threshold, prior licensing from the departmental Prefect is required. This licence is issued after a public and administrative inquiry, on the basis of the report of the classified installations inspectorate and on the recommendation of the departmental health committee.

Whereas the provisions for facilities subject to declaration are standardised, those applying to facilities subject to licensing are drawn up according to the characteristics of the facility. However, for certain facility categories, ministerial orders set the minimum requirements to be included in the licensing orders.

The rights of third parties are always protected, even if the industrial facility complies with the regulations.

"Polluter pays" is a key principle in environment policy. It consists in having the polluter pay for the damage it causes to the environment through its activity and in particular through the impact of liquid and gaseous discharges, or even waste.

Depending on the substance concerned, mineral extraction works are placed in either the mines or quarry category. The mines category in particular contains workings of all metal ores, in particular uranium and its compounds. Mines must first of all be issued an extraction permit for the substance concerned from the central government: concession or mining permit for small quantities. A licence to begin mining must then be obtained, in particular in the light of the impact assessment for the activities in question.

Substances in the quarry category are left at the disposal of the owner of the land. Quarries are however ICPEs and their operator must obtain the necessary licences or declarations accordingly.

E.2.3.2 Regulatory framework for mines

For mining operations, the discharge of radioactive substances into the environment is regulated by decree 90-222 of 9 March 1990 and its implementing circular of 9 March 1990. This decree forms the second part of the "Ionising radiation" section of the general regulations of the mining industries created by decree 80-331 of 7 May 1980, itself implementing article 77 of the Mining Code.

These regulations apply to the actual mining work as well as to their legal dependencies, in other words the related surface installations and the other essential installations, such as mechanical preparation of the ore before its chemical treatment, which is itself not covered by the Mining Code, but by the Environment Code.

A mine may only be operated under a concession or with an operating permit. The authorisation to begin works is granted by the Prefect of the *département* following a procedure which includes a public inquiry.

At the end of mining operations, or part of operations, the operator must declare cessation of activity, indicating the steps it intends to take to protect the interests mentioned in article 79 of the Mining Code. The Prefect either acknowledges the declaration or specifies additional measures.

Since the law of 30 March 1999, when major risks are likely to prejudice the safety of property or persons, the operator is required to install and operate the equipment necessary for monitoring and preventing such risks. With the end of the validity of the claim, responsibility for monitoring of these risks passes to the State.

The State drafts and implements mining risk prevention plans in the conditions laid down in articles 40-1 to 40-7 of law n° 87-565 of 22 July 1987 concerning the organisation of civil security, the protection of forests against fires and the prevention of major risks.

E.2.3.3 The scope of ICPE and mines inspections

E.2.3.3.1 Safety inspections

As part of its monitoring duties, the inspectorate of ICPEs looks at all elements contributing to the safety of the facilities and their impact on the environment. Supervision thus concerns both the actual equipment constituting the installations and those responsible for their operation, together with the related working methods and the organisational arrangements.

When the checks carried out by the installations classified on environmental protection grounds (ICPE) inspectorate reveal any failure to comply with the requirements of the facility licensing conditions, penalties may be imposed on the operators. The first of these penalties is formal notice. When such formal notice is ignored, the Prefect may resort to other administrative penalties: sequestration of funds with a public accountant, having the work carried out at the expense of the operator, or suspension of operation of the facility. A programme of inspections is set yearly. The inspection frequency for the facilities depends on their hazard potential.

Mines are inspected by the DRIRE. This concerns the safety of mining operations, the health and safety of the mine workers and any environmental hazards arising from the mine working.

E.2.3.3.2 Monitoring of radiation protection outside the BNIs

Decree 2002-255 of 22 February 2002 states that the DGSNR draws up the technical regulations concerning radiation protection and is responsible for organising the inspections involved in monitoring it in the industrial, medical and research fields, including by monitoring sources of ionising radiation used in these fields. This duty is exercised jointly with other inspection agencies, such as the work and safety inspectorate, the ICPE inspectorate and the inspectorate of the French agency for the safety of health products. The aims of the inspections are to check compliance of the facilities with the application file for a licence to possess sources and compliance with the safety and radiation protection requirements.

E.3 Regulatory body (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 financial and human resources to fulfil its assigned responsibilities.

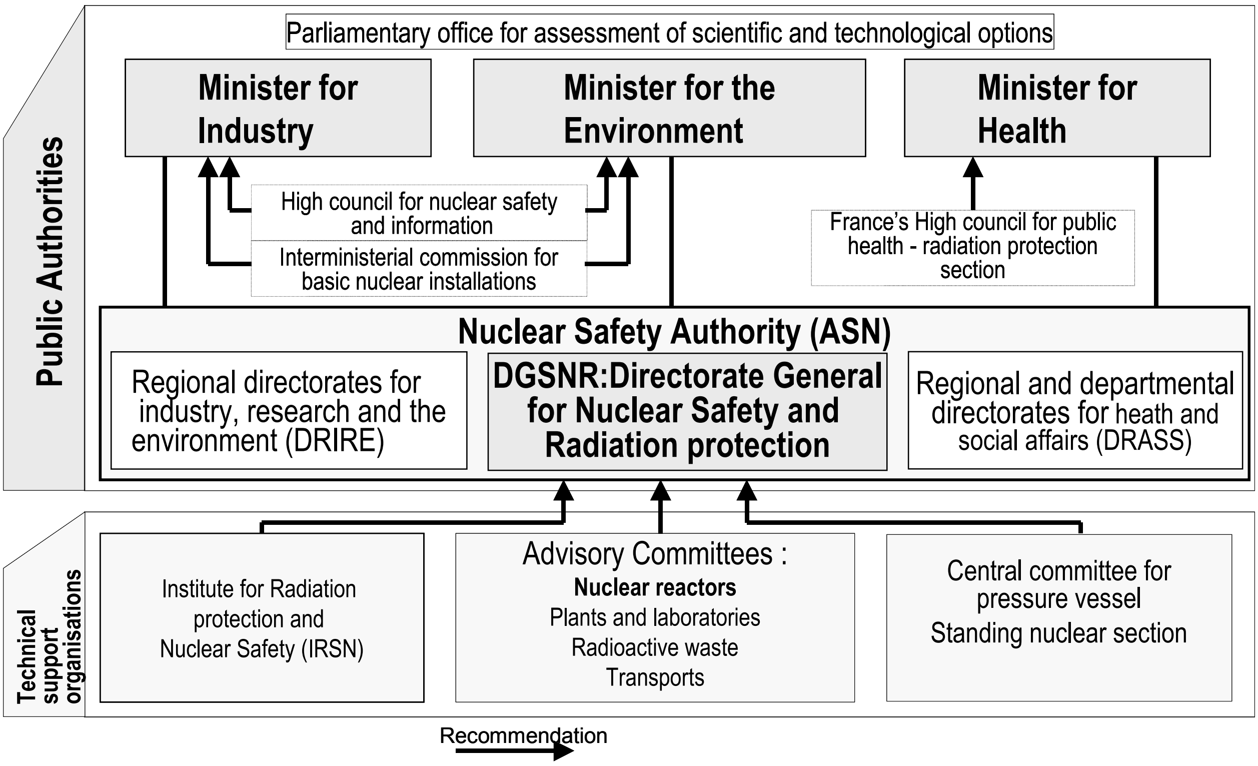
2. Each Contracting Party, in accordance with its legislative and regulatory framework, shall take the appropriate steps to ensure the effective independence of the regulatory functions from other functions where organizations are involved in both spent fuel or radioactive waste management and in their regulation.

E.3.1 Nuclear Safety Authority

Within the public authorities, responsibility for supervision of the safety of basic nuclear installations (BNIs) and the safety of nuclear transportation lies with the Ministers for the Environment and Industry.

According to decree 2002-255 of 22 February 2002, the Directorate General for Nuclear Safety and Radiation Protection (DGSNR) draws up and proposes government policy regarding nuclear safety, under the joint supervision of the Ministers for Industry and the Environment, and radiation protection, under the supervision of the Minister for Health, respectively.

The authority comprising the DGSNR and the nuclear safety and radiation protection departments (DSNR) within the regional directorates for industry, research and the environment (DRIRE) is referred to as the "Nuclear Safety Authority" (ASN). The organisation of the Nuclear Safety Authority described in this chapter is illustrated by the following diagram.



In the field of nuclear safety, this double supervision by the Ministers for Industry and the Environment guarantees the independence of the Nuclear Safety Authority from the General Directorate for Energy and Raw Materials, responsible for management of spent fuel and management of radioactive waste, which reports exclusively to the Minister for Industry.

In terms of radiation protection, the ASN is responsible for preparing and implementing government policy for all nuclear facilities and activities. It is more particularly tasked with preparing and implementing the safe management of spent fuel and the safe management of radioactive waste. In this respect, it constitutes the regulatory body stipulated by the Convention.

The ASN relies on the expertise of outside technical organisations, in particular the Institute for Radiation Protection and Nuclear Safety (IRSN), and asks the Advisory Committees for their opinions and recommendations.

E.3.1.1 The Directorate General for Nuclear Safety and Radiation Protection

Its main tasks are as follows:

- to draw up and check implementation of the general technical regulations for the safety of basic nuclear installations;
- to draw up and implement – together with the other competent administrations -, all measures designed to prevent or limit health risks linked to exposure to ionising radiation;
- to implement BNI licensing procedures (licences for construction, commissioning, discharges, final shutdown, dismantling, etc.);
- to organise and co-ordinate surveillance of the installations by the BNI inspectors;
- to monitor the discharge of effluents and waste from the BNIs;
- to organise, co-ordinate and manage all radiation protection inspections;
- to organise and manage radiation protection inspections in the industrial, medical and research fields;
- to follow-up sources of ionising radiation;
- to supervise the transportation of radioactive and fissile material for civilian purposes;
- to organise radiological monitoring of the environment nationwide;
- to prepare and implement regulations covering the monitoring of radioactive waste management;
- to prepare an emergency response plan (in a BNI, during transportation of radioactive material or in any other nuclear activity) in the event of an incident or accident likely to compromise human health through exposure to ionising radiation;
- to organise public and media information on subjects relating to nuclear safety and radiation protection;
- to take part in the activities of international organisations and develop bilateral relations with foreign nuclear safety and radiation protection authorities.

The ASN also collects all information about research and development work conducted in the fields of nuclear safety and radiation protection, in particular that by the French Atomic Energy Commission, COGEMA, Andra and Electricité de France.

It is not mandatory for operators to submit their research programs to the ASN. However, the ASN maintains a global overview of the research programs of the operators, in particular to be able to have up-to-date information about scientific developments, and to detect whether enough research efforts are being carried out on specifically important topics for safety. Important safety and radiation protection related research is also carried out within the ASN’s technical support organisation, the IRSN.

By participating in research assessment committees, the ASN may contribute to develop and finance possibly specific research programs.

An exception is the research carried out on geological disposal, where assessment and follow-up committees are in place in the administration, including the ASN, according to the specific law on this topic.

E.3.1.2 The devolved departments

E.3.1.2.1 The safety and radiation protection departments of the DRIREs

The safety and radiation protection departments (DSNRs) which replaced the DINs, carry out their activities in a geographical zone comprising one or more administrative regions.

The DSNRs take part in examining authorisation applications submitted by the operators of BNIs located in their geographical zone:

- creation, modification or shutdown of a BNI;
- water intake and effluent discharge from a BNI;
- waivers to general operating rules.

Supervision of examination of these applications remains the responsibility of the DGSNR and issue of authorisations is the responsibility of the Government or ministers.

The DSNRs also take part in surveillance of basic nuclear installations and radioactive material transports, through:

- inspections;
- examination of incidents and accidents;
- supervision of unit outages.

This supervision concerns not only regulations covering nuclear safety as specific to BNIs, but also regulations concerning radiation protection, water intake and effluent discharge, installations classified on environmental protection grounds (ICPE) and pressure vessels (ESP).

In an emergency situation, the DSNRs play a two-fold role to support the prefect of the *département* , who is responsible for protection of the population, and provide on-site monitoring. In preparing for these situations, they take part in drafting emergency plans established by the prefects and in periodic emergency exercises.

Finally, the DSNRs take part in informing the public about nuclear safety and radiation protection in the BNIs, by contributing to the ASN's publications, its website and its magazine entitled “Contrôle”, by taking part in the Local Information Committees (CLI) and through relations with local associations and media

E.3.1.2.2 The regional and department health and social action directorates

The DRASS and DDASS carry out their activities in a given geographical zone, *department* or administrative region.

In 2004, based on the conclusions of the DDASS-DRASS-DRIRE Working group, a circular sent out to the Prefects specified the tasks the DDASS and DRASS would be continuing to handle in the field of radiation protection supervision and those from which it could withdraw.

The DRASS and DDASS take part in supervising radiation protection in both the natural and social environments:

- radiological monitoring of drinking water;
- monitoring of radon in establishments open to the public and in the habitat.

The DRASS and DDASS also take part in preparing and managing radiological emergency situations, in particular through:

- support for the Prefect in the event of an incident or accident;
- contribution to drafting the emergency plans established by the Prefects;
- stockpiling and distribution of iodine tablets;
- participation in periodic emergency exercises.

However, the DRASS and DDASS will no longer be required to take part in radiation protection related licensing or declaration procedures for medical nuclear activities, nor take samples from the environment. Their role in supervision radiation protection of patients has yet to be defined.

E.3.1.3 ASN human resources and human resources management

E.3.1.3.1 Resources

E.3.1.3.1.1 Human resources

As at 31 December 2004, the ASN's total workforce stood at 332, split between the DGSNR and the DRIRE DSNRs.

This workforce can be broken down as follows:

- 216 civil servants assigned to the ASN;
- 4 staff seconded from or made available by the Ministry for Public Works or the Public Health Service - Paris Hospitals (Assistance Publique – Hôpitaux de Paris);
- 21 contracted staff;
- 91 staff made available by the CEA and the IRSN.

75% of the ASN's staff are executives, with 21% of them being women. These executives are mainly State engineers (mines engineers, construction engineers, industrial engineers, public works engineers, public health medical inspectors, public health engineers) often with prior experience of supervision activities (in the nuclear or other fields). They are also executives made available by the CEA or the IRSN and who have experience of nuclear or radiological activities, along with contracted engineers specialised in radiation protection.

E.3.1.3.1.2 Financial resources

The ASN's 2004 budget amounts to 34.1 million euros. It comprises salaries (€15.2 m), operating expenses (€6.9 m), as well as safety work and analyses, assessments entrusted to outside experts (€1.3 m). To this should be added a sum of €53.78 m corresponding to the assessment work done by the IRSN.

E.3.1.3.2 Human resources management

E.3.1.3.2.1 Staff training

Competence is one of the core values of the ASN. Initial and continuous training is a fundamental aspect of professionalism within the Nuclear Safety Authority. The system used relies on training in nuclear techniques, general training and training in communication methods.

One of the bases of managing the qualification levels within the ASN is a formalised curriculum for technical training of staff. This training curriculum comprises four technical training categories, according to the position occupied within the ASN:

- inspector training: this is a training course necessary to move up from trainee inspector to qualified inspector. The BNI inspector's card can only be issued once this qualification is obtained;
- 1st year basic training: this type of training is not essential to making the transition from trainee inspector to qualified inspector, but it is advisable to follow the various modules as soon as a session becomes available;
- senior inspector training: this is the training curriculum required to make the transition from qualified inspector to senior inspector. "Senior inspector training" implies having first taken the training for the previous categories "inspector training" and "1st year basic training";
- refresher courses: this type of training is not necessarily required to achieve senior inspector status. This training can be taken by the employee at his own request or the request of his hierarchy, depending on the specific subjects for which he has responsibility.

E.3.1.3.2.2 Inspector qualification

To reinforce the credibility and quality of its actions, the Nuclear Safety Authority in 1997 undertook a process of qualification of its inspectors, based on recognition of their technical competence. This was backed up by the creation on 25 April 1997 of a Nuclear Safety Authority Accreditation Committee. This is an Advisory Committee mainly comprising members from outside the Nuclear Safety Authority. Its role is to rule on the qualification system as a whole. It examines the training courses and the qualification systems of reference applicable to the various Nuclear Safety Authority units. These systems of reference in particular comprise definition of the levels of qualification (inspector and senior inspector), a description of the corresponding tasks and the rules governing transition from one level to the next.

On the basis of these systems of reference, the Accreditation Committee interviews the inspectors presented by their hierarchy as candidates for senior inspector. It proposes senior inspector appointments to the Director general of the DGSNR, who has the final decision on the outcome.

On 31 December 2004, 34 senior inspectors were working within the Nuclear Safety Authority. It should be noted that achieving the grade of senior inspector is a prerequisite before any inspector can be made available with a foreign Nuclear Safety Authority.

E.3.1.3.2.3 Internal quality management

To guarantee and improve the quality and efficiency of its actions, the ASN defines and implements a quality management system based on:

- listening to what the stakeholders want (public, elected members, associations, media, unions, industry) during the course of statutory procedures (public inquiry) or in less formal contexts (opinion poll, hearings, etc.);
- action plans laying out the ASN's objectives and annual priorities, adjusted on a day to day basis through exchanges between entities (discussions, periodic meetings, internal memos, etc);
- organisation notes and procedures, gradually structured and grouped to constitute an organisation manual, defining the ASN's in-house rules to ensure the correct performance of each of its tasks;
- internal audits and inspections by the General Mining Council, plus context, activity and performance indicators designed to check and improve the quality and effectiveness of the ASN's actions.

Eight periodic meetings per year between the heads of the various ASN entities lead to decisions, the implementation of which is also checked.

Finally, updating of the ASN organisation procedures is carried out as and when necessary.

Another factor in checking internal quality is periodic visits of the DSNR and sub-directorates by the DGSNR head office, as well as DSNR inspections by the General Mining Council.

E.3.1.4 Technical support organisations

The regulatory bodies rely on the expertise of technical support organisations. The Institute for Radiation Protection and Nuclear Safety (IRSN) is the main one, but the Authorities also rely on other national and international organisations.

E.3.1.4.1 The Institute for Radiation Protection and Nuclear Safety

The Institute for Radiation Protection and Nuclear Safety was created by law 2001-398 of 9 May 2001 and instituted by decree 2002-254 of 22 February 2002. This decree organised a separation between the French Atomic Energy Commission (CEA) and its old Institute for Nuclear Protection and Safety (IPSN), and a merger between the latter and the old Office for Protection against Ionising Radiation (OPRI), setting up a large nuclear safety and radiation protection research and assessment body, called the Institute for Radiation Protection and Nuclear Safety (IRSN).

Safety analyses on basic nuclear installations, including interim storage and disposal of radioactive waste, constitute a significant part of the IRSN's activities. These are carried out on the basis of operator proposals, to give the Safety authorities concerned the recommendations they need to conduct their supervision duties. For the more important subjects (examination of safety analysis reports, major modifications to facilities, discharge licences), the ASN asks the relevant Advisory Committee for its opinion on the basis of data provided by the operator and critical analysis of these data by the IRSN. For other matters (minor modifications to facilities, steps taken following minor incidents), the safety analyses give rise to recommendations sent directly to the ASN by the IRSN.

The ASN also calls on the IRSN for examination of the provisions adopted by the operator to guarantee transportation safety of radioactive or fissile materials.

In 2004, for the facilities covered by this convention, the IRSN sent the ASN about:

- 140 recommendations concerning minor modifications to facilities or incidents
- 6 recommendations intended for the Advisory Committee, concerning major modifications or new facilities,
- 130 recommendations concerning the transportation safety of radioactive materials.

About 200 experts and specialists took part in preparing these recommendations.

The IRSN also carries out research into radiation protection, radio-ecology and the safety of facilities. These latter aspects concern the main risks encountered in the facilities covered by this convention (criticality, fire, dispersal, structural strength). An increasingly large share of this research is carried out jointly with French and international entities.

E.3.1.4.2 The other technical support organisations

The INERIS (National institute for study of the industrial environment and risks) is the government's special technical support organisation with regard to major non nuclear technological risks. It in particular offers its expertise regarding fire and explosion and chemical hazards. It also has expertise in the field of chronic risks. It can intervene concerning the safety of radioactive substances when such a risk is present.

The BRGM (Geological and mining research bureau) is the institute in charge of providing data regarding geological characteristics and the processes involved. It in particular intervenes if there are problems with soil pollution or to evaluate geology-based waste disposal structures. The BRGM is also developing expertise in the fields of chronic risks and waste.

Among the other organisations which recently worked for the ASN, one could mention the CETEN-APAVE concerning quality assurance and fire safety, the British company Galson Ltd, specialising in radioactive waste storage matters.

E.3.1.5 The expert groups

The Nuclear Safety Authority also relies on opinions and recommendations from various expert groups:

- the Advisory Committees,
- the standing nuclear section of the Central Committee for Pressure Vessels (this expert group is not involved under the scope of the convention);
- the radiation protection section of the French Higher Public Health Council.

Four Advisory Committees comprising experts and representatives of the administration were set up to assist the DGSNR by ministerial decisions on 27 March 1973 and 1 December 1998. They examine the safety-related technical problems posed by the construction, commissioning, operation and shutdown of nuclear facilities and their auxiliaries and transports of radioactive materials.

The Advisory Committees are consulted by the Director General for nuclear safety and radiation protection with respect to the safety of the installations and activities within their sphere of competence.

They therefore examine the preliminary, provisional and final analysis safety analysis reports for each of the BNI. They have access to a report presenting the results of the analysis conducted by the IRSN, and issue an opinion along with a number of recommendations.

Each Committee can call on anyone whose competence would seem to warrant assistance. It may interview representatives of the operator.

The participation of foreign experts can lead to further and more diverse approaches to problems and offer greater benefit from experience acquired internationally.

The Chairmen, Vice-Chairmen and experts in these Advisory Committees are appointed by the Ministers for the Environment and Industry for a renewable three-year term.

Small groups chaired by the chairman of the Advisory Committees are tasked with examining the consequences on safety of the measures adopted with respect to the security of the facilities.

E.3.2 Inspection of the ICPEs and inspection of mines

Inspection is performed by personnel chosen from the devolved services, mainly from the DRIRE (regional directorates for industry, research and the environment), the veterinary services and the STIIC (Technical service of the Paris police department). The inspectors – engineers, technicians, veterinarians – are sworn officers of the State. In each region, the DRIRE director is responsible for organising inspection, under the responsibility of the departmental Prefects.

The Inspectorate is to ensure that the operators - industry, artisans, farmers, local authorities – comply with the applicable regulations and assume their responsibilities in full. The inspectors examine licensing applications, and carry out inspection visits and various checks on the classified facilities. In the event of a breach, the inspectorate submits proposals for administrative sanctions to the Prefect and criminal charges to the public prosecutor's office.

With respect to mines, prospecting and operations are subject to supervision by the administrative authority represented by the Prefect of the *département* and the DRIREs. Inspections are performed by DRIRE engineers specialised in the extraction industries.

E.3.3 The other parties involved in safety and radiation protection supervision

E.3.3.1 The Parliamentary Office for assessment of scientific and technological options

Created by law 83-609 of 8 July 1983, the Parliamentary Office for assessment of scientific and technological options, a parliamentary delegation comprising eight members of parliament and eight senators (as well as the corresponding number of deputies), is tasked with informing Parliament of the consequences of scientific and technological choices, in particular so that decisions can be made in full possession of the facts.

This Office is assisted by a Scientific Council consisting of 24 members, the composition of which reflects the diversity of scientific and technical disciplines.

In 1990, the Parliament asked the Parliamentary Office to examine how the safety and security of nuclear facilities was supervised. Since then, this duty has been renewed on a yearly basis.

From the outset, the Parliamentary Office strictly limited the scope of the work of its rapporteurs. Their duties are to examine the organisation of safety and radiation protection, both within the administration and at the operator, to compare these characteristics with those of other countries and to check that the authorities are given the resources they need to perform their duties. This supervision concerns both the working of the administrative structures and technical aspects, such as the future of nuclear waste or shipments of radioactive materials, as well as socio-political matters, such as the conditions in which information about nuclear subjects is distributed and perceived.

Hearings open to the press are by now a well-established tradition at the Parliamentary Office. They enable all interested parties to make their views known, put across their arguments and publicly debate a given topic, under the chairmanship of the Office's rapporteur. The full minutes of the hearings are appended to the reports. These therefore represent a substantial contribution to informing the Parliament and the public, and to ensuring that decisions are fully transparent.

E.3.3.2 The Advisory Bodies

E.3.3.2.1 The High Council for Nuclear Safety and Information

Through the High Council for Nuclear Safety and Information (CSSIN) created by decree 87-137 of 2 March 1987, the Ministers for the Environment and Industry have a highly competent advisory body whose role extends to all questions concerning nuclear safety and radiation protection, and information of the public and the media.

This Council comprises personalities from a wide variety of backgrounds: parliamentarians, personalities chosen for their scientific, technical, economic or social competence, information or communication specialists, representatives of trade union organisations and associations devoted to protection of nature and the environment, operator representatives and members of the administrations directly concerned (Prime Minister, Defence, Environment, Industry, Interior, Health, Labour).

The Council sends the Ministers for the Environment, Industry and Health its recommendations for improving the efficiency of the overall action taken in the fields of nuclear safety and information and of radiation protection. It may decide to entrust examination of particular subjects to working groups, and may call in outside personalities. The DGSNR keeps it informed of its actions and handles the secretarial duties.

E.3.3.2.2 The Inter-ministerial Commission for Basic Nuclear Installations

The Inter-ministerial Commission for Basic Nuclear Installations (CIINB), created by decree 63-1228 of 11 December 1963 concerning nuclear facilities, as modified, must be consulted by the Ministers for the

Environment and Industry regarding licences to construct, modify or shut down a BNI, and for special provisions applicable to each of these facilities. It is also required to give its opinion on the drafting and implementation of general BNI regulations. A permanent section within the commission is competent for subjects of no particular difficulty.

The CIINB is an internal co-ordinating body with executive power, comprising representatives from ministries or government establishments, with varying levels of nuclear safety competence or responsibilities. The members of the Commission are appointed by order of the Prime Minister for a 5-year term.

E.3.3.2.3 The French High Council on Public Health

The French High Council on Public Health (CSHPF) is a scientific and technical advisory body, reporting to the Ministry for Health, with competence in the field of public health.

It is tasked with issuing opinions and recommendations and for carrying out assessments for predicting, evaluating and managing health risks.

Notwithstanding the legislative and regulatory provisions which make consultation of the CHSPF mandatory, the Minister for Health or any other Minister may refer to it any draft texts, administrative decisions or any other question within its field of competence.

The CSHPF comprises four sections (water, transmissible diseases, ambient environments, radiation protection) each comprising 23 members appointed by the Minister for Health, for a 5-year term. The section's recommendations are issued in the name of the CSHPF and published in the official gazette of the Ministry for Health.

E.3.3.2.4 The laboratories accreditation commission

Environmental radioactivity measurements are to be made public. French regulations (art. R.1333-11 of the Public Health Code) therefore stipulates that they be combined in a single network - the national environmental radioactivity measurement network - the guidelines of which are set by the DGSNR and which is managed by the IRSN. This network will collate the various statutory environmental analysis results, in particular those produced by the various State services and its public establishments. In order to guarantee that the results thus published come from measurements of sufficient quality, a laboratory approval process was set up. Against justification of their quality organisation and in the light of measurement cross-comparison results, the laboratories may be approved by order of the Ministers for the Environment and Health on proposals from the laboratories accreditation commission. This arrangement is stipulated by the order of 17 October 2003 currently under revision.

So that the measurement results used are validated and comparable, the laboratories in this network must meet the approval criteria defined by this order.

E.3.3.3 The public health and safety agencies

E.3.3.3.1 The Health Monitoring Institute (InVS)

The Health Monitoring Institute, which reports to the Minister for Health, is responsible on the one hand for permanent monitoring and observation of the state of health of the population, for collating data concerning health risks and for detecting any event likely to alter the state of health of the population. Its role is also to alert public authorities, in particular the three public health and safety agencies presented below, of any threat to public health or of any emergency situation, and to recommend appropriate measures.

E.3.3.3.2 The French Health Product Safety Agency (AFSSAPS)

The French Health Product Safety Agency is a State public establishment, placed under the supervision of the Minister for Health. It takes part in applying laws and regulations governing all activities relating to the assessment, testing, manufacture, preparation, import, export, wholesale distribution, packaging conservation, exploitation, marketing, advertising, service entry or utilisation of health products intended for human use and cosmetic products, in particular drugs, biomaterials and medical devices, medical in-vitro diagnosis devices, including those which employ ionising radiation.

With regard to "radiogenic" health products, the AFSSAPS issues the radiation protection licences for distribution of radiopharmaceuticals and medical devices emitting ionising radiation (radioactive sources, electrical generators of X rays, etc.). It is also responsible for organising supervision of medical devices and in particular issues approvals to organisations in charge of this supervision and defines the corresponding reference frameworks per category of equipment.

E.3.3.3.3 The French Food Safety Agency (AFSSA)

The role of the French Food Safety Agency, reporting to the Ministers for Agriculture, Consumer Affairs and Health, is to contribute to ensuring the health safety of food, from production of the raw materials to distribution to the consumer. It assesses the potential health and nutritional risks from food intended for man or animals, including from water intended for human consumption. In the field of ionising radiation, the AFSSA's vocation is to issue opinions on the radiological quality of the food and water intended for human consumption, particularly in an accident or post-accident situation.

E.3.3.3.4 The French Environmental Safety Agency (AFSSE)

The role of the French Environmental Safety Agency, reporting to the Ministers for the Environment and Health, is to contribute to public health and safety in terms of the environment and to assess health hazards related to environment. Its task is to provide the public authorities with the competence and scientific and technical back-up needed for drafting and implementing the legislative and regulatory measures within its area of competence.

Section F – OTHER GENERAL SAFETY PROVISIONS (Art. 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 must be produced and stored in basic nuclear installations. The fundamental principle on which the entire specific nuclear safety organisation and regulatory system is based is that of prime responsibility of the operator. This principle of prime responsibility of the operator for safety is the result of the regulatory framework summarised below.

Article 1 of law 61-842 of 2 August 1961 stipulates that "industrial facilities […] must be built, operated or used in such a way that they comply with the provisions implemented under application of this law, in order to prevent atmospheric pollution […] compromising public health or safety, or harming […] the character of the sites". Article 8 of the law stipulates that the provisions of the law "are applicable to pollution of all types caused by radioactive substances".

Article 3 of decree 63-1228 of 11 December 1963 stipulates that a BNI cannot be operated without a licence, which is based on a safety analysis report and a hazard analysis supplied by the operator.

Finally, article 1 of the "quality" order of 10 August 1984 stipulates that the operator of a BNI must ensure that quality commensurate with the safety importance of the function is defined, obtained and maintained for the various components of the facility and its operating conditions.

The system put in place by the operator must demonstrate that the quality of the components is obtained and maintained as of the design phase and then throughout all subsequent phases of the existence of the BNI.

On behalf of the State, the ASN ensures that this responsibility is assumed in full, in compliance with the provisions of the regulations. The respective roles of the ASN and the operator are divided up as follows:

- the ASN defines the general safety objectives;
- the operator proposes and explains technical measures for achieving them;
- the ASN then ensures that these measures are appropriate to the objectives set;
- the operator then implements the approved measures;
- finally, during inspections, the ASN checks correct implementation of these measures and draws the corresponding conclusions.

F.1.2 Radioactive waste management

With regard to radioactive waste, as for any other type of waste, the producer of the waste remains responsible for it up until final disposal in duly authorised facilities. This is a general principle expressed in law 75-633 of 15 July 1975 (codified in Section IV of part V of the Environment Code) concerning waste of all types.

It should be noted that even if the producer of the waste sends it for treatment or storage in a facility operated by another company, it remains responsible for the waste until such time as it has been disposed of in a duly authorised waste disposal facility.

With regard to radioactive waste installations that are BNIs, the respective roles and responsibilities of the ASN and the operator are in all points identical to those presented in the previous paragraph concerning spent fuel management facilities.

Legislation concerning installations classified on environmental protection grounds (ICPE) enables the State to take the place of any defaulting party (winding up, actual or alleged insolvency of one of the managers, etc.), to ensure control of the hazards from the sites concerned. With regard to sites polluted by radioactive substances, most of the waste concerned comes from the radium industry or the radium-based clock/watch-making active at the beginning of the 20th century. Using a specially allocated fund, the State takes charge of collecting and disposing of this waste, or if no disposal solution is available, of storing it. Legal action will always be taken against those responsible, to obtain reimbursement of the public funds committed, whenever possible.

It must be possible to prove ownership to the authorities, even if the package or the physical/chemical form is modified.

However, the operator of the facility in which the waste is stored and/or processed is responsible for the safety and radiation protection of its facility. It is also responsible for the operations involved in dismantling this facility.

According to French regulations, the supplier of a sealed source is responsible for the source it has sold. A user who ceases to use a sealed source must immediately return it to the supplier, who is obliged to accept it unconditionally. Until he can prove that he has returned it, the user retains sole responsibility for it. The supplier contributes to the guarantee fund until it can prove that it has recovered the sources sold. The user commonly pays an advance on the recovery costs.

It is important to note that the regulations apply to all source suppliers, even if from abroad.

The suppliers of sealed sources have set up a non-profit organisation for management of disused sources as requested by the regulation since the 1990s and also contributes to orphan source management. This organisation has proven to be effective to date. However, the ASN is looking at ways of applying the financial guarantee principle imposed on the suppliers by the Public Health Code. This is still at the project stage and it is far from certain that a bank or insurance company will want to take on a responsibility of this nature.

F.2 Human and financial resources (Article 22)

Each Contracting Party shall take the appropriate steps to ensure that:

i) qualified staff are 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;

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 The requirements of the Nuclear Safety Authority concerning BNI

With regard to safety as such, French regulations set no official amount for the resources to be assigned by nuclear facility operators to safety aspects. Nonetheless, there is an indirect specification, in that the regulations stipulate that the holder of an operating licence must guarantee that all the measures needed to guarantee safety are taken, according to the nature of the activities and the conditions in which they are performed. This guarantee must extend up to the facility dismantling and clean-up phase, since these operations must be carried out in conditions approved by decree. It is therefore at the licensing application stage that the Nuclear Safety Authority checks that the operator will have the human and financial capacity to operate its facility correctly.

Article 7 of the "Quality" order of 10 August 1984 stipulates that the "human and technical resources and the organisation implemented for performance of an activity concerned by quality (see § F.1.1) must be appropriate to this activity and enable the defined requirements to be met. In particular, only persons with the required competence may be assigned to an activity concerned by quality; the assessment of competence is in particular based on their training and their experience."

The regulations require that dismantling operations be carried out following the final closure of the facility. The operator is required to define the steps in the corresponding process.

The financial provisions are monitored by supervisory organisations (supervision group, auditors, etc.)

Target contracts are signed by the State and the operators EDF, COGEMA, CEA or Andra.

F.2.2 Presentation by the BNI operators of the resources allocated to safety

F.2.2.1 Andra human and financial resources

F.2.2.1.1 Andra financial resources

Andra was created in 1979 as part of the French Atomic Energy Commission, and was transformed by law 91-1381 of 30 December 1991 on radioactive waste (now covered by articles L.542-1 and following of the Environment Code) into a public establishment of an industrial and commercial nature (EPIC). This status gives it a certain independence from both the producers of waste and the organisations responsible for research into waste management. The organisation of Andra is presented in the appendix (see § L.5.1).

Its mission is to manage all radioactive waste produced in France by the nuclear power industry, the military nuclear industry and small nuclear users (primarily industries not producing nuclear power and hospital/university activities). Its duties are detailed in the law of 30 December 1991:

- participation in research and the definition of research into the long-term management of radioactive waste;

- management of repositories;
- design, siting and construction of new repositories;
- drafting of packaging and disposal specifications;
- drafting of a directory of radioactive waste located in France.

Andra's funds come from conventions or contracts signed with the main waste producers (EDF, COGEMA, CEA and other industrial firms involved in the nuclear power sector). These conventions pre-financed the expenditure incurred in the building of the Aube repository and covering of the Manche repository. Operation of the Aube repository is determined by contracts for reception of waste packages based on deliveries. A project run by the Ministry for Industry is under way to define long-term financing methods for surveillance of the Manche repository. This financing is currently provided by a periodically renewed convention.

The small nuclear waste producers who have signed no convention with Andra, are invoiced for the services provided by Andra on their behalf, and according to demand. Furthermore, specific conventions are drawn up with the industrial firms concerned, for studies into disposal facility feasibility and design.

In 2004, turnover for the financial year was €175 m. Operation of the repositories (Aube, Manche) and the corresponding activities in 2004 represented a budget of about €52 m. The rest is devoted to study of disposal concepts, and above all to geological disposal feasibility studies, in particular including the creation of the Bure underground laboratory in the Meuse *département* (on the border with the Haute-Marne *département*).

F.2.2.1.2 Andra human resources

Andra employs about 360 people, including 63% engineers and managers. About 90 staff are assigned to general management or transverse support functions: human resources, buying, management, accounts, quality, communication. Safety is the core function of the other personnel, either directly or indirectly.

About 90 staff contribute directly to the industrial activities, in particular operation and surveillance of the surface repositories (Aube and Manche). These staff include persons in charge of checking that the packages delivered are compliant with the repository safety rules. With regard to these staff, the Agency aims to maintain and develop a strong safety culture through training and through the daily operating procedures (particularly in conjunction with its quality and environmental protection approach). About ten staff in the Aube repository are devoted exclusively to quality, safety, security and environmental surveillance actions. In addition, 6 staff remain based in the Manche repository, with the support of the Aube repository.

Official drafting of safety principles, help for the operators in implementing them and control of their correct implementation, definition of safety analysis methods and experience feedback from operation of the repositories, are carried out in a department whose duties also cover quality and environmental management activities. This department comprises about 40 people.

A science department of about fifty staff contributes to all Andra activities in fields such as geology, hydro-geology, materials, the biosphere and modelling. They thus take part in safety studies for both operational and planned repositories.

A project department with a staff of about 80, runs the design studies into future waste management solutions, taking particular account of safety and security at all stages, together with the safety, quality and environment department. It is responsible for the Bure underground laboratory.

F.2.2.2 CEA and ILL human and financial resources

F.2.2.2.1 CEA and ILL financial resources

The French Atomic Energy Commission (CEA) is a public research agency created in October 1945 to give France atomic expertise, enabling it to be used in the energy, health and defence sectors. The organisation of the CEA is presented in the appendix (see § L.5.2).

In 2004, the CEA's resources for civilian nuclear programmes amounted to €1,682.4 m, 53% financed from public funds (subsidy) and 47% from its own resources (€513 m external revenue).

Since 2002, clean-up and dismantling operations for CEA civilian sites are financed from a special fund created in 2001 and fed by revenue from CEA Industrie and by contributions from industry and CEA partners to the dismantling costs. This fund is placed under the responsibility of the CEA and its use is monitored by a supervisory committee which examines the annual expenditure, eligibility for financing, multi-year spending forecasts and financial management of assets. Annual spending stands at about €170 m.

The Institut Laue Langevin (ILL) is a research institute founded in 1967 by France and the Federal Republic of Germany, joined in 1973 by Great Britain. Its High Flux Reactor (RHF), with a thermal power of 58.3 MW entered service in 1971 and provides the scientific community with the most intense neutron source available, primarily for fundamental research purposes.

In 2004, the ILL's resources stood at €74 m, equally financed by the three main associates and 22% by the other member states (Austria, Czech Republic, Russia, Spain, Switzerland,).

At the end of 2004, the dismantling reserve amounted to €185 m.

F.2.2.2.2 CEA and ILL human resources

At the end of 2004, and for civilian programmes, the French Atomic Energy Commission employed about 10,400 staff, split 52% managerial and 48% non-managerial, out of a total workforce of about 14,900, including the defence sector. The staff assigned to civilian programmes are spread over 5 centres: Saclay, Cadarache, Valrho (Marcoule), Fontenay-aux-Roses and Grenoble.

Apart from personnel assigned to radiation protection or security, the human resources allocated to safety stand at about 300 engineers: facility safety engineers, engineers and experts in the support units or safety expertise centres, engineers from the safety control units, etc.

At the end of 2004, the ILL employed 435.5 people, split 34% management and 66% non-management. 25 employees are assigned to safety. The ILL also draws on the skills of the CEA.

F.2.2.3 COGEMA human and financial resources

F.2.2.3.1 Organisation of COGEMA and AREVA

The COGEMA group was created in 1976 as a subsidiary for certain of the CEA's industrial activities, with the CEA as sole shareholder. At the end of 2001, COGEMA's single shareholder is the AREVA holding company, whose own shareholders are as follows:

Shareholder	Stake in %
CEA	78.96
State	5.19
Investment certificate bearers	4.03
Caisse des dépôts et consignations	3.59
ERAP	3.21

EDF	2.42
Framépargne	0.86
Calyon	0.72
Total	1.02

The consolidated 2004 turnover for the AREVA group is €11,109 m, and the consolidated net revenue is €428 m.

In June 2000, the COGEMA group reorganised, as presented in the appendix (see § L.5.3). The aim of this new organisation is to strengthen its technological and industrial advance, stimulate its commercial activities and consolidate its international positions. This organisation comprises three sectors comprising 13 business units and corporate functions (general management).

At the end of 2004, the group employed 19,038 people, divided up into the following categories

Category	Number of employees
Engineers and managers	4,371
Supervisors and technicians	11,075
Labourers	3,592
Total	19,038

The turnover of the reprocessing business unit, in charge of spent fuel management, was €1,946 m in 2004.

The hierarchy in the units is responsible for deciding to assign competent personnel to the required tasks and thus for assessing this competence. To do this, it looks at initial training and experience and identifies the need for further training and qualification or certification for specific tasks. It is supported by the competent services of the Human resources directorate and its functional representations on the various sites, who are responsible for providing training and keeping training records.

Under the terms of article 7 of the Quality Order of 10 August 1984, the Nuclear Safety Authority regularly organises monitoring visits to check that the human resources are appropriate to the safety requirements.

F.2.2.3.2 Financial aspects

COGEMA, which provides a reprocessing service for the electricity utilities, who retain ownership of their waste, in fact holds little waste of its own.

AREVA waste management reserves are based on the waste of all categories which has not yet been removed. They take account of all the waste to be managed, including waste from past practices and dismantling waste. To be as exhaustive as possible, the cost of operations such as packaging and disposal are included, as is the cost of recovery of waste from past practices. For AREVA, the amount of the reserves at closure of the 2002 accounts was €3,779 m and in 2003 it was €3,859 m.

A portfolio dedicated to coverage of these expenses was set up. As at 31 December 2003, the size of the portfolio was such as to cover the total cost to be borne by the group when the dismantling operations fall due. On the basis of a real minimum net performance expected of this portfolio, after inflation and taxes (about 3.5%), the group aims to break even between the cost of the dismantling and waste packaging work for which it is responsible and the value of this portfolio. The 2002 market value of this portfolio was €1,809 m, while in 2003 it was €2,009 m.

F.2.2.4 EDF human and financial resources

F.2.2.4.1 EDF human resources

The workforce of EDF's Nuclear Generation Division (DPN) is about 20,000 strong, split into three branches: operations (about 11%), supervision (about 65%), management (about 24%). The organisation of EDF is presented in the appendix (see § L.5.4).

To these 20,000 people, directly involved in operating EDF's installed base of 58 nuclear reactors, can be added the following EDF human resources devoted to the development, operation and dismantling of the nuclear reactors:

- nearly 2,500 engineers and technicians in the Nuclear Engineering Division (DIN);
- about 180 engineers and technicians in the Nuclear Fuels Division (DCN);
- about 600 engineers and technicians in the EDF Research and Development Division (EDF R&D).

In terms of human resources devoted to nuclear safety and radiation protection, EDF underlines the fact that it is organised so that a large majority of its personnel devotes a significant part of its time and effort to these matters. The policy of empowerment and decentralisation implemented within the company, and the development of the safety culture among the teams, mean that safety and radiation protection are an integral part of preparing and performing interventions, and controlling and checking the work done.

If we look only at the personnel whose duties and activities are concerned exclusively with nuclear safety (safety engineers in the nuclear power plants, safety specialists and experts in the national staff, engineering entities and monitoring entities), then more than 300 persons are involved.

About the same numbers are assigned to security and radiation protection activities.

F.2.2.4.2 EDF financial resources

As an integrated public company responsible for generating, transmitting and distributing electricity nationwide, EDF has in recent years transformed into an international energy group. This change, encouraged by deregulation of the electricity markets in Europe, is the fruit of an expansion policy based on growth by acquisition. This in particular led to its legal status being changed, with EDF becoming a Limited Company in which the State is the major shareholder, thus enabling it to extend its range of products and services.

In 2004, EDF's net production in France was 487 TWh including 427 TWh of nuclear origin; 73.9 TWh was sold to the European markets. EDF production represents 89.2% of total French production.

EDF group turnover amounts to €46.9 bn (+4.5%), of which 95% is achieved in Europe, with a net result of €1.3 bn.

The reserves created by EDF at the end of 2004 amount[2] to about €14.3 bn for the back end of the nuclear fuel cycle (management of spent fuel and nuclear waste) and about €12.6 bn for dismantling and last core.

These reserves are created on the basis of evaluated waste processing and disposal costs, at a rate determined by burn up in the reactor and taking account of future spending schedules.

With regard in particular to the dismantling of nuclear reactors and treatment of the resulting waste, EDF sets aside accounting reserves throughout the operating period of these reactors, proportional to the investment costs, in order to be able to cover these expenses when the time comes. This reserve is the sum of the reserves for dismantling the 58 EDF power reactors currently in operation and which are set

[2] in current values in accordance with international standards

aside every year, plus the reserves for dismantling of the 9 EDF reactors finally shut down, for which dismantling work has begun.

In the light of all the above, EDF considers that it has the financial resources to meet the safety needs of each nuclear facility for its entire life, including the management of spent fuel, treatment of waste and dismantling of the facilities.

F.2.3 The ASN analysis

As mentioned at the beginning of this chapter, it is by checking that the operator meets all its requirements, that the Nuclear Safety Authority ensures its financial ability to operate its facility safely.

Furthermore, the "Quality Order" of August 1984 provides for supervision of human resources and in this respect, at regular intervals, the ASN examines the general organisation of the operators. At present there are no particular problems in this area with the operators. Nonetheless, the ASN is currently working to improve its system of human resources supervision.

F.2.4 The case of ICPEs

Legislation concerning installations classified on environmental protection grounds requires that financial guarantees be provided for quarries, waste storage facilities and the most dangerous "Seveso" class facilities (chemical industries, paper-mills, gas or flammable liquid depots, etc.).

When the Prefect calls in these financial guarantees, the State takes the place of the operator and becomes responsible for cleaning up the site.

The purpose of these guarantees is, depending on the nature of the hazards or inconveniences of each category of installation, to ensure that the site is supervised and kept safe, as well as to provide adequate response in the event of an accident before or after closure. This measure aims to cover the possible insolvency or cessation of activity of the operator. It does not cover compensation due by the operator to any third parties who may suffer prejudice owing to pollution or an accident caused by the installation.

These measures apply in particular to the ICPEs used for radioactive waste disposal (in practice, in France, the only ones currently concerned are those used for disposal of uranium ore processing residues and future disposal of VLL waste), The operator is responsible for the installation throughout its operating life and at least 30 years after closure (after which period, the State decides whether or not to assume responsibility for the site). For VLL waste disposal, the operator is Andra, the National Radioactive Waste Management Agency, which will probably retain responsibility for surveillance of the repository, without time limit.

For ICPEs employing radioactive substances but not used 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 classified installations inspectorate simply checks that the operator is taking all necessary steps. The hazards linked to these installations would not seem to justify any additional provisions. In the event of defaulting by the operator, there are mechanisms based on public funds for resolving situations constituting a hazard for the public or the environment.

For mines, any new licence is currently dependent on presentation of the conditions governing cessation of work, along with an estimate of its cost. In the past, this was not required and not all of the French uranium mines were therefore covered by this provision. However, closing down a mining concession at the end of its operating life was already subject to the implementation of measures stipulated by the Prefect, to protect the health and safety of both the public and the environment.

F.2.5 Radioactive sources

The source manufacturer is required by the regulations to take back the source when its user no longer needs it or if the source has expired. The cost of these operations must be included in the price of acquisition of the source.

To allow application of this general principle, a system of mutual guarantees was set up by an association of source suppliers and manufacturers, so that the sources concerned by defaulting of one of the members can be recovered.

Under implementation of the new radiation protection regulations in France, consideration is currently being given to examining the benefits of adding financial guarantees to this system.

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 Nuclear Safety Authority requirements concerning BNIs

The order of 10 August 1984, concerning the quality of design, construction and operation of basic nuclear installations, provides a general framework for the steps that the operator of any basic nuclear installation is required to take in order to design, obtain and maintain the quality of its installation and its operating conditions, such as to guarantee safety.

The order first of all stipulates the quality looked for by means of specified requirements, then the quality obtained through appropriate skills and methods, and finally the guarantee of quality by checks on compliance with the requirements.

The "Quality Order" also requires that:

- detected deviations and incidents be corrected thoroughly and preventive action be taken;
- appropriate documents provide proof of the results obtained;
- the operator supervise its contractors and check the correct functioning of the organisation adopted to guarantee quality.

Experience feedback from incidents and accidents in nuclear facilities, and the findings of inspections, enable the ASN to assess application of the "Quality Order" by analysing the problems that have occurred.

Article 8 of the "Quality Order" requires that within each BNI operator, there be an internal team to examine quality-related tasks independently of those who performed them. The effectiveness of the internal checks conducted by the operators is evaluated by the ASN through inspections in the various central services.

F.3.2 Steps taken by the BNI operators

F.3.2.1 Andra quality assurance policy and programme

Andra is covered by a solid legislative and regulatory framework which defines its role and what is expected of it: the law of 30 December 1991 lays down the broad outlines underpinning the activities of the Agency. The law in particular states that the Agency is responsible for the long-term management of radioactive waste and contributes to national policy concerning radioactive waste management.

The aim of the Agency is to carry out this radioactive waste management, or propose options for carrying it out, with a permanent concern for public service and protection of individuals and the environment, while complying with legal and regulatory provisions.

The Agency's proposals and actions are designed to set a three-fold example: scientific, environmental and social. The Agency comprises the best scientific skills for conducting high quality research and projects, with the constant concern of protecting individuals and the environment. It can prove the thoroughness of its management and can provide the authorities and the public with all information they need for a completely transparent assessment of radioactive waste management.

The Agency's mission also includes three additional duties, giving it a complete picture of radioactive waste management: industrial operator, research, management of radioactive waste information and inventories, and of the characteristics of this waste.

On the industrial side, the aim is to continue to improve exemplary operation of the existing disposal facilities, with a permanent concern for safety and protection of individuals and the environment. In terms of research, the Agency is pursuing an active policy of knowledge acquisition, so that it is in possession of all the skills necessary for the design, evaluation and implementation of management solutions. With regard to information, the Agency is working in two directions:

- the search for an even more exhaustive inventory of radioactive waste, in order to improve knowledge of the current situation and obtain reference scenarios for the future;
- greater public access to verifiable factual evidence concerning the status of radioactive waste, its location, the problems it raises, the solutions proposed or implemented and the management channels.

Andra's quality policy is based on a set of requirements common to all the Agency's roles: consistency in the Agency's approaches, thoroughness and simplicity, greater transparency in Andra's actions, shared information, dialogue and explanations.

Andra thus set up a quality and environment system meeting all the requirements of the ISO 9001 (quality, 1994 version) and ISO 14001 (environment) standards, as well as the provisions of the order of 10 August 1984 applicable to basic nuclear installations (Aube and Manche repositories, and study of new facilities). It had its organisation certified compliant with ISO 9001 and ISO 14001 by a certification organisation in April 2001. Through its continued efforts, monitored by internal audits and six-monthly external audits, Andra will maintain these certifications of compliance with these standards and their future updates. The renewal of ISO 9001 certification has been obtained in 2004 and the renewal of ISO 14001 in 2005.

F.3.2.2 CEA + ILL quality assurance policy and programme

In the 1950s, "quality" procedures were set up, particularly with regard to nuclear activities and essentially through application in Basic Nuclear Installations of the order of 10 August 1984 (quality in nuclear safety). The first quality manual, published in 1993, was revised in 2001 to take account of changes to the 2000 version of standard ISO 9001. In clearly opting for a process of continual improvement of all activities influencing the organisation's performance, the CEA aims for excellence, making satisfaction of its customers (industrial firms, public authorities and partners) the core of its key processes. This strategic commitment applies to all CEA activities: programmes and all associated support activities.

The most significant impact of the 2000 version of standard ISO 9001 is implementation of the "process" based approach. Most CEA units had adopted this method by identifying their customers, their tasks and the associated resources, differentiating between performance, supervision and support processes. Each operational centre set up a quality management system most appropriate to its activities and their context (type of customers, partnerships, membership of European or international networks). In addition to clarifying the picture, this identification constitutes the basis for truly stimulating improvement, both owing to the opportunities for simplification and consistency that it offers, and through setting up a system for monitoring the fact that the targets set have actually been reached.

Environmental protection, and a safety, security and quality culture would seem to be the priority areas for implementing the medium long term plan (PMLT) and the State - CEA multi-year contract.

In 2004, the General Management targeted its actions for progress on two key areas: continued implementation of the principles of governance tailored to current changes (constitutional bylaw on budget acts, Creation of the European Research Area, Research Code, Regionalisation) and enhancement of the programme oversight mechanisms aimed at improving risk control, in particular the risk of over-programming. A risks map, consolidated by the General Management, was produced on the basis of the information provided by the operational and functional centres.

The CEA's core quality actions concern setting up project-based management, identification of processes, control of their interfaces, and provision of accessible, updateable guides along with the appropriate training. The CEA is implementing generalised quality management systems and most directorates are accompanying this process by implementation of laboratory certification (ISO 9001 and 14001) or accreditation (ISO 17025, laboratory good practices).

In 2004, the Technological Research Directorate consolidated its ISO 9001 version 2000 certification which includes all support activities for the Fontenay aux Roses and Grenoble centres. This led to recognition within partnerships initiated with industry, in particular for running European and international projects.

The Nuclear Energy Directorate (DEN), which in particular is in charge of the CEA's fuel and waste treatment and storage facilities, intensified its quality management approach and hopes to obtain ISO 9001 version 2000 certification for all its activities, through gradual certification of departments and centres, covering laboratories, processes and transport of radioactive effluent. In this way, the Saclay and Valrhô centres obtained ISO 9001 version 2000 certification for all the activities of the DEN units. The Cadarache centre obtained certification for all the DEN operational departments and aims to extend it to support services and to the centre management. At the end of 2003, it also obtained certification of the process for experimental studies of fuels and materials under the effects of irradiation.

At the same time, the Saclay centre was rewarded for its environmental approach with ISO 14001 certification.

Upstream of applied research, the fundamental research teams continue their involvement in innovative approaches aimed at formalising and guaranteeing the quality of their work. (Use of laboratory logs, theses quality, research project performance guide, in particular for laboratory networks). The CEA took an active role in the work done by the "Research quality" standardisation committee, set up by the French standards authority (AFNOR) the first stage of which led to publication of a French standard which will constitute a reference for future European standardisation.

The CEA aims eventually to create integrated management systems by primarily merging the Quality, Security, Nuclear Safety and Environment systems. For BNIs, a first step led to grouping of the requirements of the order of 10 August 1984 and standard ISO 9001 (version 2000).

In the field of design, construction, operation and dismantling of those basic nuclear installations assigned to management of radioactive waste, the CEA has added to its project methodology reference framework a booklet entitled "performance of facility projects" which identifies the milestones linked to the regulatory obligations and is currently drafting a supplement specific to clean-up and dismantling projects.

Good practices are identified, enhanced and made available to all units. Comments and non-conformities may be highlighted by audits and internal inspections, leading to both corrective and preventive actions.

The CEA contractors are mainly monitored through the quality systems put in place in the Buying and Sales Directorate and in the centres units. An internal radioactive clean-up contractors acceptance committee (CAEAR) assesses these suppliers through audits against a common requirements reference framework using qualified auditors. It grants acceptance for a 3-year term that may be renewed.

From the outset, the ILL has implemented quality procedures, applicable to design, construction and operation. The ILL applies the "Quality Order" of 10 August 1984. The Quality Organisation Manual (MOQ), created in 1984, has been revised twice; it is supplemented by numerous Quality Assurance Memos (NAQ) and procedures.

The ILL's aim is to improve the level of research, with the constant concern of protecting man and the environment. As part of a continuous improvement approach, the ILL contributes actively to analysing risks applied to the "processes" and to project-based management.

Environmental protection, the safety culture and management of availability are the priority areas of the multi-year budget plan (Multiannual Financial Estimates).

F.3.2.3 COGEMA quality assurance policy and programme

The managers of the COGEMA group are committed to a policy of environmental excellence and sustainable development. This commitment is a response in depth to various concerns within the company, such as quality, safety, security, environmental impact, economic results and social well-being.

This commitment is an extension of the other steps taken in these various fields, since the company was created, with the aim of satisfying the customers and partners of all types, and ensuring the sustainability of the company. It is expressed in the terms of the following charter:

- constantly improve the group's knowledge of the environment and the environmental impact of COGEMA's activities;
- anticipate changing regulations by setting discharge and emission targets that are always lower than the limit values set by the authorities;
- implement human and material environmental management and hazard prevention resources tailored to the specific nature of each site;
- design installations and processes allowing constant optimisation of consumption, reduction of discharges, waste and detrimental effects and encouraging recycling of the materials and energy produced;
- develop environment analysis and monitoring practices to identify all the impacts and rank them so that those with the greatest significance for the environment and human health are dealt with as a priority;
- involve everyone working for COGEMA in this effort to achieve environmental excellence, so that they are all aware of the need to protect the environment on a day to day basis, through responsible working practices and attitudes;
- involve the customers, partners, subcontractors and suppliers of the group in this approach, by reinforcing hazard prevention and environmental protection aspects of their contractual and commercial relations;
- give free access to precise, clear and full information concerning COGEMA's activities, their impact on the environment and the means used to monitor and reduce them;
- dialogue with everyone concerning the environment, in order to compare experiences, understand the expectations of the public and the group's customers and identify fresh areas for progress;
- evaluate the economic and social aspects of the group's environmental performance.

In the field of quality, the first COGEMA quality assurance manual was published in 1978, two years after the company was created. It was added to over the years, leading to ISO 9000 certification of all the establishments concerned by reprocessing-recycling. This certification is periodically re-assessed.

The "Quality Order" of 10 August 1984 was incorporated into the procedures and appears as such in the quality assurance manual. It is a key element of the safety targets.

Under application of this order, COGEMA monitors its contractors and subcontractors and, before selecting them, assesses their ability to meet the safety requirements. Furthermore, with a view to total quality and continual progress, incorporation of the EFQM (European Foundation for Quality Management) management system model began in the mid-90s and is currently continuing.

Along the same lines, but in a more specific field (which nonetheless falls within the sustainable development category), an environment-related approach has been undertaken and led to ISO 14001 certification of all the establishments concerned by reprocessing-recycling.

Finally, in their own field, the discharge and environmental analysis laboratories at La Hague are accredited by the COFRAC (French accreditation agency) as compliant with the requirements of standard NF EN 45001 covering calibration and testing. This implies regular calibration of the detectors with secondary control standards connectable to the primary standards for cross-comparison with other laboratories, both national and international (independently of the regulatory cross-comparisons with the IRSN).

Among other actions specific to sustainable development, one should note the gradual implementation of progress indicators combining the concerns for quality, safety and the environment, and efforts made towards greater transparency. With regard to this last point, the creation of a web site concerning the La Hague plant should be noted, as should the site's extreme willingness to receive visits, COGEMA's participation in the La Hague special standing information committee and in the work performed by the North-Cotentin radio-ecology group (GRNC), publication of brochures, and so on.

F.3.2.4 EDF quality assurance policy and programme

The steps taken by EDF with regard to the quality of spent fuel management and waste management, as well as of its dismantling activities, are part of its general quality and safety organisation.

Within the context of its industrial vocation and its public service duty to produce electricity, it is up to EDF to guarantee that the design, construction and operation of its nuclear reactor fleet is both safe and efficient, technically and economically. Quality policy helps to ensure this and can provide the proof needed to generate confidence and trust, which is a precondition to nuclear power becoming accepted by the community.

There are thus three objectives:

- to consolidate what has been achieved and improve the results wherever necessary;
- to encourage faith in the quality system, one of the essential preconditions to correct implementation;
- to obtain a quality system meeting the French regulatory requirements and international quality recommendations.

Design, construction and operation are the keys to correct working of the plants. The quality policy primarily covers safety-related activities and relies on the following guiding principles.

- Developing the EDF quality system on the basis of what has been achieved

The need to guarantee safety in the nuclear power plants led EDF to develop a quality system based on:

- personnel competence;
- work organisation;
- formalisation of methods.

Acquired experience will lead to development of the quality system regarding the following points:

- having a complete picture of all activities;
- prior reflection;

- the need to tailor quality system requirements to the activities of importance for safety, availability, cost control and human resources management.

- Using the EDF quality system as a professional tool

The fundamental responsibility for quality when carrying out an activity lies with the persons in charge of doing it. This is why their competence, experience and culture is vital to attaining the desired level of quality.

The quality system is the umbrella covering all these individual actions. It ensures overall quality and the corresponding quality assurance. It is based on the participants and provides them with methods, organisation and tools, with which they can enhance their know-how.

Within the framework of the quality system, the hierarchy has a key role; it must be heavily involved by explaining the issues, allocating resources, defining objectives and priorities and setting an example.

- Tailoring the EDF quality assurance requirements to the importance of the activities

Activities of importance to the issues of the installed base are identified. Each activity is analysed beforehand. This analysis concerns the problems inherent in the activity and the consequences (in particular for safety) resulting from the possible failures at each step in it.

This highlights the quality aspects essential to the activity, in particular the required level of quality, leading to the appropriate quality assurance provisions, in particular the pre-determined methods and procedures to be applied. These pre-determined provisions are a tool for use by the party concerned. By constantly questioning and suggesting improvements, a responsible player contributes to making this tool even better.

- Giving EDF the organisation and resources it needs

Attaining quality targets requires that the activities be clearly assigned and that the roles, responsibilities and co-ordination between the various players be defined at all levels within the company.

The human and technical resources, along with the methods and procedures, are adapted to the level of quality required.

To guarantee the quality of its services, EDF monitors the activities entrusted to its contractors. This monitoring in no way relieves the contractor of its contractual responsibilities, in particular those concerning implementation of quality assurance rules. The contracts between the principal and the contractors clearly define the responsibilities of each party and the applicable requirements.

- Guaranteeing EDF quality through appropriate checks

The quality of an activity depends primarily on those carrying it out. Conducting checks is a way of guaranteeing this quality. They concern compliance with the requirements defined during the prior analysis of and control over all activities and interfaces.

These processes are tailored to the importance of the activity and apply at all levels, from the individual person up to the system as a whole. As necessary, they include:

- self-checks;
- checks by another qualified person able to offer a critical view;
- checks conducted with sufficient distance and independence to ensure correct implementation of the quality system.

This arrangement contributes to defence in depth.

- Confirming quality at EDF through traceability

The attainment of quality is confirmed by documents produced at all stages in the activity, from prior analysis to subsequent report. Conservation of these documents ensures that the operations are traceable, in particular with respect to safety.

- Anticipating, preventing and progressing at EDF

To prevent defects and improve results, an experience feedback process is used. This approach is based on collection of deviations, analysis of them and a search for their underlying causes, as well as on validation of good practices and their widespread use. The experience of the EDF reactor fleet is enhanced by incorporating experience from other operators.

As part of this approach, indicators highlight trends and enable preventive measures to be taken. The indicators in place must be few in number, determined according to the particular goal and defined with the participation of the parties concerned.

Periodic reviews take stock of what has been achieved and define the aspects on which the improvement effort is to be concentrated.

- Implementation of monitoring by EDF

EDF in particular monitors:

- the transport chain, conducting audits and spot checks with the transporters;
- spent fuel reprocessing operations at COGEMA in La Hague.

- Quality Assurance of computer databases.

EDF's quality assurance requirements applicable to the working and maintenance of the spent fuel and waste database are taken from the Quality Manual used at EDF in the same way as for activities related to safety.

The spent fuel computer database is independent of the Euratom rules used for nuclear materials accounting.

For waste, the site inventories and the computer databases (called DRAs) are used for traceability of production and volumes sent for storage.

F.3.3 Analysis by the ASN

Experience feedback of incidents or accidents occurring in nuclear facilities and the various inspection reports enable ASN to analyse the malfunctions that have occurred and thus assess implementation of the "Quality Order". Furthermore, an overall examination of the operators' quality and safety organisation is conducted regularly. This was the case for the CEA in 1999.

BNI maintenance operations are for the most part subcontracted to outside companies by the operators. This activity concerns some 40,000 people every year. While setting up this type of industrial policy is the choice of the operator, the Nuclear Safety Authority checks that under application of the “quality” ministerial order of 10 August 1984, the operators nonetheless exercise their responsibility for the safety of their facilities by putting in place a quality process, in particular concerning monitoring of their contractors. The subject of "contractor monitoring" was in fact one of the ASN's recurring inspection topics. For example, to illustrate the importance the ASN attaches to this monitoring, 10 inspections were conducted in 2004 on the EDF nuclear facilities alone.

Generally speaking, the nuclear industry pioneered quality assurance in France, thanks to the order of 10 August 1984 which requires that adequate measures be taken on this subject and there are now widespread quality references (in particular the ISO 9000 and ISO 14000 standards) in the industry. Nonetheless, it would seem that the requirements of the order of 10 August 1984 remain valid and in certain areas even go further than the international standards (in particular with respect to operator monitoring of the operations performed by its contractors).

The ASN observed that quality assurance requirements are on the whole met by the main nuclear operators.

F.3.4 The case of ICPEs and mines

French waste legislation places responsibility for disposal with the party producing or in possession of the waste. It organises monitoring of the disposal circuits by requiring submission of a declaration by certain producers, transporters and disposal facilities for waste having detrimental effects.

Like all special industrial waste, the radioactive waste produced by the ICPEs must be subject to special precautions at collection and storage (appropriate packaging and labelling), during shipment (compliance with regulations for the transport of dangerous goods) and treatment (must be carried out in a facility authorised by legislation concerning installations classified on environmental protection grounds). For all these operations, the administration must be informed. A follow-up form (BSDI) must be issued and each intermediate operator must keep a copy of it. The treatment centre must return the last page to the producer within one month, to confirm that the waste is effectively in its possession.

Any producer of special industrial waste (DIS) who sends a load of more than 100 kg of waste to a third party must transmit a follow-up form. This form accompanies the waste up to the destination facility, which can be a disposal facility, a grouping centre or a pre-processing facility. The producer must send a sample of its waste to the operator of the destination facility, to obtain its approval prior to shipment. The key data mentioned on the form are:

- the identity of the waste producer;
- the characteristics, quantities and destination of this waste;
- the means of transport and disposal of the waste;
- the identity of the firms concerned by these various operations.

F.3.5 The case of radioactive sources

The special licensing conditions for the manufacture, possession, distribution and use of radionuclide sources, which are included in the current regulations, provide for measures to identify their movements.

Responsibility for tracing these movements (acquisition, transfer, import, export) lies with the IRSN, which notifies the DGSNR accordingly. This management is made easier by the use of dedicated software, of which the design and operation anticipate the implementation of quality assurance.

F.4 Operational radiation protection (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 The general regulatory framework for radiation protection

F.4.1.1 The legislative bases of radiation protection

Since publication of the Euratom 96/29 and 97/43 directives, the legislative and regulatory provisions of the Public Health Code and the Labour Code have been completely updated. The legislative part was updated in 2001 and the implementation decrees were published between 2002 and 2005.

F.4.1.1.1 The Public Health Code

The principles of radiation protection

The new chapter III "Ionising radiation" of part L of the Public Health Code (section III, book III, 1st part) covers all "nuclear activities", that is all activities entailing a risk of human exposure to ionising radiation, either from an artificial source, whether substances or devices, or from a natural source when natural radionuclides are or have been processed owing to their radioactive, fissile or fertile properties. It also includes "responses" designed to prevent or reduce a radiological risk following an environmental contamination accident.

The general principles of radiation protection (justification, optimisation, limitation), established internationally (ICRP) and included in directive 96/29 Euratom, are incorporated into the Public Health Code (art. L.1333-1). They constitute the guidelines for the regulatory actions for which ASN has responsibility.

1°) The principle of justification – "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 in the ionising radiation to which the persons are likely to be exposed."

Depending on the type of activity, the decision regarding justification lies with the various levels of authority: it is up to the government for questions of general interest as in the case of the decision to use nuclear power, it is delegated by the Minister for Health to the DGSNR in the case of sources used for medical, industrial and research purposes, it is the responsibility of the AFSSAPS when dealing with release to the market of a new irradiating medical device, and it lies with the doctors when prescribing and performing a diagnostic or therapeutic procedure.

Assessment of the expected benefit of a nuclear activity and the associated health detriment may lead to an activity being prohibited if the benefit does not appear to outweigh the hazard. The ban may either be generic (for example: no intentional addition of radioactive substances to consumer goods), or the license required by radiation protection regulations may be refused or not renewed. For existing activities, a review of justification may be initiated if current knowledge and technology so warrants.

2°) The principle of optimisation – "Exposure of persons to ionising radiation resulting from a nuclear activity or intervention must be kept as low as reasonably achievable, given current technology, economic and social factors and, as applicable, the medical purpose".

This principle, referred to as ALARA, for example leads to a reduction in the discharge permits of the quantities of radionuclides present in the radioactive effluent from nuclear facilities, to a requirement for monitoring of exposure at the workstations in order to reduce it to the strict minimum, or to ensure that medical exposure levels resulting from diagnostic procedures remain close to the predetermined reference levels.

3°) The principle of limitation – "Exposure of a person to ionising radiation resulting from a nuclear activity may not raise the sum of doses received beyond the limits set in the regulations, except when this person is subject to exposure for medical or biomedical research purposes."

Exposure of the general population or workers that is induced by nuclear activities is subject to strict limitations. These comprise significant safety margins to prevent the appearance of deterministic effects. They are therefore far below the doses for which probabilistic effects (cancers) began to be observed (100 to 200 mSv). Overshooting these limits reflects a situation felt to be unacceptable; in France, this may lead to administrative or criminal penalties.

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

The declaration and licensing system

The new legislative basis introduced into the Public Health Code enables the Council of State to issue decrees to lay down general rules concerning the regimes for prohibition, licensing or declaration of the use of ionising radiation (art. L. 1333-2 and 4), along with rules for the management of artificial or natural radionuclides (art. L. 1333-6 to L. 1333-9). These licences and declarations concern all uses of ionising radiation generated by radionuclides or electrical X-ray generators, whether for medical, industrial or research purposes. Some may however be granted exemptions.

Exposure to enhanced natural radiation

The transposition of directive 96/29 also leads to new provisions for assessing and reducing exposure to natural radiation, in particular exposure to radon, when human activities contribute to enhancing this exposure (art. L. 1333-10).

Radiation protection inspection

In 2004, new measures were introduced to create the new radiation protection inspection regime (art. L.1333-17 to L.1333-19) coordination of which is entrusted to the ASN. The radiation protection inspectors appointed by the DGSNR, will be mainly chosen from among the ASN's staff, including the

IRSN staff seconded. The administrative and judicial policing powers given to the radiation protection inspectors were also defined (art. L.1336-1-1).

Finally, a new regime of criminal penalties accompanies these provisions (art. L. 1336-5 to L. 1336-9).

F.4.1.1.2 The Labour Code

The new provisions of the Labour Code (art. L.230-7-1 and 2) introduce a legislative basis specific to the protection of workers, whether or not employees, with a view to the transposition of directives 90/641/Euratom and 96/29/ Euratom. They bring French legislation into compliance with directive 90/641 on the operational protection of outside workers exposed to the risk of ionising radiation.

The link with the three principles of radiation protection included in the Public Health Code is established in the Labour Code. The rules concerning worker protection will be the subject of a specific decree (decree 2003-296).

F.4.1.2 Protection of persons against the hazards of ionising radiation from nuclear activities

F.4.1.2.1 General protection of workers

The new articles R. 231-71 to R. 231-116 of the Labour Code introduced by decree 2003-296, create a single radiation protection regime for all workers (whether or not salaried) likely to be exposed to ionising radiation in their professional duties. These provisions include the following:

– application of the principle of optimisation to equipment, processes and the organisation of work (art. R. 231-75), which will lead to clarification of the procedures for the exercise of responsibilities and the circulation of information between the head of the establishment, the employer, in particular when not the head of the establishment, and the person with competence for radiation protection;

– the dose limits (art. R. 231-76), which were reduced to 20 mSv over 12 consecutive months, except in the case of waivers granted to take account of exceptional exposure which has been justified beforehand, or emergency professional exposure;

– the dose limit for pregnant women (art. R. 231-77) or more precisely for the child to be born (1 mSv during the period from declaration of pregnancy up until birth).

The publication in 2003 and 2004 of a number of implementing orders provides the clarifications necessary for setting up these new arrangements. Other orders are expected in 2005, such as:

Zoning

New requirements concerning controlled zones, monitored zones and specially regulated zones are currently under preparation (publication in 2005), in order to take account of the new dose limits. The monitored zone should cover potential worker exposure of more than 1 mSv per year and the controlled zone should cover exposure likely to exceed 6 mSv per year. Moreover, this order should contain additional provisions for defining the rules for signposting and the health and safety rules in these zones.

The person with competence for radiation protection (PCR)

The duties of the person with competence for radiation protection (PCR) were expanded to include marking out work areas where radiation is present, studying exposed workstations and measures intended to reduce exposure (optimisation). To perform these duties, the PCR will have access to passive dosimetry data and operational dosimetry data (art. R. 231-106). PCR training was updated in the order of 29 December 2003.

The main innovations concern the duration of PCR training, which increases from 7 to 10 days (two 5-day modules); trainer certification will be issued by the organisations, themselves accredited by the COFRAC and refresher courses organised every 5 years.

Dosimetry

The new procedures for approval of organisations responsible for worker dosimetry were also published (order of 6 December 2003); the new procedures for medical supervision of workers and transmission of individual dosimetry information were published by an order of 30 December 2004.

Approved inspection organisations

Technical control of sources and devices emitting ionising radiation, protection and alarm devices and measurement instruments, plus ambient checks, may be entrusted to the IRSN, to the service with competence for radiation protection or to approved organisations, in application of article R.1333-44 of the Public Health Code. However, once a year, these checks must be performed either by the IRSN or by the approved organisations. The duties of the approved organisations will be published in an order (in 2005). The duties of the approved organisations are defined by the order of 9 January 2004. Approvals for 2005 are the subject of one or more orders.

F.4.1.2.2 General protection of the population

Apart from the particular radiation protection measures applicable to the individual authorisations concerning nuclear activities for the benefit of the general population and workers, a number of more general measures incorporated into the Public Health Code contribute to protecting the public against the hazards of ionising radiation.

The intentional addition of natural or artificial radionuclides to all consumer goods and construction products is prohibited (art. R. 1333-2 of the Public Health Code). Waivers may however be granted by the Ministry for Health after receiving the advice of the French Higher Public Health Council, except with respect to foodstuffs and materials placed in contact with them, cosmetic products, toys and jewellery. This new range of prohibitions does not concern the radionuclides naturally present in the initial components or in the additives used to prepare foodstuffs (for example potassium 40 in milk) or for the manufacture of materials used in the production of consumer goods or construction materials.

Furthermore, the use of materials or waste from a nuclear activity is also in principle prohibited, when they are contaminated or likely to have been contaminated by radionuclides as a result of this activity.

The maximum effective annual dose (art. R.1333-8) received by a member of the public as a result of nuclear activities is set at 1 mSv; maximum permissible dose equivalents for the crystalline lens and for the skin are set respectively at 15 mSv/year and 50 mSv/year (average value for any 1 cm^2 area of skin). The calculation method for the effective and equivalent dose rates and the methods to be used to estimate the dosimetric impact on a population are defined by an order of 1 September 2003.

Management of waste and effluent from BNIs and ICPEs are subject to the provisions of special regulatory regimes concerning these facilities. For management of waste and effluents from other establishments, including hospitals (art R. 1333-12), general rules will be drafted by inter-ministerial order (not yet published). This waste and effluent will be disposed of in duly authorised facilities unless there are special arrangements for organising and monitoring their radioactive decay in-situ (this concerns radionuclides with a half-life of less than 100 days).

Although permitted by directive 96/29 Euratom, French regulations have not incorporated the notion of clearance threshold, in other words the generic level of radioactivity below which effluent and waste from a nuclear activity can be disposed of without monitoring. In practice, elimination of waste and effluent is monitored on a case by case basis when the activities generating them are subject to licensing (case of BNIs and ICPEs); otherwise these discharges are the subject of technical specifications. Neither is the notion of "trivial dose" included, in other words a dose below which no radiation protection action is felt to be necessary. This notion however appears in directive 96/29 Euratom (10 microSv/year).

F.4.1.2.3 Ionising radiation source licensing and declaration procedures

The new licensing or declaration system, which covers all sources of ionising radiation, is described in full in section 3 of chapter III of the Public Health Code.

All medical, industrial and research applications are concerned by the new systems put in place by the decree of 4 April 2002. More precisely, this concerns the manufacture, possession, distribution, including import and export, and the use of radionuclides and products or devices containing them. The use of X-ray machines is subject either to declaration in the case of medical radio-diagnostic (except for heavy machinery) or to a licence in all other cases.

The licensing system applies without distinction to companies or establishments in possession of radionuclides, but also those which trade in them without being directly in possession. This provision, which already applies in France, would seem to be in conformity with directive 96/29, which explicitly mentions import and export. From the health safety viewpoint, this obligation is necessary to ensure close monitoring of source movements and avoid accidents linked to orphan sources.

It should be recalled that, in accordance with article L.1333-4 of the Public Health Code, licences concerning industries covered by the Mining Code, BNIs and ICPEs also act as radiation protection licences. However, this exception does not concern the use of ionising radiation for medical purposes or biomedical research.

The procedures for submitting license applications or declarations were specified in the order of 14 May 2004.

The new regulatory part of the Public Health Code is described below :

F.4.1.2.3.1 The medical, biomedical and medicolegal fields

For medical and biomedical research applications, there are no exemptions to the licensing system:

• the licences required for the manufacture of radionuclides, or products or devices containing them, as well as for their distribution, import or export, are issued by the French agency for the safety of health products.

• the licences required for the use of radionuclides, or products or devices containing them are issued nationally by the DGSNR;

• X-ray generating devices which previously required technical approval by the OPRI now require declaration to the Prefect if of low intensity (radiology or dental surgery), while sophisticated equipment (scanners) however requires a license issued by the DGSNR.

X-ray installations used in medicolegal procedures are subject to the licensing or declaration system applicable to medical installations, if their activity involves exposing humans to ionising radiation.

F.4.1.2.3.2 Industrial and non-medical research fields

The DGSNR is also responsible for issuing authorisations on behalf of the Minister for Health, for industrial and non-medical research applications. In these fields, this concerns:

• the import, export and distribution of radionuclides or products or devices containing them;

• the manufacture of radionuclides, products or devices containing them, the use of devices emitting X rays or radioactive sources, the use of accelerators other than electron microscopes and the irradiation of products of whatsoever nature, including foodstuffs, with the exception of activities authorised under the Mining Code, the basic nuclear installations regime or that of installations classified on environmental protection grounds.

The new license exemption criteria contained in directive 96/29 Euratom were introduced into the appendix to the Public Health Code. Values for additional radionuclides were introduced by the order of

2 December 2003. These criteria replace those which were contained in decree 66-450 of 20 June 1966. Exemption will be possible if one of the following conditions is met:

- the total quantities of radionuclides held are less than the exemption values in Bq;

- the radionuclide concentrations are lower than the exemption values in Bq/kg.

For this latter criterion, this decree also introduces a maximum mass criterion (the mass of material involved must be less than 1 ton), this being the reference criterion used when drafting scenarios employed to define the exemption values. The French transposition is thus more restrictive than directive 96/29 which does not include this mass limit. Introduction of this restrictive criterion is meant to avoid the risk of dilution of radioactive material in order to fall below the exemption threshold.

For quantities of more than 1 ton, two procedures are applied:

- for certain industrial activities which use large quantities of nuclear materials of natural origin or for those entailing a risk of significant exposure to natural radioactivity, an inter-ministerial order requires a radiation protection study within two years, including how waste management is to be dealt with. The ASN then decides on the radiation protection measures to be taken for the installation and/or for waste management.
- in addition to this systematic approach, a case by case analysis is possible if any unexpected radioactive material is discovered.

The ASN in any case pays particular attention to scenarios involving quantities of more than 1 ton, because the materials concerned may have been diluted.

The DPPR circular of 19 January 2004 specifies how this system of licences issued under the Public Health Code functions alongside the system for ICPE.

F.4.1.2.3.3 Supervisory bodies

Technical supervision of the radiation protection organisation, including management procedures for any associated radioactive sources and waste, is given to approved organisations (R.1333-44). The procedures for approval of these organisations were defined in the order of 9 January 2004. The ASN is now responsible for examining approval applications submitted by the organisations.

For the year 2004, the approval of those organisations already approved was renewed for a further year. An initial list of approved organisations was published on 17 March 2005. A second order will be issued.

F.4.1.2.4 Radioactive source management rules

The general rules concerning the management of radioactive sources appear in section 4 of chapter III of the Public Health Code. They are drawn up on the basis of rules which had been laid down by the Inter-ministerial commission on artificial radionuclides (CIREA) and their supervision now lies with the ASN. However, the CIREA's competence in the field of radioactive source inventories was transferred to the IRSN (article L. 1333-9).

These general rules are as follows:

– sources may not be transferred or acquired from anyone who does not hold a licence;

– prior registration with the IRSN is mandatory for the acquisition, distribution, import and export of radionuclides in the form of sealed or unsealed sources, or products or devices containing them, this prior registration being necessary for organising monitoring of the sources and inspection by the customs authorities;

– traceability of the radionuclides in the form of sealed or unsealed sources, or products or devices containing them, is required in each establishment and a quarterly record of deliveries must be sent to the IRSN by the suppliers;

– any loss or theft of radioactive sources must be declared;

– the formalities concerning the import and export of radioactive sources or products or devices containing them, as defined by the CIREA and the customs authorities, are renewed.

The system for disposal and collection of sealed sources which are expired or have reached the end of their useful life is taken Public Health Code:

– all users of sealed sources are required to arrange for collection of sources if expired, damaged or at the end of their useful life, at their own expense (barring waivers granted for radioactive decay on-site);

– if simply requested by the user and without conditions, the supplier is obliged to recover from the user any sources the user no longer employs or if the source is expired.

The conditions of use for gammagraph devices were updated by the order of 2 March 2004, thereby abrogating the particular conditions which had been laid down by the CIREA.

The question of financial guarantees will be dealt with in another decree implementing the new article L.1333-7 of the Public Health Code which introduces the obligation on the supplier to collect sources and the principle of financial guarantees. This new decree will also take account of the provisions of the new directive 2003/122 Euratom of 22 December 2003 concerning monitoring of high-level sealed radioactive sources and orphan sources.

F.4.1.2.5 Protection of persons in a radiological emergency

The population is protected against the hazards of ionising radiation in an accident or radiological emergency situation by implementing countermeasures appropriate to the nature and scale of the exposure. In the particular case of nuclear accidents, these countermeasures were defined in the inter-ministerial circular of 10 March 2000, in association with response levels expressed in terms of doses. Exceeding these levels is not considered to be breach of regulations as they simply constitute guidelines for the public authorities (Prefects) who have to make a local decision on a case by case basis of the feasibility of the action to be taken.

These countermeasures are:

• sheltering, if the forecast effective dose exceeds 10 mSv;

• evacuation, if the forecast effective dose exceeds 50 mSv;

• administration of stable iodine, when the forecast dose for the thyroid is likely to exceed 100 mSv.

These response levels were incorporated into the order of 14 October 2003, implementing article R. 1333-80 of the Public Health Code. The exposure reference levels for persons intervening in a radiological emergency situation are also defined by the regulations (art. R. 1333-86); two groups of response personnel are defined:

a) The first group comprises the personnel making up the special technical or medical response teams created in advance to deal with a radiological emergency situation. In this respect, these personnel are subject to radiological supervision, a medical aptitude check-up, special training and are given equipment appropriate to the nature of the radiological hazard.

b) The second group comprises personnel who are not members of the special teams but who perform duties within their sphere of competence. They are given appropriate information.

The individual exposure reference levels for the response personnel, expressed in terms of effective dose, are set as follows:

a) The effective dose likely to be received by the personnel in group 1 is 100 mSv; and it is set at 300 mSv when the purpose of the intervention is to protect people.

b) The effective dose likely to be received by personnel in group 2 is 10 mSv. Exceeding the reference levels is accepted on an exceptional basis in order to save human lives, for volunteers who have been informed of the potential risks of their actions.

Information of the population in a radiological emergency situation

The procedures for informing the population of a radiological emergency situation are the subject of a specific community directive (Directive 89/618 Euratom of 27 November 1989 concerning information of the population regarding the health protection measures applicable and what to do in the event of a radiological emergency). This directive was transposed into French law in decree 2001-470 of 28 May 2001 amending decree 88-622 of 6 May 1988 concerning emergency plans and by two implementing orders (the order of 30 November 2001 concerning setting up of an alert mechanism around a basic nuclear installation and the order of 21 February 2002 concerning information of the population).

To complete the transposition process, a draft decree amending section 7 of chapter II of the Public Health Code was forwarded at the end of 2004 to the *Conseil d'Etat* (highest administrative court in France). These supplements will be accompanied by two implementing orders, one concerning the information to be brought to the attention of the public, the other concerning training and information of response personnel in an emergency situation (publication in 2005).

F.4.1.2.6 Protection of the population in a long-term exposure situation

In recent years, The Directorate General for Health set clean-up thresholds on a case by case basis for sites contaminated by radioactive substances. These were sites that had been contaminated by former or historical nuclear activities (use of unsealed sources, radium industry, etc.) or an industrial activity using raw materials containing non-negligible quantities of natural radionuclides (family of uranium or thorium). Most of these sites are listed in the inventory distributed and periodically updated by Andra.

This approach has today been abandoned in favour of a complete methodological approach defined in the IPSN guide (methodology guide for sites contaminated by radioactive substances, version 0, December 2000), produced at the request of the Ministers for Health and the Environment, and distributed to the Prefects (DRIRE and DDASS/DRASS). Given current and future usage of the land and premises, this guide proposes an approach comprising a number of steps and leading to a local level definition of rehabilitation objectives expressed in terms of doses. The stakeholders (site owners, elected members, neighbours, associations) are associated with the approach. Operational decontamination values can then be established on a case by case basis.

This new approach now has a regulatory framework in article R. 1333-90 of the Public Health Code.

F.4.1.3 Protection of persons exposed to " enhanced " natural radiation

F.4.1.3.1 Protection of persons exposed to radon

The regulatory framework applicable to management of the radon risk in premises open to the public (art R. 1333-15) introduces the following clarifications:

• the obligation for radon surveillance applies in geographical areas in which radon of natural origin is likely to be measured in high concentrations and in places where the public is likely to spend extended periods of time;

• measurements will be taken by organisations approved by the Minister for Health, said measurements to be repeated every 10 years and whenever work is carried out to modify the ventilation or radon-tightness of the building.

Apart from introducing action levels of 400 and 1000 Bq/m^3, the implementing order of 22 July 2004 defined geographical areas and premises open to the public for which radon measurements are now mandatory: the geographical areas correspond to the 31 *départements* given priority classification for radon measurement ; the categories of premises open to the public concerned are teaching establishments, health care and social establishments, spas and prisons.

The obligations of the owner of the establishment once the action levels have been exceeded are also specified.

The conditions for approval of the organisations qualified to measure the activity concentration were defined in the order of 15 July 2003 concerning the approval of organisations responsible for measuring radon. The list of approved organisations was published in the order of 19 August 2004, on the recommendation of the accreditation committee comprising representatives of the ministries concerned, technical bodies (Institute for Radiation Protection and Nuclear Safety, Building industry scientific and technical centre, French Higher Public Health Council), building professionals and professionals concerned by radon measurement.

The order of 22 July 2004 was accompanied by publication of a recommendation defining the standards applicable to radon measurement and published in the official gazette (OG of 11 August). Another recommendation concerning the definition of action and work to be carried out if the action levels of 400 and 1000 Bq/m^3 are exceeded should be published in 2005.

With regard to the habitat, the National Health Environment Plan identified a number of regulatory priorities concerning management of the radon hazard:

- implementation of a radon diagnostic to improve information available to future real estate buyers and tenants;
- definition of construction rules for new-build homes located in the priority areas.

Finally, in the working environment, the new article R. 231-115 of the Labour Code obliges the head of the establishment to measure radon activity and take the necessary steps to reduce exposure when the results of the measurements reveal an average radon concentration of more than 400 Bq/m^3. An implementing order is expected and will define the categories of establishments concerned by this new requirement.

F.4.1.3.2 The other sources of exposure to "enhanced" natural radiation

Professional activities which use materials naturally containing radionuclides and not used for their radioactive properties but which are likely to lead to exposure such as to be detrimental to the health of workers and the public ("enhanced " natural exposure) are subject to the provisions of the Labour Code (art. R. 231-114) and the Public Health Code (art. R. 1333-13). The list of these activities should be published in an order at the beginning of 2005.

- Industrial activities subjected to exposure to augmented natural radiation (draft list)

- Industrial oil and natural gas drilling facilities

- Coal fired power plants

- Industrial facilities for processing of tin, aluminium, copper, titanium, niobium, bismuth and thorium ore

- Industrial facilities producing or using refractory ceramics;

- Industrial facilities producing or using compounds containing thorium;

- Industrial facilities producing or using zircon and Baddeleyite;

- Industrial facilities producing phosphated fertiliser and manufacturing phosphoric acid;

- Industrial facilities processing titanium dioxide;

- Industrial facilities for the disposal, processing or use of rare earths;

- Facilities for treatment of groundwater by filtration and intended for the production of water for human consumption and mineral water.

For these activities, there will be a new obligation to monitor exposure and estimate the doses to which the population is subjected. The Minister for Health may also implement measures to ensure protection against ionising radiation if this were to appear necessary in the light of the estimates made. When these activities are covered by the ICPE system, these measurements will be defined within the framework of these regulations.

In addition, and if protection of the public so warrants, it will also be possible to establish radioactivity limits in construction materials and consumer goods produced by some of these industries (art. R.1333-14). This latter measure supplements the ban on the intentional addition of radioactive substances into consumer goods.

For professional exposures resulting from these activities, a process of dose assessment under the responsibility of the establishment head was introduced into the Labour Code. If the dose limit of 1 mSv/year is exceeded, measures to reduce exposure must be taken. The draft order mentioned above will clarify the technical aspects of the measures to assess the doses received by the workers.

Finally, the Labour Code (art. R. 231-116) stipulates that for aircrews likely to be exposed to more than 1 mSv/year, the establishment head must assess exposure, take measures to reduce exposure (in particular in the event of a declared pregnancy) and inform the personnel of the health hazards. The order of 7 February 2004 defined the practicalities for implementation of these provisions.

F.4.1.4 The radiological quality of drinking water and foodstuffs

European directive CE/98/83, transposed into national law by the decree of 20 December 2001 concerning the quality of water intended for human consumption, set radiological quality criteria for water intended for human consumption. Two radioactivity quality indicators were taken into account: tritium and the total indicative dose (TID). The reference level for tritium was set at 100 Bq/L, while that of the TID was set at 0.1 mSv/year. Tritium is considered to be an indicator able to reveal the presence of other artificial radionuclides. The TID covers both natural radioactivity and radioactivity due to the presence of artificial radionuclides.

Appendices 2 and 3 of directive CE/98/83 will shortly be supplemented to specify the radiological analysis strategy associated with TID calculation. The document recently adopted by the committee of member States instituted by directive CE/98/83 recommends introducing total alpha and beta activity indicator measurements and the corresponding values chosen by the World Health Organisation (0.1 Bq/L and 1 Bq/L respectively), plus a search for the specific natural and artificial radionuclides when one or other of these total activity criteria is reached.

On this basis, the order of 12 May 2004, implementing the decree of 20 December 2002, defines the new radiological monitoring programmes for public mains water and non-mineral bottled waters.

A number of European regulations (Euratom regulations n° 3954/87 and following, EEC regulation n° 2219/89) were adopted following the Chernobyl accident, to establish maximum allowable radioactivity levels in contaminated foodstuffs.

F.4.1.5 Radiation protection in BNIs

BNIs are part of the "nuclear activities" (see § F.4.1.1.1), specifically regulated and monitored owing to the risks of significant exposure to ionising radiation. In particular, the performance of this type of activity requires prior radiation protection licensing, in this case through procedures defined in decree 63-1228 of 11 December 1963 concerning basic nuclear installations, as modified, and decree 95-540 of 4 May 1995 concerning liquid and gaseous discharges and water intake by BNIs. Under the terms of these procedures, the BNI operator provides the necessary proof of compliance with the general principles of radiation protection and the special rules applicable in this field (see § F.4.1.2.1)

Apart from the general provisions contained in the Public Health Code concerning the general principles of protection against ionising radiation, the prevention and monitoring of public exposure as a result of normal operation of BNIs are regulated by the decree of 4 May 1995 mentioned above. In order to obtain a licence to discharge radioactive effluents, the operator of a BNI must prove that the effluent produced is collected and treated so that the discharges are kept as low as reasonably possible, and estimate the foreseeable radiological impact on the most exposed populations (we talk of "reference groups") in order to check that the annual exposure limits will be adhered to. The validity of this demonstration is checked, with the support of the IRSN, by the ASN responsible for examining the discharge licence application. Once the inter-ministerial discharge licence has been granted, the discharges and the environment will be monitored on the one hand by the operator under the terms of its regulatory obligations and on the other by the ASN inspectors responsible for checking compliance with the relevant regulations (including by means of unannounced inspections during which samples are taken).

Finally, the regulations require that emergency plans be drawn up (on-site emergency plan produced by the operator, off-site emergency plan drawn up by the Prefect) defining the organisations and resources intended to control an accident situation, limit its consequences and take the appropriate measures for protecting persons against its effects.

F.4.1.6 Discharge permits

F.4.1.6.1 BNI discharge permits

Normal operation of nuclear facilities produces radioactive effluents. In general, it also requires intake of water and discharge of non-radioactive liquid and gaseous effluent into the environment. The permit concerns water intake, as well as liquid or gaseous effluent discharges, whether or not radioactive. It takes account of the radioactivity as well as the chemical characteristics of these two types of discharges.
In this respect, BNIs are subject to the provisions of decree 95-540 of 4 May 1995 implementing on the one hand the law of 12 August 1961 concerning atmospheric pollution and odours and on the other, law 92-3 of 3 January 1992 concerning water, as modified. This decree sets the conditions for granting licences to discharge liquid and gaseous effluents and to take water into these installations. Under application of this decree, a single licence issued at ministerial level regulates discharge of radioactive and non-radioactive liquid and gaseous effluents as well as intake of water by the BNI in question. The procedure, explained by two inter-ministerial circulars (health – industry – environment) of 6 November 1995 and 20 May 1998, is carried out on the basis of a single application submitted accordingly and in all cases examined by the ASN.

The orders authorising effluent discharge and intake of water for all the basic nuclear installations are currently being renewed under application of decree 95-540 of 4 May 1995. For this purpose, the ASN has initiated a systematic approach with all the nuclear operators to revise the licences concerning all intake of water and discharge of effluents, including discharge of chemical substances. The ASN's aim is to ensure that most of the existing licences are reviewed by 2006. For many of them, changing techniques and practices should enable a reduction to be made in the authorised discharge limits.

These licence renewals are an opportunity for the ASN to merge into a single text all the provisions which were stipulated in a variety of ministerial or prefectoral orders, depending on the nature of the discharges. In this context, the ASN decided to modify the discharge regulations in accordance with the following principles:

- concerning radioactive discharges, and as the actual discharges from the installations are frequently well below the current limit values, the ASN intends to lower these limit values, in line with its clearly stated policy of recent years. For example, for power reactors, the discharge limits have been divided by a factor of from 1 to nearly 40, depending on the radionuclides. Furthermore, iodine and carbon 14 discharges are now covered by separate individual limits;
- with regard to chemical substances, the ASN has decided to improve the way discharge of these substances is regulated, to fill in the gaps in the previous provisions.

The discharge orders in particular set the authorised limits, the monitoring and discharge conditions and the details of the environmental monitoring programme. The determining limit from the standpoint of impact on the public and the environment is the maximum volume activity added to the environment by a facility, whatever its size. This limit, in terms of calculated added activity, was traditionally regulated by the licensing orders. The new orders also make it possible to introduce one of the total volume activity limits measured in the receiving environment, which are easier to check and which are more representative of the overall impact of the nuclear activities on the quality of the environment. The annual activity which it is authorised to add to the environment induces a total dose, assuming that the resulting concentration is kept at the limit level throughout the year, which is far lower than the permissible dose limits.

The procedural rules of the above-mentioned decree also apply to installations classified on environmental protection grounds, included within the perimeter of a BNI. This process thus enables the overall impact of a facility's water intake and discharges on its environment to be assessed.

Finally, in compliance with article 37 of the Euratom treaty, France provides the European Commission with general data on all planned discharges of radioactive effluents.

F.4.1.6.2 Discharge permits for ICPEs and mines

For the ICPEs, the regulations require an integrated approach to risks. The discharge licences and conditions are set in the general facility licence (see § E.1.2). The general principles governing setting of the discharge conditions and limits are identical to those followed for the BNIs, because they stem from the same laws (in particular law 92-3 of 3 January 1992 concerning water).

Mines discharges are regulated by the second part of the "Ionising radiation" section of the general regulations for the mining industries. The work permits given by the Prefect's decrees specify these conditions. However, it should be noted that the installations associated with the mines and from which the discharges are likely to have the most significant impacts (ore processing plants, etc.) are generally classified as ICPEs and their discharges are consequently regulated by this framework.

F.4.2 Presentation of radiation protection measures taken by BNI operators

F.4.2.1 Radiation protection and minimisation of effluents 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 in normal operation should be at as low a level as reasonably achievable and should not exceed a fraction of the regulation limit set by directive 96-29/Euratom of 13 May 1996 transposed by decree 2001-215 of 8 March 2001, that is 1 mSv/year. Andra set itself a threshold of 0.25 mSv/year. This guideline is consistent with the recommendations of the IAEA, the ICRP or the French basic safety rules applicable to the design of high level or long-lived waste disposal facilities.

With regard to workers, Andra decided not only to apply European directive 96-29 but also to set a more ambitious target. Given the growing importance of the principle of optimisation and the experience feedback from the Aube repository, as early as the design stage, Andra set itself the operational protection goal of not exceeding an annual dose of 5 mSv/year. This objective should be reached for Andra personnel and contractor personnel working in Andra facilities.

F.4.2.1.2 Surveillance by Andra

Surveillance of the impact of the repositories operated by Andra involves application of a surveillance plan proposed by Andra and approved by the ASN. The surveillance goals concern 3 subjects:

- verification of the lack of impact;
- checking of compliance with regulatory requirements;
- detection of any anomaly as early as possible.

Radiological measurements are taken of the air, surface water (rivers, run-off water), underground water, rainwater, river sediment, flora and the food chain (milk for instance). The personnel in the facilities undergo individual dosimetric monitoring.

The surveillance results are periodically forwarded to the ASN. Both the Manche repository and the Aube repository publish quarterly brochures distributed to the public and to the press. They are presented to the Local Information Committees of the facilities.

In the Manche repository, which has now entered the surveillance phase, the maximum annual individual dose rate recorded on the personnel working in the facility in 2004 was below the detection threshold. It was 1.62 mSv in the operational Aube repository.

Andra also completed radiological surveillance of the disposal facilities by surveillance of the physico-chemical quality of the water and by ecological monitoring of the environment.

F.4.2.1.3 Effluents and discharges from Andra's facilities

In order for the Manche repository to make the transition to surveillance phase, the disposal structures were protected from rainwater by alternating layers of permeable and impermeable materials, in particular including a bituminous membrane. The result was a very significant reduction in the volume of water collected at the base of the disposal structures (by a factor of about 100 between 1991 and 1997); this water is treated in the COGEMA plant at La Hague.

Furthermore, as the regulatory process for transition to surveillance phase is conducted in the same way as for the construction of a basic nuclear installation, Andra in 2000 submitted a request for a radioactive and chemical waste discharge permit, at the same time as its authorisation application. This application dealt on the one hand with surface water (rainwater, collected above the bituminous membrane) and its discharge into the river, and on the other with the water collected at the base of the structures, transferred to the COGEMA plant at La Hague for discharge at sea. The discharge orders were notified on 11 January 2003 and constitute the regulatory reference system for the Manche repository.

With regard to the Aube repository, and given the very low level of radiological activity concerned by the effluents, the 19 July 1991 circular from the Central Service for Protection against Ionising Radiation (SCPRI, the radiation protection regulatory body at the time) defined the requirements concerning the activity of water leaving the facility's stormwater tank: 0.0008 Bq/l for alpha activity, 0.8 Bq/l for beta activity, 400 Bq/l for tritium. Since operations began, up to the end of 2004, the maximum values recorded were 24% (primarily due to cumulative measurement thresholds), 3% and 0.3 % of these limits respectively.

Changes to the regulatory picture, particularly the publication of the decree of 4 May 1995 implementing the water law of 3 January 1992, and the publication of the order of 26 November 1999 defining general requirements for effluent discharge and/or water intake, led Andra on 17 March 2004 to submit an application for a liquid and gaseous discharge permit and a request for modification of the repository's authorisation decree. After public inquiries at the end of 2004 and following the administrative process in progress, the discharge permit and modified authorisation decree should be published before the end of 2005.

The radioactive discharge applications come at a time of thresholds being lowered as compared to the values authorised by the recommendations of the SCPRI.

The volumes of effluent produced by the disposal facilities are very small as a result of the steps taken for operation of the structures, which are sheltered by mobile covers, based on the experience feedback from operation of the Manche repository.

F.4.2.2 Radiation protection and minimisation of effluents at the CEA + ILL

The CEA attaches considerable importance to protecting workers, the public and the environment, starting with design of the facilities, through operation to dismantling, paying particular attention to limiting exposure of workers and effluent discharges, and to monitoring their impact on man and his environment. To meet the discharge reduction targets and thus reduce their health impact, the CEA relies on making those in the operational chain more aware and more conscious, on implementing effluent treatment technologies that are as efficient as is socially and economically reasonable, and finally on permanent monitoring of effluent discharges and surveillance of the environment.

F.4.2.2.1 Radiation protection of workers

Steps to control external and internal exposure of CEA workers at the workstations are taken as of the design of the facilities and continue through their operational life and, for some of them, through to dismantling.

This approach is the result of applying the principles of justifying practices, minimising doses and the number of persons exposed, and limiting exposure to below predetermined dose targets. Every operation involving exposure to radiation is conducted in accordance with the ALARA optimisation principle.

The optimisation process concerns both the layout and fitting out of the premises. This layout is designed both to facilitate tasks and minimise task duration and avoid having to pass near or stay near radiation sources. It takes account of operational requirements and those linked to supervision, maintenance and disposal of waste, whether process waste, contaminated materials or radioactive materials.

This optimisation process is associated with a work organisation providing for both classification and surveillance of the premises, along with classification, protection and supervision of the workers:

- classification of the work premises, defined to take account of the radiological hazard encountered and often determined as early as the design of the facilities, is checked and updated throughout operation of the facilities according to the results of radiological surveillance exercised at the workstation;
- classification of the workers for its part depends on the level of exposure likely to be received at the workstation. To limit this exposure, protective measures are taken, concerning on the one hand the installation of biological protection, using the principle of defence in depth (several physical shields between the radioactive source and the environment), and on the other the use of dynamic

containment supplementing the static devices, by establishing a negative pressure cascade circulating air from the least contaminated areas to the most contaminated areas;

- radiation protection of the workers is ensured by collective real-time measurement systems (external and internal exposure), by individual dosimetric monitoring and by medical supervision appropriate to the radiological hazard likely to be encountered.

The steps taken have in recent years enabled workers' exposure to be reduced on all CEA sites. The average individual annual dose received by the personnel working in the CEA centres was thus 0.19 mSv in 2004 (dose higher than the detection threshold).

In 2004, 8500 employees were monitored and the collective dose was 1.43 man.mSv. Sixteen people received a dose in excess of 5 mSv and the maximum dose was 9.4 mSv.

F.4.2.2.2 Exposure of the public

The design of the biological protection of the facilities adjoining zones accessible to company employees and who do not normally work in regulated zones, or to members of the public, is evaluated on the basis of a level of exposure that is as low as reasonably achievable, below a regulation limit set at 1 mSv per year.

The same applies to the public outside the perimeter fencing of the various CEA facilities. The level of exposure is monitored both inside the site and at the fencing by a large number of periodically checked dosimeters. These steps are supplemented by real-time, continuous measurement of the dose rates by detectors installed in the measurement stations positioned around the CEA facilities. All these continuous measurements are transmitted in real-time to the environment control centre in the facility concerned.

The implemented arrangements lead to approximately the same measured values as the natural background radioactivity.

F.4.2.2.3 Reduction of effluent discharges

Discharge of radioactive effluents into the environment by the CEA's facilities is subject to the general regulations (see § E.2.2.4.3), and to the regulations specific to each site (inter-ministerial order), which define the limits authorised for discharges (annual and monthly limits, maximum concentration added to the receiving environment), discharge conditions and the environment surveillance procedures. Well before the first discharge permits are issued by the authorities (as of 1979), the CEA tackled the task of controlling its discharges of radioactive effluents into the environment, monitoring them and measuring their impact, while trying to keep them as low as possible.

The Nuclear Safety Authority has been gradually revising the discharge and water intake permits for the CEA Centres since the 1990s, given the recent changes to the regulatory framework. This leads to a reduction in the facilities' discharge permits (case of Grenoble with the order of 25 May 2004) and, for the new facilities, by the publication of a permit per facility.

Before discharge into the environment, the gaseous effluents are treated by filtration and liquid effluents by physical and/or chemical separation. After purification and before discharge into the environment, a thorough check is conducted in accordance with the requirements of the regulations.

The discharges are monitored by the Radiation Safety Unit (SPR) of the CEA facilities, under the supervision of the Nuclear Safety Authority. For at least the last twelve years, and on all the sites, radioactive effluent discharges have always been lower than the limits set by the ministerial orders.

Monitoring of liquid effluent discharges covers the activity of alpha, beta and gamma emitting radionuclides, typically measured by global counting, as well as that of tritium, measured by liquid scintillation.

Analysis of the results highlights a significant drop in all discharges over the last twelve years. At the end of 2004, liquid discharges of beta-gamma emitters and of tritium accounted for less than 15 % and 24 % respectively of current discharge permits. Alpha emitter discharges, which are over-evaluated because of the sensitivity limits of the measurement methods, stand at about 14 % of the authorised limits.

Atmospheric discharges are monitored on the basis of the aerosols generally measured by global counting, of halogens measured by gamma spectrometry, and of tritium measured by scintillation after trapping in spargers. Discharges of other gases, identified by spectrometry, are measured with an ionisation chamber.

In the same way as for liquid discharges, analysis of the results of the last twelve years shows a significant drop in discharges. The 2004 totals show tritium discharges of no more than 7% of the authorised limits, halogen discharges not in excess of 2% of the limits and aerosol discharges of less than 1%. Discharges of other gases, over-evaluated owing to the sensitivity limits of the methods used, represented less than 30% of the annual regulation limit.

The dosimetric impact of the radioactive discharges remains very low. In highly penalising conditions, calculation of this impact using recent gaseous and liquid discharges as the source term, leads to annual values never in excess of 5 microsieverts for the reference group most exposed both to gaseous discharges and liquid discharges from the Saclay site. For the other CEA sites, the dosimetric impact is less than one microsievert, which should be compared with the reference values such as the regulation limit for the public (1 mSv/year) or the annual average dose equivalent resulting from natural radioactivity, which is about 2.4 mSv/year in France.

For renewal of the CEA centres' discharge permits, the ASN is asking the centres to modify their discharge accounting rules, and in particular to estimate the activity levels discharged based on isotopic analyses and no longer on global analyses.

F.4.2.2.4 Environmental monitoring

Environmental monitoring, which is also carried out by the Radiation Protection Departments (SPR) in the CEA facilities, under the control of the Nuclear Safety Authority, contributes to checking that the potential impact on the environment of the discharges from the facilities remains well below the regulation limit values for the public, and below those evaluated using modelling of radioactivity transfers from the environment to man. (See section L.6)

An environmental monitoring plan is defined by each facility and validated by the supervisory authorities, to monitor the influence of the discharges on the various environments.

Environmental monitoring includes the continual monitoring conducted on the releases from the gaseous and liquid discharge outfalls into the environment, but also that performed by the monitoring stations equipped with systems for continuous monitoring of the radioactivity in the water and air and the ambient gamma radiation. This alert function for real-time detection of any abnormal operation of an installation is combined with ex post measurements in the laboratory constituting the CEA facilities discharge impact monitoring and control function.

The radioactivity measurements in particular concern the air (aerosols), surface water upstream and downstream of the site, underground water below the site and outside it, as well as vegetation, milk and the main crops in the region. They are carried out on representative samples at points selected using meteorological, hydrological and socio-economic criteria, but also on the basis of experience feedback. Monthly monitoring of these various environments involves checks through total alpha and beta count and specific measurements by liquid scintillation (H-3, C-14...), gamma spectrometry (traces of fission or activation products) or by counting after selective separation (Sr-90).

This regulatory monitoring is supplemented by annual programs conducted on various compartments of the environment, such as sediments, aquatic flora and fauna, during which more sensitive analyses than operational monitoring are employed, or other physico-chemical parameters are used.

Analysis of the radio-ecological checks confirm that there is no significant impact by current discharges from the CEA's civilian facilities on their environment, with the main exception of tritium. This tritium, partly attributable to old activities, can be detected in underground water below a few sites and in their immediate vicinity, or in the receiving environment just downstream of the liquid effluent discharge, but in concentrations which have dropped significantly in recent years and are generally below 100 Bq/l. It is sometimes detected in vegetation downwind of the prevailing winds around atmospheric tritium discharges, but is only very rarely detected in milk.

In the aquatic and terrestrial environments, and with the exception of sediments in which traces of artificial radionuclides can be measured, no artificial radionuclide other than tritium is detected at levels higher than one becquerel per litre or one becquerel per kilogram of material.

F.4.2.2.5 Information and competence

All the results are transmitted to the supervisory authorities and are published in monthly and annual reports made available to the public (web site "www.asn.gouv.fr", videotext "36.14 MAGNUC" or in brochures published by the CEA and available on "www.cea.fr"). All CEA sites maintain regular contacts with their local authorities and with the local information committee, whenever there is one.

Accreditation of the CEA's environment monitoring laboratories by the COFRAC (French accreditation committee) is a further guarantee of the credibility of the measurements made by these laboratories, which also take part in a number of cross-comparisons organised by the ASN or by other national and international bodies. The laboratories are also approved by the Ministers for Health and the Environment as part of the process to set up the national environmental radioactivity measurement network.

F.4.2.3 Radiation protection and effluent minimisation at COGEMA

F.4.2.3.1 Radiation protection and emissions

F.4.2.3.1.1 Worker exposure

Control of worker exposure has always been one of COGEMA's main responsibilities. When the facilities currently in service on the La Hague site were designed in the early 1980s, the design limit for workstations was set at 5 mSv/year, in other words one quarter of the limit stipulated by Europe 15 years later. It was clear at the time that this dose was due only to external exposure as work was only carried out in zones with no permanent contamination.

Experience shows that this target was easily reached, as the average individual exposure of the personnel working in the La Hague plant was only 0.071 mSv in 2003 (COGEMA or subcontractor personnel), with the maximum dose recorded being 4.75 mSv.

These results were obtained using the following means:

- upstream, by designing efficient and reliable process equipment, this result being achieved through extensive R&D programmes;
- making widespread use of remote control of operations;
- conventionally, by installing shielding (biological protection) appropriate to all foreseeable operating and maintenance situations;
- ensuring extremely stringent containment of the facilities: a minimum of two complete physical barriers are placed between the radioactive materials and the environment. The chemistry

equipment is completely welded and enclosed in leaktight cells, while mechanical equipment is fitted with dynamic containment systems (negative pressure, air curtains) and placed in closed cells in which the mechanical penetrations to the working zones were particularly closely studied. Dynamic containment supplements the static arrangements, by establishing a negative pressure cascade ensuring that air circulates from the least contaminated to the most contaminated zones. Ventilation is by a number of complete and separate systems, depending on the level of contamination of the ventilated premises, so as to avoid contamination backing up in the event of a ventilation malfunction. The process equipment in particular is ventilated by a completely separate network, including for the atmospheric discharge outfall. All these means ensure that the premises can be kept operational in conditions of cleanness that rule out internal exposure;

- taking account at the design stage of all maintenance operations, which leads to the equipment being designed on the basis of these operations, in particular so that consumables (pumps, valves, measurement sensors, etc.) can be replaced remotely, without any breach in containment and with full biological protection (use of mobile equipment removal chambers).

F.4.2.3.1.2 Exposure of the public

The provisions adopted limit exposure around the buildings to values which are practically indistinguishable from the background natural radiation. Visitors moving around inside the site cannot therefore receive doses which exceed the dose limits recommended at national level.

The same must therefore apply to the public outside the site perimeter fencing.

The radiation level is monitored inside the site and at the fencing by a large number of regularly checked dosimeters (15 on the fence), supplemented by eight stations at the perimeter fence which permanently monitor the dose rate. Finally, continuous measurements are taken in five neighbouring villages. All the continuous measurements are transmitted to the site's environment control centre.

F.4.2.3.1.3 Minimising emissions

The construction measures adopted for normal operation and to counter any external hazards (earthquake, falling object, flooding, explosion, etc.) rule out unplanned and uncontrolled discharges.

F.4.2.3.2 Impact of discharges

Reducing discharges and their impact has always been one of the prime concerns of the CEA, and then COGEMA, jointly with the authorities. Siting was in particular guided by this concern.

Discharge permits have always been issued on the practical basis of dose constraints far lower than the regulation limits. Furthermore, the process installations can only be authorised if they are safe enough to ensure that the risk of an uncontrolled discharges is kept at a very low level. Very low probability events must nonetheless be considered as part of a beyond-design-basis approach, whenever their consequences are potentially high, and steps must be taken to limit them. In these conditions, we can consider that the risk of exposing an individual to doses exceeding the nationally prescribed limits owing to discharges, is extremely low.

The principles adopted are the following:

- use of a stringent containment system to prevent losses, as mentioned above;
- optimisation of processing of by-products, the main priority being to recycle them as much as possible in the process, with the second priority, for those which cannot be recycled, being to send them whenever reasonably possible for processing as solid waste (preferably with vitrification, or failing which with compacting and/or cementing). The remainder is discharged either into the atmosphere or the sea, depending on what is technically possible, preferably in a place where the impact on the environment and the reference groups is minimal;

- when selecting various options, taking account of worker exposure and the hazards caused to the population and to the workers.

In application of these principles, the effluents are collected and then processed as far as possible to recover all reagents, purify them and if necessary convert them to be able to recycle them in the process, with the rest being concentrated and sent with the radionuclides contained for solid disposal, mostly by vitrification, which is the most compact and effective means of packaging radionuclides. Some parts of the process which produce effluents that can be neither vitrified nor concentrated (such as certain laboratory analyses) were modified in order to eliminate production of active effluents.

For example, all the aqueous solutions used to rinse the structural elements of fuel assemblies (top and bottom end-pieces and cladding debris) are recycled in the dissolution solution prepared with highly concentrated nitric acid, itself recycled, concentrated and purified by evaporation after the other products (fission products, uranium and plutonium) have been extracted from it during the process. This is also the case with solvent and thinner, which are cleaned of their radioactivity and the decay products they contain by vacuum distillation in a special evaporator. The residue in this case cannot be vitrified and is packaged as solid waste by encapsulation in cement, after being calcined in a dedicated unit. This is a first and extremely important way to reduce the volume and activity of the effluents.

For solutions which cannot be recycled, the old effluent management process was based on sorting according to activity level. High level effluents were all sent for vitrification, while medium and low level effluents were collected and sent separately to the STE3 effluent reprocessing station, without breaking down the batches, whatever the origin, acidity and chemical content (insofar as it was compatible with the STE3 equipment and process). The very low level effluents, which normally receive no activity and are thus known as "V" effluent, standing for "to be verified", were stored, checked in batches to verify that their activity was indeed lower than the prescribed threshold, then filtered and discharged into the sea, between the active effluent discharge periods, which are only during periods of strong tidal currents.

As part of the "new effluent management", as it is known by the operator, high level effluents are still sent for vitrification. The difference lies in the medium and low level effluents, which are now collected on the basis of their acidity, with acid effluents on one side and bases on the other. Instead of being sent to the effluent treatment station for sorting according to activity level, they are concentrated in dedicated evaporators installed in such a way that operation does not have to be halted. Most of the products which are fed into the acids and bases evaporators exit in the form of distillates which are virtually free of contamination and can then be considered "V" effluents and discharged as such. The residual concentrate contains all the radioactivity and thus becomes high level effluent (but of far smaller volume than the initial effluent), and is sent for vitrification with the other high level effluents. This is a second and also very important means of reducing the activity and volume of effluents, and also that of the solid waste.

These technical developments were made possible in UP 2-800 and in UP 3-A thanks to significant improvements resulting from modified implementation of the process in these plants. This led to a substantial reduction in the quantity and activity of effluents (improved decontamination factors). This reduction enabled the effluents to be concentrated in evaporators of reasonable size, which could then be fitted into the free space in the plants. It was impossible to use this type of arrangement in the old plants which employed far less efficient processes and process equipment.

The case of analysis laboratory effluents is a particular one. The activity they contained accounted for a large part of alpha activity and a small part of beta-gamma activity of the effluents before volume reduction was employed. Once most of the reduction mechanisms were in place, the proportion of beta-gamma activity they contained also became significant. The most important measures taken to remedy this situation were to develop new on-line analysis techniques, which no longer required samples to be taken 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. A few analyses of remaining plutonium solutions were the cause of the high alpha activity of the analysis laboratory effluents. Installation of a special plutonium recovery unit on this stream led to a significant reduction in the alpha activity discharged by the laboratory.

Following improvements to the control of the STE3 process which have been implemented since 1989 and which led to substantial reductions in discharge activity, implementation of the principles described above since 1991 has led to significant discharge reductions concurrent with a reduction in the volume of solid waste, as instead of being encapsulated in bitumen or cement, the radionuclides are sent for vitrification which is compatible with far higher level concentrations. In this way, discharges were not reduced at the cost of increased solid waste volumes, but simultaneously with improved compacting of this waste.

The result of the steps taken is particularly visible for discharges at sea, which had risen appreciably during the period in which light water reactor fuels were being reprocessed in the old facilities (See France's 1st report under Joint Convention). The impact of these discharges is now at a very low level, well below that required by international regulations and recommendations and by health considerations. In any case, the impact corresponding to gaseous and liquid discharges has never exceeded the current dose limits for the public (and therefore certainly never exceeded those which were applicable at the time). Application of the BAT (Best Available Technology) principle, nonetheless means that the reduction process must be continued, taking account of progress made in similar processes or operations, developments in scientific and technological knowledge, the economic feasibility of the new techniques and the time needed to implement them, as well as the nature and volume of the discharges considered.

The calculated impact values were confirmed by a particularly exhaustive study conducted by the 60 experts of the North-Cotentin radio-ecology group which, at the request of the government, examined all discharge values and more than 50,000 analysis results from samples taken from the environment by various bodies, and by the North-Cotentin 2000 exercise which revealed that environmental marking from the plant discharges was insignificant when compared with natural radioactivity and the fall-out from Chernobyl and atmospheric testing of nuclear weapons, levels which were already very low.

F.4.2.3.3 Control of emissions

Limiting the risk of emission at the source makes it unnecessary to attempt to mitigate the effects, especially as the feasibility of this has yet to be proven. There is no justification for placing decay buffers on potential emission sources as the emissions cannot concern radionuclides with high toxicity and very short half-life, as these have practically all disappeared through radioactive decay during the first months of cooling on the reactor site, before being sent to the treatment site.

F.4.2.4 Radiation protection and minimisation of effluents at EDF

F.4.2.4.1 Radiation protection of workers

Any action to reduce the doses received by the personnel must begin with clear knowledge of the individual doses. The doses received by the workers can result from internal contamination or from external exposure to radiation. EDF's policy, referred to as the "clean plant" policy, means that cases of internal contamination are rare and rarely serious. A high degree of cleanness in the controlled zone is sought, in particular for circulation areas and areas in which the work sites are few in number and entail little contamination. In the other zones where such levels cannot be reached during operation (hard to completely eliminate leaks, isolated work sites with a risk of contamination), collective protection measures (airlock with negative pressure system for example) or individual protection measures (ventilated leaktight suits or hoods) are used. Setting thresholds on the contamination monitoring portals (exits from the controlled zone) and adding portals at the site exits are incentives designed to further reduce the small number of external or internal contaminations. Most of the doses received can thus be attributed to external irradiation, and that is the targeted area for reduction. This policy and its results form an inseparable whole and it is impossible to isolate those aspects strictly linked to spent fuel management or radioactive waste management: the following presentation therefore concerns all aspects of nuclear power plant reactor operations.

To optimise and reduce the doses received by the exposed persons, EDF in 1992 launched the ALARA 1 policy. Major gains were then achieved with the collective dose dropping from 2.4 man.SV per year and per reactor in 1992 to 1.08 in 2000 and 1.02 in 2001. This reduction is also the consequence of actions taken to limit the individual dose to 20 mSv per year as of 1999.

To continue to progress, EDF has launched a new ALARA programme, implementing the optimisation principle as a whole, in particular relying on development of quality-based radiation protection management. The collective dosimetry per unit thus continued its downward trend and in 2004 and reached 0.80 man.Sv/unit.

This approach is based on three areas of progress:

- Reduce contamination of the systems

  Contamination of the systems is one component of dosimetry, the control of which must also contribute to reducing doses during operation and outages. This leads to action being taken to optimise the operating factors, in particular through chemical treatment and filtration.

- Preparing work to be done by optimising the doses

  The process is the following:

  - make a forecast dosimetry evaluation for operations in controlled zones, in terms of collective and individual dose;

  - rank these operations according to the dosimetry (low, significant or high);

  - perform an optimisation analysis of these operations, varying according to the potential dosimetry;

  - set a collective and individual dosimetry target for each operation, resulting from this optimisation analysis;

  - conduct real-time monitoring of collective and individual dosimetry of these operations and analyse any deviations;

  - implement experience feedback with analysis of deviations and of good practices which will be of use for future operations.

  Preparation of the activities must include individual and collective dosimetry evaluation, with the analysis level depending on the potential dosimetry of the operation. The optimisation phase consists in lowering the previously evaluated doses.

  For work sites with a dosimetry issue, preparation of the activities must include an analysis of the site by a pair comprising a person with radiation protection expertise and a person responsible for design. The operation is examined phase by phase, workstation by workstation, to determine the most appropriate protection, tools and working methods. Individual and collective dose targets are set after optimisation.

  As part of this optimisation process, individual and collective dose targets are set and notified to the personnel, enabling them to compare the doses actually received with those determined during the preparatory phase. In the event of any significant deviation, the work site may be stopped for a further optimisation analysis.

  Optimisation is an iterative process as subsequent analysis of the work done allows further optimisation of future work.

The operational dosimetry put in place by EDF in the early 1980s and which became enacted in the decree of 24 December 1998, amending decree 75-306 of 28 April 1975, allows real-time monitoring of the dosimetry of the parties involved during an operation and visualisation of any deviation from the targets set. This system in particular allows monitoring of personnel for whom the total annual dose is approaching the regulation limit. The values are recorded in a single database containing all the doses received by a worker (EDF or outside contractor) during his work on one or more of the 19 EDF reactor sites in operation. When the person arrives for further access to a controlled zone, this access is only granted if his total annual dose extracted from the centralised system does not exceed a given threshold (18 mSv), which is lower than the regulation dose limit. If not, access is temporarily withheld until a joint analysis is conducted with the employer, with production of a schedule of subsequent exposure compatible with the regulation limit.

- Using and distributing experience feedback

  The second ten-yearly inspections for the 900 MWe plant series are also an opportunity to look closely at work sites with high potential dosimetry in order to learn lessons. Optimisation is an iterative process and subsequent analysis of how this work is done should lead to further optimisation of future work, while taking account of the economic and social criteria which constitute the other aspect of optimisation.

  To limit the doses which are received by the parties involved, EDF has anticipated the reduction in the annual limit to 20 mSv since 1999. Furthermore, dosimetry management alarm thresholds have been set at 16 and 18 mSv, allowing precise monitoring of persons approaching the future limits, in order to avoid any overshoot.

- Implementation of an ALARA approach to shipments

  To optimise the dosimetry linked to shipment of radioactive materials, EDF employs an ALARA approach. In particular for shipment of spent fuels, the available data are used by the operators in charge of removal operations, but also by the designer in order to define the tools associated with the new packagings.

F.4.2.4.2 Radiation protection of the public

The EDF group and all its units have received ISO 14001 international certification. This proactive approach comprises a number of objectives; continual improvement, control of impacts and prevention of pollution, combined with compliance with the regulations. The new environmental regulations for basic nuclear installations, applicable in the short term, imply considerable and complex implementation work. These two approaches, one regulatory and the other voluntary are highly complementary and many actions overlap between the two.

F.4.2.4.3 Effluent discharges

The regulations concerning discharge of radioactive effluents comprise:

- general texts (decree of 4 May 1995 on discharge of liquid and gaseous effluents and water intake by BNIs, order of 26 November 1999 setting general technical requirements concerning BNI water intake and discharges, order of 31 December 1999 setting the general technical caused by BNI operations, etc.);
- specific ministerial orders for each site.

The general regulations in particular define:

- the procedures for obtaining discharge permits;
- the discharge standards and conditions;
- the role and responsibilities of the head of the nuclear site.

The orders specific to each site in particular set:

- the limits not to be exceeded (authorised annual limits, maximum added or total concentrations in the receiving environment);
- discharge conditions;
- the methods of the environmental monitoring programme.

The concentration limits are associated with annual total activity limits set not for reasons of public health and safety, but for reasons of good management. For a given type of reactor, these limits depend on the installed power. They obviously meet the previous health criteria with an acceptable margin, including for the larger sites.

This regulatory framework also implies use of the principle of optimisation, the aim of which is to reduce the impact of radioactive discharges to a level which is "as low as reasonably achievable, after controlling for economic and social factors ". This approach was integrated into the design of the structures (installation of effluent treatment resources, etc.) and is reflected by stringent management of effluents during operation.

These measures led to a very significant reduction in discharges of liquid effluents, excluding tritium, (factor 100) which was originally the main contributor to impacts on the environment and on health (dose).

The substantial reduction in liquid effluents except tritium observed for a number of years means that the dosimetric impact of the discharges from a plant is chiefly attributable to discharges of tritium and carbon 14.

The dosimetric impact of radioactive discharges nonetheless remains extremely low as it does not exceed about 0.001 mSv per year. This value is well below the natural exposure level in France (2.4 mSv per year) and the limit set for the public (1 mSv per year). It is also lower than the "triviality" level set at 0.01 or 0.03 mSv per year by international agencies such as the ICRP and IAEA. This level is defined as being a value below which the hazard, if it exists, is considered to be negligible.

F.4.2.4.4 Environmental monitoring

Environmental monitoring includes continuous environmental monitoring and measurements of radioactive and non-radioactive discharges into the environment. The environment begins at the exit from the controlled zone. Monitoring of site roads and monitoring of radioactivity on leaving the site, are thus part of this subject.

Environmental monitoring is a regulated activity, the quality of which is supervised.

Environmental monitoring by the operator involves 3 technical functions:

- alert function;
- monitoring function;
- follow-up and study function.

The alert function means that any environmental anomaly is notified rapidly. It concerns any variation in a measurement which can be directly linked to operation of the plant.

At EDF, the alert function concerns discharges monitoring and continuous recording of the ambient gamma radiation around the plant, automatic chemical monitoring of the receiving environment, for riverside plants, and the radioactivity inspection gates at the site entrance and exit.

The monitoring function ensures that the regulations are complied with. It compares a parameter with a criterion. The monitoring function corresponds to the checks stipulated by the discharge permits and the checks on the presence of radioactivity on the roads.

The scientific follow-up and study function is used to observe and predict changes. It monitors a parameter which changes slowly and which is generally linked to an integrating phenomenon. The follow-up function comprises radio-ecological studies (ten-year review, annual reviews, special studies, helicopter surveillance, etc.), and hydro-ecological campaigns.

These technical functions are combined with the task of communicating with the authorities and with the public.

Keeping of regulation registers (effluents and environment) is entrusted to a single service which reports directly to the plant manager and is functionally independent from the services responsible for requesting permits for and carrying out the discharges.

Particular efforts have been deployed by EDF to standardise radioactivity measurements in the environment and cross-compare the results from the nuclear power plant laboratories, under the supervision of the primary laboratory (Henri Becquerel national laboratory). This effort must be continued at an international level.

Every year, radio-ecological follow-up is carried out on all operating nuclear sites. It is part of a follow-up programme defined in a framework agreement with the IRSN. This follow-up covers the entire installed base since 1992 and offers a picture of the impact of the facilities in terms of both space and time.

A ten-yearly review, comparable to the "point zero" at the time of commissioning the first unit of a site, is also conducted. All the sites (except Chooz and Civaux, which were commissioned in 1996 and 1997 respectively) have completed their first ten-yearly review. The second ten-yearly reviews began in 1998 on the Fessenheim site.

Analysis of the radio-ecological follow-up results confirms the absence of any impact of atmospheric discharges on the terrestrial environment.

In the aquatic environment, radionuclides from liquid discharges from the plants are detected as traces in the sediments and aquatic flora in the areas closely downstream of the discharge point.

F.4.3 Dosimetric follow-up of workers and environmental monitoring

F.4.3.1 The case of BNIs

The dosimetric follow-up review for the year 2003, for the personnel working in the BNIs, is presented in the following table:

Company	Number of persons monitored	Sum of doses (Man.Sieverts)	Doses > 20 mSv
EDF	19,987	9.87	-
CEA	6,702	1.48	-
COGEMA	5,462	0.23	-
INP (Orsay + Strasbourg)	4,404	0.05	-
CERN	2,091	0.34	-
Andra + subcontractors	586	0.92	
Other contractors	30,280	24.4	13
Total	69,512	37.29	13

The results of environmental monitoring around the BNIs are presented in the appendix (see § L.6).

F.4.3.2 The case of ICPEs

The dosimetric follow-up review for the year 2003, for the personnel working in the other facilities monitored, is presented in the following table:

Company	Number of persons monitored	Sum of doses (Man.Sieverts)	Doses > 20 mSv
Hospitals - Doctors	112,459	9.26	44
Dentists	22,805	0.43	2
Veterinary surgeons	6,915*	0.56	4
Conventional industries	26,160	22.76	40
Research	7,898	0.07	0
Miscellaneous	5,005	0.24	0
Total	181,242	33.32	90

* increase by 75 % of the number of dosimeters used between 2001 and 2003

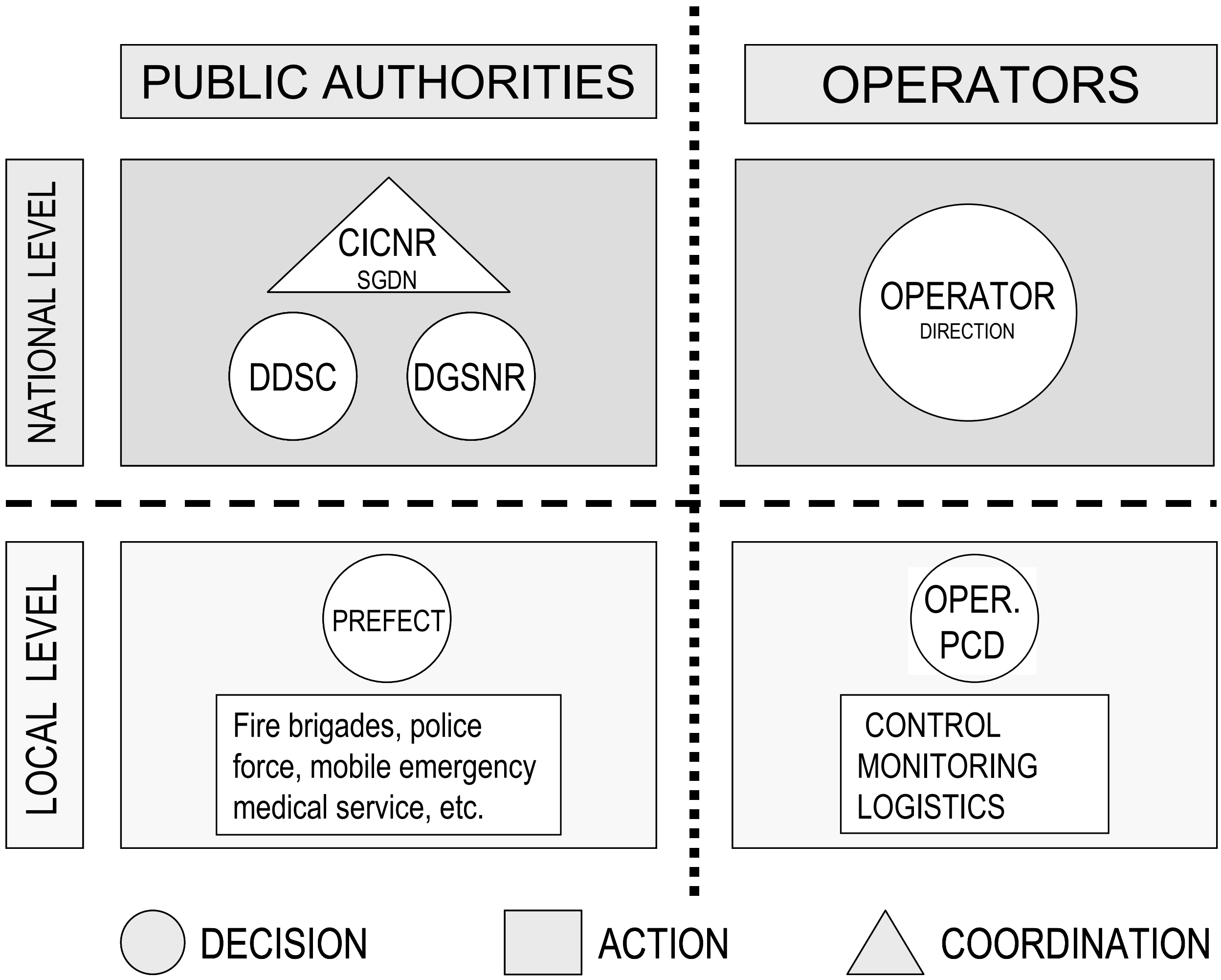
F.5 Emergency preparedness (Article 25)

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 a BNI

The preparedness of the public authorities for a possible incident or accident is set by directives issued by the Prime Minister, concerning nuclear safety, radiation protection, public order and civil security, as well as by the emergency plans stipulated in decree 88-622 of 6 May 1988. These directives were updated in 2005 under the authority of the SGDN. The preparedness of the public authorities and that of the operator in the event of an accident in an EDF reactor or any other nuclear installation are presented in the following diagram.



With regard to information of neighbouring states in the event of a radiological emergency, this is the subject of the Early Notification Convention of 26 September 1986 ratified by France in 1989. In addition, bilateral conventions could be signed with the authorities of bordering countries.

F.5.1.1 Preparedness at the local level

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

- the operator of the nuclear facility in which the accident has occurred, who must implement an organisation and resources such as to control the accident, evaluate it and limit the consequences, protect persons on the site and alert and regularly inform the public authorities. This arrangement is defined beforehand in the on-site emergency plan (PUI) that the operator is required to prepare;
- the Prefect of the *département* in which the facility is located, who is responsible for deciding on the necessary measures to protect the population and property threatened by the accident. He acts within the framework of an off-site emergency plan (PPI) which has been specifically prepared for the facility in question. In this respect, he is responsible for co-ordinating the resources committed in the PPI, both public and private, material and human. He informs the population and the elected representatives.

F.5.1.2 Preparedness at a national level

The ministries concerned join efforts to advise the Prefect on the measures to be taken, in particular by providing him – in the same way as the operator – with information and recommendations likely to give him a clearer picture of the status of the facility, the scale of the incident or accident, and possible developments. The main participants are the following:

- Ministry for the Interior: the Directorate for Civil Security and Defence (DDSC) which has the support of the Inter-ministerial emergency management operational centre (COGIC) and the Office of Major Risks, to provide the Prefect with the human and material reinforcements needed to protect persons and property;
- Ministry for Health: the DGSNR which is responsible for the protection of persons against the effects of ionising radiation;
- Ministry for Industry and Ministry for the Environment: the DGSNR, for monitoring the safety of nuclear installations with the technical support of the IRSN. The Minister for Industry also coordinates communication at a national level in the event of an incident or accident affecting a nuclear facility under his supervision, or occurring during shipment of nuclear materials; as the competent authority, the DGSNR collects and summarises information so that it is able to issue the notifications, information and assistance requests provided for in the international conventions dealing with information of third party countries in the event of a radiological emergency.
- Ministry for Defence and Ministry for Industry: the Defence Nuclear Safety and Radiation Protection Delegate (DSND) is the competent authority for monitoring the safety of secret basic nuclear installations, military nuclear systems (SNM) and defence-related transports.

NB: A memorandum of understanding was signed by the DGSNR and the DSND in particular to ensure coordination between the two entities in the event of an accident affecting an activity supervised by the DSND in order to facilitate the transition from the emergency phase handled by the DSND to the post-accident phase for which the DGSNR is competent.

- National defence general secretariat (SGDN): the SGDN handles the secretarial duties for the Inter-ministerial commission on nuclear and radiological emergencies (CICNR). It is responsible for ensuring the consistency of inter-ministerial measures planned in the event of an accident and for ensuring that drills are scheduled and assessed.

F.5.1.3 The emergency response plans

F.5.1.3.1 The general principle

Application of the principle of defence in depth means that when drafting the emergency plans, account must be taken of severe accidents with a very low probability of occurrence, in order to define measures necessary to protect the personnel of the site and the population, and to mitigate the accident on the site.

There are two types of emergency response plans for nuclear facilities:

- the on-site emergency plan (PUI), drawn up by the operator, which is designed to return the facility to a safe status and limit the consequences of the accident. It specifies the preparedness and the resources to be deployed on the site. It also comprises steps for rapidly informing the public authorities;
- the offsite emergency plan (PPI), drawn up by the Prefect, which is designed to provide short-term protection of the population if threatened, and to support the operator with outside response resources. It specifies the roles and duties of the various services concerned, the information and alert diagrams and the material and human resources.

F.5.1.3.2 The technical basis and countermeasures of the emergency response plans

The emergency response plans must be prepared in order to provide an appropriate response to accidents occurring in a BNI. This requires definition of a technical basis, that is adoption of one or more accident scenarios determining the envelope of possible consequences, in order to define the nature and scope of the resources to be deployed. This task is difficult, because real significant accidents are rare, and the approach relies primarily on a theoretical and conservative approach leading to estimation of the source terms (that is the quantities of radioactive material released), then calculating their dispersal into the environment and finally, evaluating their radiological impact.

On the basis of the response levels defined by the regulations, it is then possible to define countermeasures in the PPI, in other words the population protection actions which would seem justified to limit the direct impact of the discharge. The measures envisaged include:

- taking shelter indoors, in order to protect the inhabitants from the direct irradiation from a radioactive plume and to minimise inhalation of radioactive substances;
- administration of stable iodine when the discharge comprises radioactive iodine (in particular iodine 131);
- evacuation, when the previous measures offer inadequate protection owing to the discharge activity levels.

It should be noted that the offsite emergency plans only comprise emergency measures and do not in any way preclude steps that could be taken in the longer term and over longer distances, such as foodstuff consumption restrictions or clean-up of contaminated areas.

F.5.2 The role and preparedness of the ASN

F.5.2.1 ASN duties in an emergency

In an accident situation, the DGSNR, with the support of the IRSN and assistance of the DRIRE concerned, has a four-fold duty:

1) to ensure the soundness of the measures taken by the operator;

2) to advise the Prefect;

3) to take part in diffusion of information.

4) to act as competent authority for compliance with international Conventions.

F.5.2.1.1 Monitoring of the actions taken by the operator

As in a normal situation, it is up to the ASN to monitor the operator of a facility which has suffered an accident. In this particular context, the ASN must ensure that the operator fully assumes its responsibilities to control the accident, limit the consequences and rapidly and regularly inform the public authorities, but does not take the place of the operator in the technical steps taken to deal with the accident. In particular, when several action strategies are available to the operator to control the accident, some could have important environmental consequences, and it is then up to the ASN to check the conditions in which the operator makes its choice.

F.5.2.1.2 Advice to the Prefect

The Prefect's decision on the steps to be taken to protect the population depends on the actual or foreseeable consequences of the accident around the site, and it is up to the ASN to inform the Prefect of its position on this subject, following the analysis conducted by the IRSN. This analysis concerns both a diagnostic of the situation (understanding of the situation of the facility in which the accident has occurred) and a forecast (evaluation of possible short-term developments, in particular radioactive discharges).

The protective measures which could be recommended are typically the following:

- before discharge:
  - take shelter;
  - evacuate the persons at risk;
  - take stable iodine in the event of imminent discharge (for reactor accidents).
- after discharge:
  - possible correction of any measures taken beforehand;
  - foodstuff restrictions;
  - travel restrictions.

F.5.2.1.3 Dissemination of information

The ASN intervenes in information dissemination in several ways:

- information of the media and the public: the ASN helps to inform the media and the public in a variety of ways (press releases, MAGNUC videotext, press conference); it is important for this to be done in close co-ordination with the other communicating entities (Prefect, local and national operators);
- institutional information: the ASN informs its supervisory ministers and the SGDN, responsible for informing the President of the Republic and the Prime Minister;
- information of foreign safety authorities: the ASN informs foreign safety authorities, in particular those with whom mutual safety information agreements exist.

F.5.2.1.4 The function as competent authority under the terms of international conventions

Since publication of decree 2003-865 of 8 September 2003, the DGSNR has been the competent authority for the purposes of the international conventions (Convention on Early Notification of a Nuclear Accident, signed by France on 26 September 1986, and decision by the Council of European Communities on 14 December 1987, concerning community procedures for the rapid exchange of information in the event of a radiological emergency). In this respect, it collects and summarises information so that it is able to issue the notifications and information stipulated by these conventions dealing with information of third-party countries in the event of a radiological emergency. This information is forwarded to the international organisations (IAEA and European Union).

F.5.2.2 The ASN's nuclear safety preparedness

F.5.2.2.1 The various action entities

In the event of an incident or accident occurring in a BNI, the DGSNR with the technical support of the IRSN and the nuclear safety and radiation protection departments of the DRIREs, sets up the following organisation:

F.5.2.2.1.1 At the national level:

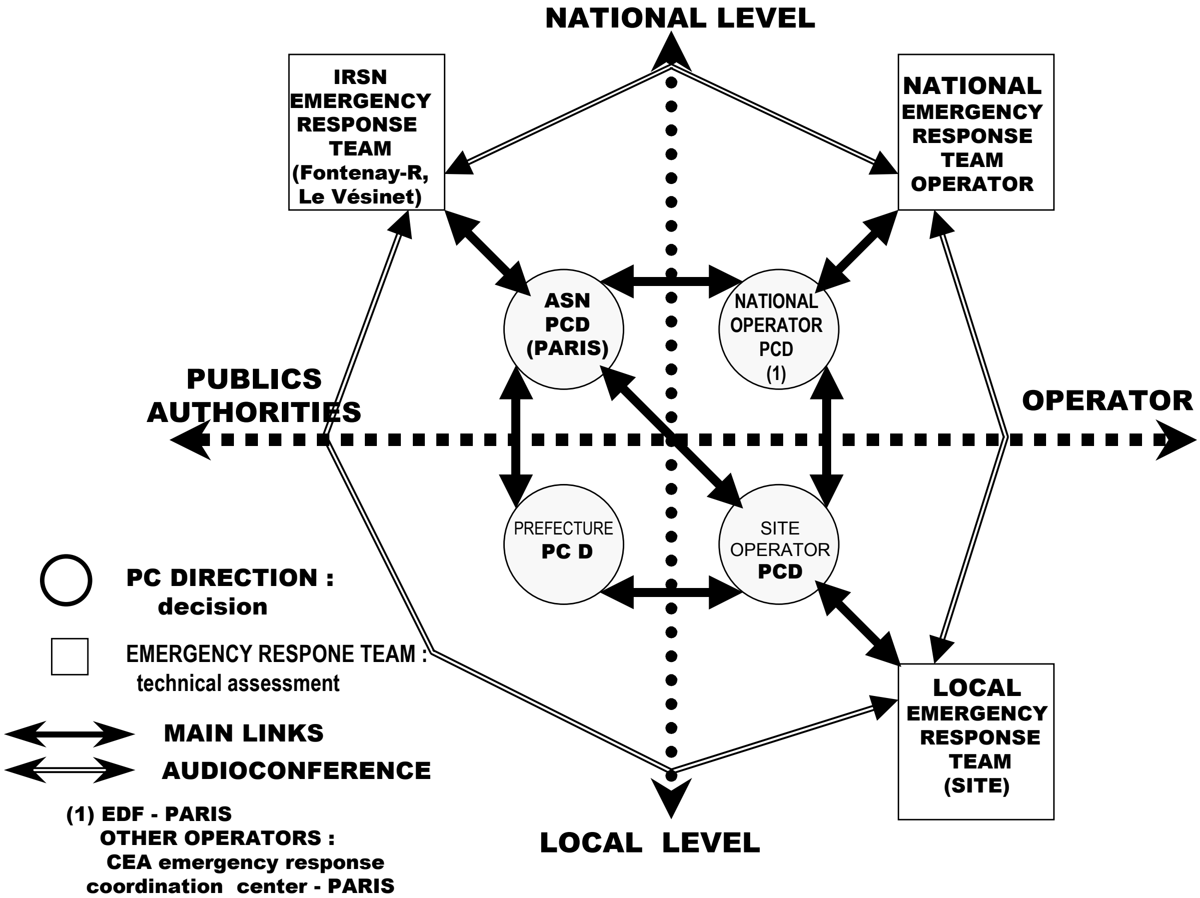
- a decision-making or command centre (called PCD DGSNR Paris), located in the ASN's nuclear emergency response centre. This command centre is headed by the director of the DGSNR or his representative. Its purpose is to adopt positions and take decisions, but not to effect a technical analysis of the accident in progress.
- a communication structure placed close to the PCD of the DGSNR, run by the director of the DGSNR, or his representative, who has the role of spokesperson, distinct from that of head of the PCD;
- a technical team run by the Director General of the IRSN or his representative. This team is present in the IRSN's technical emergency response centre (CTC) located in the Fontenay-aux-Roses nuclear engineering facility. This team must work in close collaboration with the operator's technical teams, in order to reach agreement on an analysis of the accident situation and anticipate how it will develop and what its consequences are likely to be.

F.5.2.2.1.2 At the local level:

- a local task force reporting to the Prefect, primarily comprising representatives from the DRIRE, the role of which is to assist the Prefect in his decisions and his communications, by providing him with explanations of use for technical understanding of the phenomena involved, in close collaboration with the PCD of the DGSNR;
- a local task force on the site on which the accident occurred, also consisting of DRIRE representatives along with those of the DGSNR and IRSN if necessary, reporting to the head of the site PCD. The role of this task force is, without taking part in the operator's decisions, to ensure that it assumes its responsibilities in full and in particular that it correctly informs the public authorities. This role of this local task force is also to collect all information of use to the inquiry that will follow the accident.
- an IRSN representative takes charge of the measurements unit in the operational command post (PCO) in order to coordinate the radioactivity measurements from the field. The measurements organisation is defined in an interministerial directive updated in 2005.

The DGSNR and the IRSN have signed agreements with the main nuclear operators concerning the setting up of the emergency response organisation. These agreements designate those in charge in the event of an emergency and define their respective roles and means of communication.

The following diagram gives an overview of the planned safety organisation, together with the prefecture and the operator. It shows that the operator has a local management command centre (PC) on the site, and a national management command centre in Paris, each in contact with its own technical emergency response team. The various links shown on this diagram represent the exchange of information streams.



In addition, an organisation following the same pattern is set up between the communication units and the spokespersons in the command centres, to ensure that the information sent out to the public and the media is consistent.

F.5.2.2.2 The DGSNR emergency response centre

To ensure the success of its duties, the DGSNR has its own emergency response centre, equipped with communication and IT tools enabling it:

- to alert ASN officers rapidly;
- to exchange information in reliable conditions with its numerous contacts.

This emergency response centre was used in a real situation for the first time on 28 and 29 December 1999 during the incident which occurred in the Blayais nuclear power plant, following the severe storm of 27 December 1999. It was again called into action on 2 and 3 December 2003 during the violent storms in the Rhone valley, which led the Cruas plant to trigger its on-site emergency plan and alert the ASN. During these same two days, the Tricastin NPP and the Tricastin operational hot unit (BCOT) also triggered their PUI. Finally, on 16 May 2004, the DGSNR activated its emergency response centre following a fire in a non-nuclear zone of the Cattenom nuclear power plant (Moselle).

F.5.2.2.3 The alert system

The ASN's alert system allows rapid mobilisation of DGSNR and DSNR personnel and the IRSN's duty engineer. This automatic system sends an alert signal via pager or telephone to all personnel equipped either with an appropriate terminal or a mobile phone, as soon as it is remote-triggered by the operator of the nuclear facility initiating the alert. It also contacts personnel at the DDSC, SGDN and Météo-France.

F.5.2.2.4 Telecommunication networks

In addition to the public telephone network, the emergency response centre is connected to a number of independent restricted access networks and has a direct line to the main nuclear sites. The PCD DGSNR also has a video-conferencing system primarily used with the IRSN's emergency centre. The PCD DGSNR also employs IT equipment appropriate to its duties.

F.5.2.3 Role and organisation of the operators in an emergency situation

F.5.2.3.1 General principles

The operator's emergency response organisation is designed to support the operations team in the event of an accident and performs the following roles:

- on the site, triggers the on-site emergency plan (PUI);
- off the site, mobilises accident experts from the national emergency response teams (ENC), to help the site managers;
- informs the public authorities which can, depending on the gravity of the situation, trigger the offsite emergency plan (PPI).

F.5.2.3.2 Special role and organisation of EDF

At the national level, a management team is in permanent contact with the plant manager and with the public authorities. A communication unit ensures that communications with the press and the public are reliable, rapid and continuous.

The organisation deployed, under application of the PUI, replaces the normal operating organisation, in order to deal with the specific obligations of this type of situation.

In the event of an incident in a nuclear power plant, the emergency response organisation is based on:

- a clear definition of the goals, according to the main possible situation categories;
- a precise distribution of duties and responsibilities to ensure that these goals are met;
- operating instructions giving each person a description of his or her contribution to the collective role of his or her command centre;
- mobilisation of the appropriate skills, in other words trained and experienced personnel;
- available and operational equipment for mobilisation of the company's personnel (power plant and national staff levels), alerting external players, and communication between the various networks.

The planned EDF organisation comprises a local level and a national level. This organisation is structured into teams (or command centres) to cover the four main areas to be dealt with (assessment - decision - communication - action).

The PUI safety and radiological situations are situations in which the safety of the facilities is significantly affected and/or situations in which there is a risk of a release of activity within the facilities or into the environment and likely to lead to exposure of the persons working outside the controlled zone or of the neighbouring populations.

The criteria for triggering a safety and radiological PUI are given in the operating instructions, the site protection instructions (aircraft crash onto the reactor building or fuel building) and the radiation protection monitoring panel alarm sheets. The organisation deployed in the event of a safety and radiological PUI is an umbrella organisation, in that it is able to deal with the consequences linked to conventional hazards (fire, personal injury, etc.), as well as the radiological consequences, whether real or simply potential.

Triggering the PUI is the responsibility of the manager on call, the unit director or his representative. Nonetheless, a delegation system exists in the event of problems in reaching the local PCD manager on call.

F.5.2.4 The role of the ASN in preparing for emergency situations

F.5.2.4.1 Approval and monitoring of implementation of the PUI

Since January 1994, the on-site emergency plan, in the same way as the safety analysis report and the general operating rules, has been part of the safety documents the operator is required to submit to the ASN at least 6 months prior to use of radioactive materials in the basic nuclear installation. In this context, the PUI is analysed by the IRSN and submitted to the Advisory Committee of experts concerned for its opinion.

The DSNR of the DRIREs is responsible for updating the PUIs in the following way:

- if the BNI authorisation decree stipulates PUI approval, the PUI update cannot be applied by the operator until ministerial approval is obtained; the DGSNR has defined a procedure for rapid issue of such approval (about 3 months), after prior analysis by the IRSN of those points felt to be essential;
- in the other cases, the updated PUI is immediately applicable but must be communicated to the DGSNR which can issue any observations it feels necessary.

Processing of PUI updates is entrusted to the nuclear safety and radiation protection divisions of the DRIREs.
Finally, correct implementation of the on-site emergency plans is checked by the ASN during inspections.

F.5.2.4.2 Participation in production of the PPI

Under application of the decree of 6 June 1988 concerning emergency response plans, the Prefect is responsible for drawing up and approving the offsite emergency plan (PPI). The DGSNR and the DRIRE concerned assist the Prefect by providing him with technical data based on the analysis conducted by the IRSN and taking account of the latest information concerning serious accidents and radioactive material dispersal phenomena, and ensuring consistency on this subject between the PPIs and the PUIs.

This led in recent years to a considerable amount of work to incorporate a reflex response phase in the PPIs. The ASN thus approved rapid development accident scenarios defined by the operators, and likely to lead to discharges into the environment in less than 6 hours, requiring measures to protect the population with reference to the response levels defined in the regulations.

F.5.2.4.3 Emergency drills

One should not wait for a significant accident to occur in France before testing in real conditions the preparedness previously described. Drills are therefore regularly organised, both to train the emergency response teams and test the resources and organisations in order to identify any problem areas.

In this way, emergency response drills are a way of testing the organisations set up, of training the teams in analysing, acting, co-ordinating and communicating, and constantly improving whenever possible. They are also an opportunity for disseminating information about the nuclear industry and hazard control.

F.5.2.4.3.1 Drills involving the ASN

F.5.2.4.3.1.1 Alert tests and mobilisation drills

The DGSNR carries out regular tests to check the correct working of the system to alert its personnel and those of the DRIRE DSNRs, during the national emergency drills mentioned below. Unannounced tests may also be organised.

F.5.2.4.3.1.2 National nuclear emergency drills

Carrying on from previous years, the ASN has prepared a programme of national nuclear emergency drills for 2005. The Prefects were notified by a circular jointly signed by the DGSNR, the DSND (Defence Nuclear Safety and Radiation Protection Delegate), the DDSC and the SGDN.

About ten of these national drills are organised every year and involve the public authorities, the operators and the technical support entities. Each drill is analysed with the various participants, leading to enhancement of experience feedback. There are two types of drills:

- primarily "nuclear safety" drills, which do not imply any real involvement by the population and mainly used to test the decision-making processes based on a completely free technical scenario;
- primarily "civil security" drills, involving actual implementation on a significant scale of the population protection counter-measures stipulated in the PPI (alert, shelter, evacuation), based on a technical scenario built around predetermined criteria for the population.

During these drills, simulated media pressure, which is varied according to the circumstances to reflect the actual pressure exerted by the "real" media, is placed on the main parties involved in the drills in order to test their ability to communicate.

Apart from the national drills, conducted on average once every 3 years on each nuclear site, the Prefects are asked to conduct local drills with the sites concerned in order to improve preparation for emergency situations.

F.5.2.4.4 Lessons learned from the drills

Numerous lessons can be learned from the drills, some of which recur from one drill to another. Each drill is therefore subject to a thorough assessment, concluding with a national general assessment meeting held one to two months after the drill. In addition, a variety of observers (civil servants, delegates from neighbouring countries, qualified personalities) offer a supplementary and sometimes original view of the drills.

F.5.2.4.4.1 Evolution of nuclear emergency management

In the same way as the other fields of nuclear safety, emergency preparedness has to evolve in line with acquired experience. The main sources of experience in France are the drills and exchanges with foreign countries, along with certain significant events in France (incident of 12 May 1998 on the Civaux 1 reactor, severe storm on 27 December 1999, storms of 2 and 3 December 2003 in the lower Rhone valley) or abroad (Tokai-Mura accident on 30 September 1999).

F.5.2.4.4.1.1 Experience feedback from the storms of 2 and 3 December 2003 in the Rhone valley

On 30 January 2004, the ASN organised an experience feedback meeting on the storms of 2 and 3 December 2003 in the lower Rhone valley. Following this meeting, a "meteorology and hydrology" working group was created.

The ASN concluded that it would be best to take advantage of the existing hydrology information channels, strengthening links with the central hydrometeorology and flood prediction service (SCHAPI) at the Water Directorate of the Ministry for Ecology and Sustainable Development, as well as any future flood prediction services.

F.5.2.4.4.1.2 *Revision of the nuclear PPIs*

The revision of the nuclear PPIs, announced by the interministerial circular of 10 March 2000 is now almost complete.

The main innovations introduced by this circular are the following: creation of a reflex phase; restricting initiation of the PPI in reflex or concerted mode to only those cases in which measures to protect the population need to be taken.

Finally, revision of these PPIs was an opportunity to develop information of the public and elected members, in particular through the local information committees (CLI).

F.5.2.4.4.1.3 *Stable iodine preventive distribution*

In the event of substantial accidental discharge from a nuclear reactor, provision has been made for the absorption of stable iodine tablets by populations in the vicinity of the site concerned, with a view to providing thyroid protection against the harmful effects of radioactive iodine. Up until 1997, emergency plans provided for distribution of tablets, in the event of an accident, from concentrated stocks, generally stored on or near the nuclear sites. The first accident drill sessions (1995 and 1996), which included the actual distribution of dummy tablets, in an emergency context, soon showed the difficulties involved. Apart from time considerations, this method was intrinsically contradictory: the population was asked to take shelter immediately, while at the same time emergency teams were carrying out urgent door-to-door distribution of tablets. In April 1996, the Secretary of State for Health announced that it was intended to distribute stable iodine tablets preventively to populations living in the vicinity of nuclear power plants. Once the technical and administrative aspects of this operation had been settled, the Prime Minister confirmed this announcement by the instructions of 10 April 1997.

After completion of the preventive distribution of tablets, the drill sessions revealed the necessity for further improvements in this respect. Moreover, the shelf-life of the tablets distributed in 1997 was 3 years. Under these conditions, another preventive distribution of stable iodine tablets took place in 2000 under the same conditions as in 1997, but with the shelf-life of the tablets extended to 5 years.

At the end of this new distribution campaign, about 50% of those living near the nuclear installations had iodine tablets at home. With a level as low as this, the population protection measure involving sheltering and absorption of iodine is not applicable, which, even in the event of a low discharge forecast, would require an unjustified emergency evacuation of the population. The objective of the distribution campaign is consequently not achieved.

By a circular of 14 November 2001, the government consequently decided to supplement the iodine distribution within the radius of the PPIs by asking the Prefects to use more efficient methods, such as door-to-door distribution. In a circular dated 7 October 2003, the DGSNR also began a survey of the prefectures and the DDASS to obtain a more precise assessment of the new iodine distribution campaign within the radius of the PPIs. The replies are currently being studied, but it is already clear that the new distribution methods have brought the iodine coverage of the populations up to over 80%.

A new stable iodine pre-distribution campaign was launched in 2005.

Moreover, given the terrorist context prevailing at the time, the Government also asked the Prefects, in a second part of the circular of 14 November 2001, to prepare for stockpiling to be organised in each *département*, so as to cover the entire country. To create these stocks, the Ministry for Health ordered 60 million tablets from armed forces central pharmaceutical supplies. Tablet delivery began in 2002 and by the end of 2004 was nearing completion (60 million tablets had been manufactured and 56 million delivered to the *département*s). A circular dated 23 December 2002 provides the Prefects with a guide for drawing up stable iodine tablet stock management plans. These plans are currently being drawn up by the prefectures.

F.5.2.4.4.1.4 Emergency response to a radioactive materials transport accident

In the event of a shipment accident occurring in France and leading to triggering of a radioactive materials shipment special emergency response plan (PSS-TMR), the ASN has the same duties as during an accident in a BNI. However, its operator monitoring duties are then applied to the consignor, the shipper of the packages involved and possibly the transport forwarding agent.

The ASN's response relies mainly on local bodies: the DRIREs and in particular the DSNRs, whether located in the Region or in a neighbouring Region.

Together with the DRIREs, the ASN is monitoring the PSS-TMRs revision work initiated by circular for Prefects NOR/INT/E/00008/C of 23 January 2004, revising the PSS-TMRs. The DGSNR took part in drafting this circular.

Furthermore, in order to make progress in emergency situation management in the event of a transport accident, a "transport" drill involving the Chinon plant as consignor, COGEMA Logistics as carriage commission agent, SNCF as carrier and all the public authorities, in particular the prefecture of Indre-et-Loire, which was the *département* concerned, was carried out on 30 September 2004.

A transport and civil security drill will be held in September 2005, concerning the Val d'Oise *département*.

F.5.2.4.4.1.5 Post-accident management

A nuclear plant accident can have immediate consequences due to significant release levels, requiring fast, efficient response within the framework of the emergency plans. There are also various other post-accident consequences (economic, health-related, social), which have to be dealt with in the medium or even long term, with a view to returning to a situation deemed normal.

Since the "Becquerel" drill carried out in October 1996 around the Saclay site, several inter-ministerial working parties have been set up for the purpose of defining the way in which the various post-accident problems should be dealt with. The interministerial directive of 7 April 2005 tasked the ASN with coordination of post-accident phase management. It will therefore in 2005 be setting up a structure in charge of establishing national doctrine on this subject, in particular relying on French and international experience.

F.5.3 Emergency preparedness for non-BNI accidents

The ASN is currently overseeing inter-ministerial work leading to the publication of a circular intended for the Prefects and concerning the response to a non-BNI radiological emergency. This response will be the respective responsibility of the mayor or the Prefect of the *département* concerned and the head of the establishment in which the accident takes place.

F.5.3.1 Preparedness for radiation accidents in ICPEs or mines

F.5.3.1.1 General requirements

In the case of facilities subject to licensing, regulation of the ICPEs requires that a hazards study be conducted. The hazards study must comprise:

- a list of the potential hazards posed by the facility in the event of an accident, with a description of the accidents likely to occur, whether of internal or external origin. The nature and scale of the possible consequences of an accident must also be described;
- a presentation of the measures such as to reduce the probability and effects of an accident;
- a precise presentation of the nature and preparedness of the private emergency response resources available to the licence applicant, or to which it will have certain access in order to

counter the effects of a possible incident or accident in view of the public emergency response resources of which it is aware.

- for installations likely to cause major hazards, the data needed by the Prefect to draw up an off-site emergency plan.

Hazards studies are tools for guiding safety investments and lead to definition of on-site and off-site emergency plans. These studies also allow definition of the perimeters to be used in town planning documents.

The content of the hazards study must be proportional to the scale of the hazards of the facility and the foreseeable consequences of an incident or accident on the environment as a whole. In the case of installations subject to declaration, the nature of the hazards means that there is no point in conducting a hazards study and generally implies the absence of special provisions for management of accident situations. The Prefect sets the technical specifications to be met on the basis of standard orders. Through a special order issued in the light of the classified installations inspectorate report, the Prefect may reinforce the general requirements should they appear insufficient.

F.5.3.1.2 The case of mines

The large mining companies such as HBL and Potasses d'Alsace have formed groupings such as DICAMINE to organise emergency plans tailored to a response in deep mine workings, jointly with the civil security services and fire-fighting services. Their scope of action covers all types of serious incidents and major accidents involving human safety.

However, in this field of activity, radioactive accidents are not the most important.

F.5.3.2 Response to a radiological hazard

In the case of an uncontrolled event likely to cause a radiological hazard due to present or past nuclear activity on a private site (plant, laboratory, hospital, residence, land) or a public area, it is necessary to take steps to halt all risk of human exposure to ionising radiation. In these situations, responsibility for implementing the protective measures lies with the owner of the site, with regard to the safety of the persons on the site, and with the Prefect with regard to the safety of persons in the public domain. The ASN's role is to supervise the owner and advise the Prefect regarding the steps to be taken to prevent or mitigate the effects of radiation on persons and on the environment.

The response comprises two phases: safety and then clean-up. Ensuring human and environmental safety, under the responsibility of the Prefect advised by the ASN or the responsibility of the owner, supervised by the ASN, includes first aid, marking out of the zone, containment of the radioactive sources and communication. The purpose of clean-up is to return to a normal situation in particular by removing the sources to a duly authorised facility. This may require use of the expertise of the IRSN or other body.

F.6 Decommissioning (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 BNIs

The regulations do not stipulate dismantling as soon as is reasonably feasible. However, the operator is asked to justify that the strategy proposed is the best one in terms of safety and radiation protection.

The ASN is in favour of immediate dismantling for various reasons such as loss of familiarity with the design and operation of the installation, the minimal advantage gained from radioactive decay, or the risk of equipment obsolescence. All operators in charge of a dismantling operation currently apply this policy.

After their operating period, BNIs undergo a series of clean-up and conversion operations such as to enable them to be finally shutdown and then dismantled. The work done will, depending on the final status of the installation, lead administratively either to the creation of a new BNI, or to decommissioning from a BNI to an ICPE subject to licence or declaration, or even a return to the public domain, subject to appropriate constraints.

The experience accumulated with the initial dismantling operations, mainly on small installations (pilot facilities, research reactors) led in 1990 to clarification of the regulatory framework governing the end of a BNI's life. The current texts require the operator to give thought to the future of its installation and then to the organisation of the steps involved in final shutdown and dismantling. The aim is to ensure that the safety status of the installation is satisfactory at all times, even after operations have ceased, taking account of the specific nature of dismantling.

The first steps lead to removal of the fuel or nuclear materials present in the installation, which already helps reduce the risk from the nuclear safety viewpoint. This is then replaced by risks linked to radiation protection of persons and conventional safety owing to operations close to residual nuclear material and the numerous waste removal handling operations generated by dismantling.

The Nuclear Safety Authority (ASN) now strives to integrate relevant experience feedback from past dismantling projects in France and abroad. The ASN aims to encourage complete dismantling either immediately or after slight postponement, provided that upstream of launch of the regulatory procedures, the operator is able to present and justify the chosen dismantling scenario, from the final cessation of production up to final dismantling of the installation. Regulatory practices concerning BNI dismantling operations were updated along these lines in early 2003.

The ASN considers that the current dismantling operations should be exemplary. They are an opportunity for the operators to define and implement a dismantling strategy on the one hand (level of dismantling to be attained, schedule of operations) and a management policy for the large quantity of radioactive waste generated (in particular very low level), on the other. If seen through to completion, they should also be demonstrations of the technical and financial feasibility of complete dismantling.

The technical provisions applicable to the installations to be finally shut down must obviously comply with the general safety rules, particularly with regard to external and internal exposure of the workers to ionising radiation, to criticality, to production of radioactive waste, to the discharge of effluents into the environment and to measures to reduce the risks of accidents and minimise their effects.

Safety issues, in other words protection of persons and the environment, can be significant, during clean-up or dismantling operations, as well as during passive surveillance phases. The rapidly changing nature of the installation is a non-negligible risk factor in that it is harder than for an operating installation to guarantee that all potential risks have been consistently and exhaustively taken into account.

The risks linked to waste management (radioactive waste disposed of inappropriately in a conventional channel, etc.) are present throughout all phases producing large quantities or a wide variety of waste.

As dismantling proceeds, the risks identified during operation of the installation, primarily linked to the radioactive nature of the materials handled, are gradually replaced by risks more linked to radiation protection and conventional safety (dismantling requires that the workers go into areas they were not used to visiting during operation) or risks linked to the technologies used for dismantling and cutting the structures (often involving hot points with the concurrent risk of fire or explosion). The risks linked to the problem of the stability of partially dismantled structures must also be taken into account, along with those linked to the obsolescence of the equipment (in particular concerning the possibility of fires breaking out in ageing electrical installations).

For complex nuclear installations, dismantling work often lasts more than a decade, frequently coming after several decades of operation. There is thus a considerable risk linked to loss of familiarity with the design and operation of the installation, especially when the former operators leave the installation, and it is vital to be able to collect and record the recollections of the persons involved in these phases, all the more so as the traceability of the design and operation of old installations is frequently less than rigorous.

With each subsequent phase in dismantling, arises the question of the surveillance of the installation being at all times appropriate to its state and the risks entailed. It is often necessary to replace the in-service means of surveillance with other (radiological, fire) more appropriate means, either temporarily or more permanently. As it is hard to constantly check that surveillance is appropriate to the constantly changing state of the installation, there is a risk of failure to detect an incipient hazardous situation.

Once the final installation state is reached, there is still the risk of pollution being inadequately or not at all identified or poorly characterised, having a significant long-term impact on the site or its environment.

The dismantling scenario (immediate or deferred) is selected by the operator on a case by case basis, generally in the light of comparative studies.

Similarly, the various technical provisions chosen for each stage in dismantling of a nuclear installation are chosen by the operator on a case by case basis. However, to avoid splitting up the dismantling projects and to improve overall consistency, the ASN asks that as of final shutdown of an installation, a file be submitted, explicitly presenting all the various works envisaged from final shutdown to attainment of the target final state, and demonstrating at each step the nature and scale of the risk presented by the installation and the steps taken to control it.

Finally, in the current context regarding management of industrial sites being dismantled, it would seem necessary in most cases that there be a means of preserving the memory of the past existence of a basic nuclear installation on a site, along with any utilisation restrictions corresponding to the condition of the site.

The ASN specified the regulatory framework for BNI dismantling operations in a note signed on 17 February 2003, following extensive work to clarify and simplify the administrative procedures, while improving the extent to which safety and radiation protection are taken into account.

New practical measures for application of article 6 ter of the amended decree of 11 December 1963 are now in place in order to:

- clarify the definition of the leading technical and administrative stages in dismantling to ensure that it is better tailored to the diversity of nuclear installations ;
- encourage complete dismantling initiated either immediately or after slight deferral;
- encourage presentation and justification by the operator of the dismantling scenario chosen, ahead of initiation of the regulatory procedures, from the decision to cease operations up to complete dismantling;
- clarify the administrative notion of downgrading of a basic nuclear installation and the related criteria.

This revision leads to a clearer definition of the two main phases in the life of an installation, each of which is associated with a single authorisation decree, the authorisation decree for the operating phase and the final shutdown and dismantling decree for the dismantling phase. This creates a more balanced picture, both technically and administratively, between the importance given to the dismantling phase and that given to the operating phase.

F.6.2 Measures taken by BNI operators

F.6.2.1 Clean-up and dismantling of CEA facilities

The CEA has set up a proactive strategy consisting of rapid dismantling of shut down facilities, which can be summarised as follows:

- initiate radioactive clean-up as of final shutdown of the facility, then continue with dismantling to a level corresponding to IAEA level 3, excluding civil engineering work;
- entrust project management to specialised companies (for example COGEMA);
- complete dismantling of the facilities and radioactive clean-up of the Fontenay-aux-Roses research centre in 2010 and that in Grenoble in 2015.

The number of facilities to be dealt with, about thirty during the decade 2001–2010, makes the programme a very large one, with the total cost of the works being estimated by the CEA at some €5 bn. To cover this, a dedicated fund controlled by the supervisory authorities was set up in 2002, and it releases about €140 m to these operations per year for the first few years.

The variety of facilities to be cleaned up limits the transferability of experience from one facility to the next. The age of the design, sometimes combined with how long ago shutdown took place (for example, ELAN IIB at La Hague, where operations are resumed in 2002, was finally shut down in 1973), can slow down and complicate the methodological approach. This is why, for the past ten years or so, a facility can only enter the final shutdown phase once its operators have restored it to good order and have completed transmission of information to the new team which is to prepare dismantling.

The lack of certain disposal solutions or treatment facilities for certain waste produced by dismantling (special waste such as oils, solvents, graphite or sodium) is also an obstacle to these operations, even if important channels such as that for disposal of VLL waste have been set up.

F.6.2.2 Measures taken by COGEMA

Financial reserves intended for dismantling and waste management operations are defined jointly with the supervisory Authority and regularly created on a prorata time basis until expiry of the contracts in the portfolio. The cost of dismantling of industrial units in the back end of the fuel cycle by AREVA is currently estimated, including management of "legacy" waste, at about €4 bn. As most of COGEMA's capital is institutional (see. § F.2.2.3) the long-term nature of the human and financial resources for decommissioning the facilities is guaranteed through investment of the corresponding sums in a dedicated fund that is managed completely independently of the company's own economic activity.

The provisions concerning radiation protection and monitoring of discharges apply to all activities within the facilities, without exception. The discharge permits in particular are granted for each site as a whole. The decommissioning activities are thus by definition subject to these provisions. If some operations lead to discharge levels higher than during the operation of the facility, or of a different type, then a supplementary discharge permit must be obtained.

The provisions concerning emergency preparedness are also applicable during the decommissioning phase. The periodic review of these provisions, subject to approval by the Nuclear Safety Authority, enables them to be adapted to particular decommissioning situations if necessary.

Application of quality assurance requirements to facility design and modification activities as well as to operation demands stringent traceability of all sizing, design and construction documents and of all events concerning these facilities. Measures are taken to ensure that the corresponding archives are conserved (back-up, redundancy, etc.).

With regard to experience feedback, although no COGEMA facility has yet been decommissioned in the administrative sense of the term on the La Hague site, many parts of workshops have undergone significant process modifications, requiring complete clean-up of the premises in which the new equipment was installed. This is for example the case with the plutonium building in the UP2-400, MAPu plant, in which the purification and conversion processes have been overhauled once and the conditioning process overhauled twice.

Furthermore, the ELAN IIB (industrial unit for production of radioisotopes) and AT1 (pilot reprocessing plant for fast reactor spent fuel reprocessing) plants, both located in the La Hague site, are currently being decommissioned, with AT1 having reached total clean-up level (no more radiological constraints). Although these are facilities which belong to the CEA, with decommissioning operations being performed by CEA personnel, COGEMA is involved as the nuclear operator of the site. The experience feedback from decommissioning of these facilities could be put to good use when subsequently decommissioning COGEMA facilities.

F.6.2.3 Measures taken by EDF

There are a total of eight first-generation EDF reactors, today all shut down:

- 6 natural uranium/gas-graphite technology reactors (GGR) in Chinon, Saint-Laurent and Bugey;
- the Brennilis heavy water reactor, built and operated jointly with the CEA;
- the PWR reactor at Chooz A.

To these eight reactors can be added the Superphénix fast neutron reactor at Creys-Malville, today shut down.

Until very recently, the generic strategy chosen by EDF was that of immediate level 2 dismantling of its power reactors. This strategy mainly consists in extracting the fissile material, removing the easily dismantled parts, minimising the containment zone and reorganising the external barrier. Complete dismantling, referred to as level 3, was envisaged after several decades of containment, to take advantage of the natural decay in radioactivity. This type of approach can however have drawbacks. It can in particular lead to a gradual loss of knowledge about the facility, as operators depart, which can be prejudicial to the dismantling operations. The ASN wanted EDF to take another look at this strategy and assess the feasibility of reducing the time taken to initiate work able to lead to complete dismantling.

After an initial evaluation submitted to the ASN in November 1999, EDF decided to revise its strategy for the Brennilis reactor, by undertaking to finish dismantling of the reactor rapidly, after completion of the partial dismantling currently in progress.

In January 2001, EDF chose to adopt a new dismantling strategy for all its nuclear facilities which have been finally shut down (Brennilis, Bugey 1, Saint-Laurent A, Chinon A, Chooz A and Superphénix), based on level 3 dismantling of the reactors in advance without the waiting period. This new strategy provides for complete dismantling of the reactors by the year 2025. The corresponding human and financial resources were mentioned earlier in F.2.

When combined with the creation of an engineering unit devoted to deconstruction of the facilities, these measures guarantee that the resources are adequate, that the documentation is traced and conserved and that these operations can be carried out in good conditions.

F.6.3 Analysis by the ASN

The implementation in more than twenty cases of the regulatory framework stipulated in 1990 for final shutdown and dismantling of basic nuclear installations has highlighted the need for adaptation. The current procedure covering decommissioning of BNIs is cumbersome and has a number of undesirable effects. It encourages the operators to split up the dismantling projects, which can only impede overall project consistency. It also mainly deals with power reactors and takes little account of the specific nature of laboratories and factories.

Thought is being given to this subject by the ASN, which will lead to a 2003 revision of the currently applicable texts (see § E.2.2.4.6).

The coming years will be put to good use for an in-depth analysis of the dismantling strategies and scenarios proposed by the operators. In particular, following the ASN's requests, technical-economic analyses initiated by EDF led it to make a significant change in its dismantling strategy, by opting for complete dismantling of its first-generation reactors, without a waiting period. Consequently, the ASN asked for summary documents presenting EDF's general view concerning the dismantling of its 9 reactors, along with the corresponding technical back-ups (safety of each installation, management of corresponding waste, in particular graphite, organisation in place, maintaining levels of competence, description of the targeted final status). These documents will be submitted to the Advisory Committee of experts for laboratories and factories for examination.

With regard to the CEA's installations, the same approach will be applied: a comprehensive dossier on complete dismantling of the CEA's installations is expected I by end of 2005 and will be submitted to the Advisory Committee of experts for laboratories and factories for examination.

Finally, COGEMA will soon be presenting its position regarding the schedule of dismantling operations it envisages for the UP 2-400 plant on the La Hague site in the coming years.

F.6.4 The case of ICPEs and mines

F.6.4.1 The case of ICPEs

The conditions for clean-up of a site after the end of operation of an installation classified on environmental protection grounds, can be included in the authorisation decree. In the case of facilities subject to declaration, the conditions for cleaning up the site after operation must be specified in the impact assessment supplied when the declaration is submitted.

When activities cease, the ICPE regulations stipulate that the operator must give the Prefect at least one month's notice of the end of operations. In the case of waste storage facilities, licensed for a limited period, notice must be given at least six months before the licence expiry date.
For installations subject to declaration, notice must indicate the site clean-up measures taken or envisaged.

For installations requiring a licence, the operator must enclose with the notification a dossier comprising the up-to-date plan of the land within the facility perimeter, and a memorandum on the site status, which must specify the environmental protection measures taken or planned.

This memorandum covers:

- removal or disposal of the hazardous products and waste present on the site;
- depollution of the facility site and any polluted underground water;
- landscaping of the facility site into its environment;
- as necessary, monitoring of the impact of the facility on its 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 clean-up work has not been included in the authorisation order or requires clarification, the ICPE inspectorate may suggest that the Prefect issue a supplementary order setting the requirements for clean-up of the site.

The Prefect must be informed of performance of the clean-up work as stipulated in the authorisation order or any supplementary decree. The ICPE inspector confirms the conformity of the work in a report.

If the ownership of the land is transferred, the buyer must be informed that an ICPE subject to licensing had been operated on the land and must be informed of any pollution problems that could remain on the site.

F.6.4.2 The case of mines

The end of a mining operation is marked by a dual procedure: declaration of the final cessation of work which is subject to the authority of the Prefect, and renunciation of the concession as declared by the Minister with responsibility for mines. The purpose of these procedures is to release the operator from the jurisdiction of the mining police, provided that it has met all its obligations.

However, even if notification of the cessation of works and then renunciation of the concession means that the operator is no longer subject to the jurisdiction of the special mining police, the third party liability of the operators and concession-holders is however permanent. Since the law of 30 March 1999, with regard to disappearance or defaulting of the party responsible, the State is guarantor for reparation of damages and henceforth takes the place of the party responsible in all legal action taken by the victims.

Notification of the cessation of mining of radioactive substances usually (COGEMA concessions in Haute Vienne or in the Loire) required that the operator exercise surveillance of all parameters stipulated during the operation. Given that the maximum limits were not reached for several months, additional orders, in particular for the COGEMA sites in Haute Vienne, superseded the surveillance requirements. For the Bois Noirs mine, as most of the radioactive pollution hazard originated from ICPEs, the mining police orders merely accompany the orders relative to ICPEs, given the interconnection of certain installations, including water treatment facilities.

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 steps to ensure that at 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 steps to:

- *i) ensure that criticality and removal of residual heat generated during spent fuel management are adequately addressed;*
- *ii) ensure that the generation of radioactive waste associated with spent fuel management is kept to the minimum practicable, consistent with the type of fuel cycle policy adopted;*
- *iii) take into account interdependencies among the different steps in spent fuel 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 spent fuel management;*
- *vi) strive to avoid actions that impose reasonably predictable impacts on future generations greater than those permitted for the current generation;*
- *vii) aim to avoid imposing undue burdens on future generations.*

G.1.1 Requirements of the Nuclear Safety Authority

In France, any spent fuel management facility is a BNI or part of a BNI. The various fuel management facilities are therefore subject to the general safety provisions in force, which were described in detail in section E.2.2. Article 3 of decree 63-1228 of December 11 1963 states that the operator must "submit a safety analysis report containing a description of the facility and the operations to be performed in it, the inventory of hazards of whatsoever origin that it entails, an analysis of the measures taken to prevent these hazards and the measures such as to reduce the probability and effects of accidents". These analyses in particular cover criticality, removal of residual heat, protection of individuals, chemical and biological hazards and minimising the generation of waste.

In order to improve the performance of its reactors in operation, EDF asks the Nuclear Safety Authority (ASN) for authorisation to use new management procedures for the fuel assemblies loaded into the reactors.

As the overall prime contractor, EDF must be familiar with the technical and administrative constraints of the fuel cycle, so that sufficiently in advance it is ready to deal with the interdependencies between the various steps: processing of the materials to be employed, fuel fabrication, loading into the reactor, transport of materials, removal of spent fuel, delivery and storage, reprocessing if applicable, effluent discharge, waste management.

The ASN checks that these fuel changes are consistent with the texts applicable to the fuel cycle installations and transportation of radioactive and fissile materials: the facility authorisation decrees, the liquid and gaseous discharge and water intake permits, the technical specifications and the radioactive materials transportation regulations.

As it is impossible to guarantee "preventing all impact on future generations", the Convention proposes a formula, which is to "strive to avoid actions that impose reasonably predictable impacts on future generations greater than those permitted for the current generation", or "aim to avoid imposing undue burdens on future generations".

In this sense, and for all types of activities, the regulations set the same radiation protection requirements for future generations through the use of conservative scenarios.

The predictable impacts on future generations are covered by systems of transfer of responsibility for the cost of managing waste and spent fuel.

Siting, technologies and processes are the responsibility of the operators. The ASN examines whether these choices lead to an acceptable level of safety in the light of the regulations and the objective of risk reduction. The operator must demonstrate that these choices are acceptable in terms of safety and that no other option would be safer.

The role of the ASN is to assess the safety studies for the facilities at the various stages in their operation by examining the documents supplied and through inspections

G.1.2 Safety policy of the BNI operators

G.1.2.1 Safety policy of CEA + ILL

The CEA's research activities lead it to operate 43 civilian basic nuclear installations (BNI) of various types: research reactors, research and evaluation laboratories, facilities related to management of effluents and waste (including storage), and facilities currently being cleaned-up and dismantled.

Smooth running of the activities in the facilities requires perfect control of safety, consisting in preventing the dispersal of radioactive materials and limiting worker exposure to radiation. To ensure this, a succession of lines of defence, comprising both physical barriers (equipment, containments, etc.) and organisational means (inspection methods, procedures, etc.) are placed between the radioactive substances and the personnel and environment.

Along with security, of which it is a component, nuclear safety is one of the CEA's top priorities. It uses thorough methodological principles shared by all: pessimistic scenarios for risk analysis, definition of stringent measures to prevent them and limit the consequences of a hypothetical accident, quality organisation ensuring that the measures decided on are correctly implemented, and so on.

This priority must be reflected in the decisions made and the action taken in this direction. This attitude constitutes what is referred to as the "safety culture". The CEA in particular incorporates this culture into its organisation of responsibilities, which in 2001 was restated in a general instruction note concerning the organisation of nuclear safety, and into its decision-making mechanisms. The personnel concerned are inculcated with this culture through their training, their team spirit and their management. This attitude and this organisation guarantee that the diagnostics are made, explained and taken into account in the decisions. The objectives contracts are an essential tool in formalising the conclusions, by which all parties are bound.

The nuclear safety organisation set up in the CEA is based on a continuous line of responsibility.

The Chairman takes the steps necessary for implementing legislative, regulatory and special measures and provisions applicable to the activities involving a nuclear hazard, as well as for organising nuclear safety in the CEA.

He is assisted by the Protection and Nuclear Safety Director and is supported by the other functional directors in charge of preparing the general management's decisions, and the Strategic Nuclear Safety Committee, a body tasked with preparing the decisions of the general management concerning objectives, strategic guidelines and operations in terms of nuclear safety.

Under the authority of the Chairman, nuclear safety skills and responsibilities are distributed between the operational units, the support resources and a supervisory function.

At each hierarchical level, the operational unit defines nuclear safety policy within the framework of that defined by the general management, and supervises its implementation. It makes the necessary choices and presents the Strategic Nuclear Safety Committee with draft strategic decisions concerning all questions related to nuclear safety. It implements nuclear safety resources and procedures for the units under its authority. Through delegation, the facility managers ensure the nuclear safety of the activities, facilities and materials placed under their authority.

At each level, the managers of each operational unit organise internal "first level" monitoring of the activities, facilities and materials placed under their authority, in order to guarantee nuclear safety.

The managers of the operational units enjoy support from a network of expertise in the various safety fields, logistical support and methodology and operational support provided in each CEA centre.

The "second level" monitoring function consists in checking the effectiveness and adequacy of the organisation, resources and actions taken by the operational unit managers, and their internal supervision, against the nuclear safety objectives. The monitoring function is performed by entities separate from those constituting the operational units. It takes place at general management level within the CEA and in each centre.

The CEA has set up a system of internal authorisations based on submission of an authorisation application file by the director of the centre in which the facility is installed. The director then asks for the opinion of his centre's supervision unit and, if necessary, that of a safety committee convened by himself and which comprises permanent members and experts consulted according to the specific nature of the operation examined. These members and experts are appointed by the Chairman.

With regard to the Institut Laue Langevin, correct running of its activities requires perfect control of safety, involving prevention of the spread of radioactive materials and limiting worker exposure to radiation. To ensure this, a succession of lines of defence, comprising both physical barriers (equipment, containments, etc.) and organisational means (inspection methods, procedures, etc.) are placed between the radioactive substances and the personnel and environment.

The ILL conducts risk analyses to define preventive measures and ways of limiting the consequences of a hypothetical accident, and monitors the quality of the steps taken.

The nuclear safety organisation set up at ILL is based on accountability, supervision and simple decision-making mechanisms. The ILL also calls on the expertise of the CEA. The employees assigned to safety and radiation protection report directly to the management and supervision is the responsibility of the BCAQ (Quality Coordination and Assurance Office).

Particularly with respect to management of spent fuel, the fuel elements are shipped once their after-power so allows, in order to reduce the radiological inventory in the facility. Work on seismic reinforcement of the interim storage channel and the emergency water makeup system is under way in order to guarantee evacuation of the residual heat, based on the latest, updated seismic spectra.

G.1.2.2 COGEMA safety policy

Nuclear safety is an absolute priority of the AREVA group.

From design up to final shutdown of the facilities, everything possible is done to protect man and the environment from the potential hazards linked to the use of nuclear materials. This aim is incorporated into the general approach described in § F.3.2.3, from which it is inseparable.

Safety is checked and monitored on a permanent basis. It is organised according to three complementary internal levels in accordance with the AREVA safety charter:

- on each site, the facility managers are responsible for strict compliance with the safety rules; this system of responsibilities is clearly defined and relies on competent support entities;
- each facility director has the means to monitor implementation of his delegated powers in the field of nuclear safety and radiation protection. He ensures that this internal, 1st level inspection is independent of the operational teams who actually exercise these powers;
- the group has set up a directorate with responsibility for Nuclear Safety and General Inspection, comprising senior inspectors appointed by the Board on proposals from the director in charge of Nuclear Safety and General Inspection. This team of inspectors is responsible for inspecting each nuclear facility within the group. This 2nd level inspection is independent of the operational organisation;

Above these three levels is another external level at which the ASN has the right to conduct regular checks on the company's nuclear facilities.

G.1.2.3 EDF safety policy

Responsibility as nuclear operator within the EDF Group lies with three main levels: the chairman, the director of the Energy Branch and the director of the Nuclear Generation Division (DPN), in charge of operating the entire nuclear reactor fleet, and the directors of each nuclear power plant.

The priority given to safety within EDF is based on:

- company policy, the latest version of which was published in 2000, which places safety and radiation protection at the heart of the company's concerns and priorities;
- a system of in-service safety management, the main principles of which were defined in 1997, and a quality management system compliant with the 1984 "Quality Order".

The guiding principles of the safety management system aim to attach particular importance to:

- strict compliance with safety and radiation protection requirements, and the corresponding provisions;
- known and shared aims which, going further than the requirements, reflect the desire for progress and performance in the company in the field of safety;
- the responsibility of all parties involved, based on the recognition that man is one of the key links in the safety chain and a prime mover in achieving progress;
- clear and unambiguous safety responsibilities;
- the various inspection and verification systems, designed to measure the effectiveness of the safety management system and correct any deviations or drift.

EDF considers that achieving progress in the field of safety and competitiveness, which legitimates nuclear production of electricity, depends on ensuring that all those involved are fully aware of these two issues, hence the choice of a policy of decentralisation while guaranteeing consistency.

This policy is based on development of a an approach involving hazard analysis, prior consideration and motivation of the parties concerned, in addition to an approach involving application of centralised decisions and a system of inspection and verification implemented within each DPN entity.

The personal responsibility of each person involved implies the right of expression, the ability to criticise and a system of recognition; hence the creation of conditions favourable to the development of a safety culture and in particular the right to warn[3] and the duty to warn[4].

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[3] **Reporting commitment:** to accomplish his/her activity, each player must adopt a questionning approach and alert his/her hierarchy if an order or an instruction could harm the quality of the activity.

Checking of an activity within an entity is the responsibility of each management level within the entity. Apart from monitoring by the operational levels, verifications are performed by independent entities. In terms of safety, the Safety and Quality Task force (MSQ) in the nuclear power plants, the Nuclear Inspectorate (IN) in the DPN, the Nuclear Affairs Delegation in the Energy branch, the General Nuclear Safety Inspectorate (IGSN) are these independent entities, acting on behalf of the site director, the DPN director, the Energy Branch director and the chairman of the EDF group respectively. Safety comparisons and analyses are regularly conducted at these various levels, under the aegis of the entity manager: on-site technical safety group, operational nuclear safety committee at DPN level, nuclear safety council reporting to the group chairman.

With regard to the safety indicators and co-ordination tools, the following in particular are employed:

- annual safety reviews in each nuclear power plant and the associated reporting to the DPN director;
- overall safety assessments by the Nuclear Inspectorate and the corresponding cross-comparisons;
- the annual report from the IGSN to the chairman of EDF;
- a number of "quality tools", such as hazard analysis, self-assessment and self-diagnostic;
- regular monitoring of indicators such as:
  - general conformity of operation and maintenance with the specifications;
  - quality of alignments;
  - reduced loads on scram protection;
  - fire prevention.

All the activities and facilities involved in spent fuel handling and storage are considered to be important for safety and are dealt with in the same way as the rest of the installation, in accordance with the principles recalled in paragraph G.2.2.

G.1.3 ASN analysis

In order to conduct a forward-looking assessment, EDF jointly with the industrial contractors involved in the fuel cycle must provide data concerning compatibility between changes in fuel characteristics and changes in the fuel installations.

At the request of the ASN, EDF therefore submitted in 2001a safety file concerning the impact of the envisaged changes on the cycle installations, considering:

- the quantities of stored radioactive material produced by past fuel management policies and practices;
- current management, which could require a review of the safety standards for the fuel cycle facilities, or even modification of these facilities;
- the fuel assemblies in which the structural or rod cladding materials are different from those taken into account in the cycle facilities safety studies;
- the scenarios concerning the new forms of fuel management and the new products which are to be implemented in the coming ten years;
- the unloaded spent fuel management scenarios;

[4] **Duty to warn:** any event for which the player has more serious safety concerns (compared to the judgment made by his/her direct hierarchy), must be brought to the attention of the entity responsible for safety in the EDF organisation (the Head of the CNPE Safety Quality Mission, DPN's delegated director for nuclear safety, EDF's general inspector for nuclear safety)

- the consequences of these management forms and management scenarios between 2000 and 2010 on the one hand, and then beyond 2010 on the other, for the by-products and waste resulting from fuel manufacture and reprocessing (interim storage or disposal, as well as reprocessing possibilities and corresponding technologies).

This file supplied by EDF was examined between November 2001 and February 2002 during the course of three meetings held by the laboratories, plants and waste Advisory Committees and by several members of the Advisory Committee for reactors.

For the ASN, the aim - through this forward-looking 10 year assessment - was to ensure that the options presented by the operators were acceptable. The ASN therefore wished to identify those points for which further justification was needed or for which authorisation applications would have to be submitted by the operators as and when needed.

The file presented by EDF offers significant clarification of the working of the fuel cycle and the safety issues, in particular also giving the technical and regulatory limits that might need to be modified owing to changes in fuel management, subject to the adequate justification. The review showed that the new fuel managements presented by EDF would not seem to comprise any aspects such as to rule them out.

In order to maintain an overall picture of the fuel cycle, the ASN considers that this file should be periodically updated. In particular for any new fuel management system, the ASN asked that EDF present a feasibility file, accompanied by a revision of the "fuel cycle" file, specifying and justifying any deviations.

In order to manage the traffic and stocks of materials, fuel and waste with reference to the data presented in the "fuel cycle" file, EDF implemented a project entitled "fuel cycle watch and anticipation”. EDF presents a yearly review of observed changes to the working of the cycle.

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 a facility.

G.2.1 ASN requirements

In order to take account of both the effect of time on the facilities and changes in safety expectations, the ASN requires that in addition to the permanent analysis of experience feedback, the operators conduct periodic safety reviews of their basic nuclear installations (see § E.2.2.3.1.2).

This provision is included in the regulatory texts (see § E.2.2). Article 4 of the decree of 19 July 1990, amending the initial decree of 11 December 1963, introduced an article 5 which in particular stipulates that the ministers for the environment and industry "may jointly and at any time ask the operator to re-examine the safety of the facility".

The periodic safety review comprises a study phase, the aim of which is to go over the safety analysis of an installation by comparing it with more recent technologies and using new analysis methods and tools (codes, probabilistic safety studies, etc.). This study phase can lead to changes such as to improve the level of safety of the installations, in particular the older ones.

The periodic safety reviews may convince the operators to opt for shutdown of a facility rather than initiating costly work to upgrade it.

This is the case with the plutonium technology building (ATPu) in Cadarache or the building in the UP2-400 plant at La Hague. After a decommissioning phase in which the equipment is to be cleaned up and the waste from past activities recovered and packaged, these installations will be closed down by a decree. To compensate for these shutdowns or enable themselves to carve out a position on new markets, several operators in recent years requested modifications to their authorisation decrees, in particular in order to increase their production capacity (Melox, FBFC) or distribute it differently among the various production units (plants UP2 and UP3 at La Hague). The corresponding authorisations are given by decree, after examination by the Nuclear Safety Authority. Finally, if economic and industrial constraints often lead to changes to the facilities, they can also lead to changes such that new facilities prove to be necessary. Thus for uranium enrichment, the ultracentrifuge process should eventually replace gaseous diffusion. The procedure to create a new enrichment installation which by 2012 will replace the current Eurodif plant has just been initiated. This is a large-scale project determining the future of enrichment in France and which has just been through a process of public debate prior to the public inquiry associated with the authorisation decree application.

The periodic safety reviews therefore have two main objectives.

· The first is to compare the level of safety of the facilities with their initial reference framework in order to identify any deterioration in the facility over time, along with any shortcomings or weaknesses in the safety analysis. This is the conformity check.

· The second is to compare the safety of the facilities with the most recent safety standards, in order to improve the level of safety. This is the safety review. This review will identify the changes likely to lead to a significant improvement in the level of safety and establish a new "safety reference system".

These two reviews conducted in parallel can lead to improvement requests, whether the result of equipment obsolescence or owing to scientific or technical developments. Any drift in relation to the safety requirements is examined and compensatory measures may be imposed, if necessary by restricting the facility's scope of operations.

G.2.2 Safety review of the installations by BNI operators

G.2.2.1 Safety review by the CEA + ILL

The periodic safety review of the CEA's facilities takes place either at the initiative of the CEA, in particular at an important stage in the life of the facility (significant change in its operation for instance) or at the request of the Nuclear Safety Authority.

The periodic safety review of a BNI consists not only in analysing experience feedback and changes made to the facility since the previous review, but also in analysing the effects of the passage of time (ageing) on the equipment and structures and in taking account of changing knowledge and safety practices. It consists of a new and complete review of the safety of a BNI, which should factor in the future situation (changing functions and lifetime) of the facility.

The periodic safety review leads to an improvement plan which includes on the one hand the implementation of changes (structures, equipment, operating rules, etc.) and exceptional maintenance and overhaul work, as well as housekeeping and clean-up operations, and on the other, revision of the operating documentation.

For its periodic safety reviews, the CEA uses a project type organisation. Given the issues and resources involved, all envisaged or planned periodic safety reviews are the subject of multi-year scheduling for each facility (in a sliding 15-year plan) which in theory takes place every ten to fifteen years while taking account of the important changes planned and as applicable the expected closure date of the facility.

When conducting the approach adopted by the CEA, the prime objective of the periodic safety review is to assess of the safety of the facility by incorporating all experience feedback (dosimetry, effluents, waste, incidents, etc.) and by identifying deviations from the safety reference system in force and from current safety and radiation protection regulations and practices.

The second objective is to take appropriate remediation measures to:

- bring the facility to a level which is as safe as reasonably achievable, consistent with its remaining life and according to the estimated cost of any changes, in the light of the safety issues;
- reduce subsequent exposure of operating personnel to a level that is as low as reasonably achievable, focusing particularly on the most exposed workstations;
- reduce detrimental effects on the environment (discharges and waste) to a level that is as low as reasonably achievable, concentrating in particular on eliminating the production of waste without disposal channels, limiting discharges into the environment, promoting internal recycling processes and reinforcing the safety of interim storage areas incorporated into the facility.

The periodic safety review of a facility is based on a new safety analysis which covers all the BNIs. This means that the CEA's strategy for the facility must first of all be clarified in terms of defining the future functions and operating roles of the facility, as well as their anticipated duration.

The safety assessment of the existing facility allows identification of all material or organisational aspects to be modified or implemented to meet the general safety objectives and the goal of improving safety on the occasion of the periodic safety review of the facility.

The operator proposes measures to upgrade the safety of its facility, consisting in strengthening certain lines of defence, or in adding new ones. They are given shape in requirements concerning safety-related elements (systems and equipment or operating rules).

The upgrade measures proposed then undergo a safety review prior to implementation, presenting the safety and radiation protection principles and objectives linked to the prevention of hazards arising from the changes.

The conclusions of the periodic safety review are presented to the Nuclear Safety Authority which issues its opinion before the changes are made and before the modified facility safety demonstration. The facility's safety reference system is updated.

G.2.2.2 Safety review by COGEMA

As requested by decree 63-1228 of 11 December 1963 (see E.2.2), COGEMA submits a safety analysis report, a PGSE (facility general safety programme), RGE (general operating rules) and the PUI (on-site emergency plan), prior to commissioning of each facility. These documents define the operating envelope of the facility on the basis of the safety analyses conducted. They cover actual operation, maintenance, surveillance and periodic testing. They are approved by the ASN and constitute the operational reference. Any change to these documents must be authorised by the ASN, after examining a technical dossier submitted by the operator, containing the updated safety analyses.

The safety analyses are reconsidered, to take account of experience feedback, and lead to updating of the operating documents, incorporating:

- the changes made to the facilities since the previous update. Important changes were approved by the ASN prior to implementation, based on presentation of a technical dossier. The update then consists in integrating this technical dossier into the safety analysis report;
- anomalies or incidents which have occurred in the facility since the previous update and which have led to preventive changes to the facilities or operational changes;
- possible improvements in knowledge, whether arising from independent work (improved seismic or metallurgical data, for example) or from anomalies detected in other nuclear facilities.

The periodic safety review is thus in some ways permanent, leading to updating of operating documents whenever necessary. The procedures involved are identical to those of the initial authorisation (examination of the file by the ASN's technical support body, examination by the relevant Advisory Committee and decision by the ASN with formal notification of authorisation, accompanied by any additional technical specifications to be complied with).

G.2.2.3 Safety review by EDF

G.2.2.3.1 EDF periodic safety review process for existing facilities

In order to take account of the effect of ageing on the facilities, changing expectations in terms of safety and new available data, and in addition to permanent analysis of experience feedback, EDF conducts periodic safety reviews for each plant series. For the reactors, this periodic review process, which includes a conformity check on each unit with their standard status, as compliant with the safety requirements, is implemented in conjunction with the ten-yearly inspections on the nuclear steam supply systems specified for pressure vessels (order of 1974).

The first periodic review of this type was initiated in 1988 for the older reactors in the nuclear fleet, at Fessenheim and Bugey (CP0 plant series). This in particular involved an analysis of these units by comparison with the CP1-CP2 plant series, to obtain an overall safety level comparable to that of the units of the CP1-CP2 900 MWe plant series. The periodic safety review was then conducted on the CP1-CP2 series and then the 1300 MWe series, prior to performance of the second ten-yearly inspections using a procedure approved by the Nuclear Safety Authority.

This approach comprises three phases:

- a description of the safety reference system comprising a set of rules, criteria and specifications applicable to a plant series;
- a demonstration of the conformity of the standard status of the unit series with the safety reference system, and then a conformity check on each of the units with the standard status;

- an assessment to ensure that the safety reference system is up to date and complete, based on examination of all safety-related aspects, with identification of any changes that need to be made to the plant series standard status, during the ten-yearly inspection (VD).

This approach allows clear identification of the safety requirements applicable to a given plant series and ensures conformity of the reactors with this reference system. It also highlights the safety aspects requiring further analysis, in particular on the basis of French or foreign experience feedback and changing knowledge and know-how. This analysis can lead to a change in the reference system, corresponding to a new reference status, with updating of the "VDn edition" safety analysis report and incorporation of the corresponding changes.

G.2.2.3.2 Description of the safety reference system

For example, for the 1300 MWe plant series, the safety reference system ahead of the VD2 (second ten-yearly inspection) corresponds to the 1998 edition of the safety reference system (RDS). Similarly, for the 900 MWe plant series, the safety reference system ahead of the VD3 (third ten-yearly inspection) corresponds to the VD2 edition of the RDS.

G.2.2.3.3 Conformity check by EDF

Conformity of the facilities with the safety requirements is one of the major issues involving the responsibility of the nuclear operator, at several levels.

First of all, at the design stage, the designer defines a reference facility (plant series) meeting these requirements and builds it in accordance with pre-determined rules allowing verification of conformity of the facilities, until industrial commissioning.

Then, during operation, the operator (the DPN) ensures that the facilities are kept in conformity with the applicable safety requirements, relying on organisational measures defined by the quality manual as well as on permanent surveillance (implementation of the technical operating specifications, etc.) or periodic, using periodic tests and the basic preventive maintenance programme, and taking account of experience feedback from events and incidents occurring during operation, along with analysis of relevant operational experience data. The DPN receives support from the Nuclear Engineering Division regarding engineering and technological matters, in all areas linked to maintaining safety.

During the periodic safety review, EDF identifies the aspects requiring:

- additional analysis concerning the safety demonstration for the reference facility;
- specific checks to be applied to actual units, supplementing the existing surveillance measures. For the second ten-yearly inspections, these checks consist of a "conformity check" programme and a "supplementary investigation" programme (PIC).

The conformity check programme consists of a set of specific checks or targeted actions covering topics related to the safety requirements (classification of safety-related equipment, qualification for accident conditions, extreme cold, earthquake resistance, flooding risk, risk of high-energy pipe break, etc.) and in certain areas allowing definition of a "background level" for the status of the facilities (e.g. civil engineering). Implementing this programme leads to identification of deviations which are dealt with according to their importance for safety, to establishing the degree of conformity of the units, but also contributes to revealing lessons of use in strengthening control of the conformity of the facilities, with the aim of ensuring that it is sustainable. Responsibility for this is given to each NPP, with strategic co-ordination by the NPP senior management and a project team run by an operational pilot.

The corresponding checks are carried out during the ten-yearly outage inspections on the units of the various plant series.

The supplementary investigation programme corresponds to non-destructive testing (NDT) spread over several units and carried out during the ten-yearly inspections. Its aim is to confirm the validity of the scenarios (degradation modes) on which the basic preventive maintenance programmes (PBMPs) are based for the 900 and 1300 MW units.

G.2.2.3.4 Reference system evaluation by EDF

All new data, whether resulting from national or international experience feedback, or specific studies, are examined and the most sensitive points are looked at in terms of their impact on the level of safety within the plant series. When it would appear that their benefits are high enough and clearly outweigh their drawbacks, changes are made to the safety reference system. If necessary, verification studies can be repeated.

Probabilistic safety studies may be used, in particular when searching for and analysing accident warning signs or ranking the main components of a hazard and evaluating the level of safety.

For example, evaluation of the safety reference system following the second ten-yearly inspection on the 900 MWe plant series (CP0, CP1-CP2) was initiated in 2001 with a view to preparing the third ten-yearly inspection.

G.2.2.3.5 Thematic reviews by EDF

The thematic reviews in particular include the technical review initiated by EDF into criticality hazard control, following the Tokai-Mura incident in 1999.

This review led EDF to the conclusion that the criticality risk was on the whole well under control for the spent fuel storage and disposal phases. The result of the studies thus conducted completes the criticality reference system in the safety analysis report.

G.2.2.3.6 Transport safety

Following problems encountered regarding compliance with spent fuel transportation cleanliness limits, EDF undertook a project review which led to a number of quality assurance recommendations and measures concerning implementation of transport regulations.

These rules constitute the "Shipment reference framework":

- responsibility of the consignor, in particular for the quality of checks and shipment documents;
- qualification of the shippers used by EDF;
- declaration, analysis and experience feedback from shipment incidents in the event of deviations;
- creation of local and national shipment security advisers, in compliance with the regulations.

Taken as a whole, these measures led to a higher guarantee of transport cleanness. In addition, EDF is taking part in the co-ordinated research programme conducted by the IAEA in this area, in order to better evaluate the hazards and potential impacts of surface contamination aspects.

G.2.3 Analysis by the ASN

The ASN requires a periodic safety review of each BNI about every ten years. The periodic safety review comprises two elements:

- a check on the conformity of the facility with its design;
- a re-assessment of safety in the light of new knowledge and changing regulations.

Depending on the result of the periodic safety review, the ASN may authorise the facility to continue to function or may restrict its use or lifetime, and may even demand closure of the facility within a given time. The periodic review programme for spent fuel storage facilities was thus conducted along these lines. This in particular led the CEA to plan construction of new facilities to replace the older ones, by the year 2015.

G.3 Siting of proposed facilities (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 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 4.

As mentioned at the beginning of this report and recalled at the beginning of this section G, spent fuel management facilities are defined by French regulations as being part of a broader category of facilities called "basic nuclear installations" (BNI), the definition of which was given in paragraph E.2.

Any new facility would thus be subject to the general BNI regulations which, with regard to siting, was detailed in paragraph E.2.2.2.

At present, there are no new siting plans for a spent fuel management facility.

G.4 Design and construction of facilities (Article 7)

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.

As mentioned at the beginning of this report and recalled at the beginning of this section G, spent fuel management facilities are defined by French regulations as being part of a broader category of facilities called "basic nuclear installations" (BNI), the definition of which was given in paragraph E.2.

No distinction is made between the fact that the fuels were examined before or after irradiation.

The description of the BNI general regulations, which include the design and construction of spent fuel management facilities, was presented in paragraph E.2.2.3.2 with regard to procedures, paragraph E.2.2.5 with regard to technical rules and paragraph E.2.2.4 with regard to discharges.

With regard to the technical measures for decommissioning a basic nuclear installation, the circular appended to decree 73-278 of 13 March 1973 recalls that these must be described in a specific chapter of the safety analysis report to be submitted in support of the authorisation decree application mentioned in paragraph E.2.2.3.2.1.

The measures taken by the operators to comply with these regulations are presented in paragraph G.2.2, which deals with existing facilities.

The Nuclear Safety Authority checks implementation of these regulations through the analyses and inspections it conducts, as specified in paragraphs E.2.2.6 and E.2.2.7.

G.5 Safety assessment of facilities (Article 8)

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).

As mentioned at the beginning of this report and recalled at the beginning of this section G, spent fuel management facilities are defined by French regulations as being part of a broader category of facilities called "basic nuclear installations" (BNI), the definition of which was given in paragraph E.2.

The description of the general regulations for BNIs, which include spent fuel management facilities, is given in paragraph E.2.2.3.1, with regard to their safety assessment.

In particular, the circular associated with decree 73-278 of 13 March 1973 stipulates that a preliminary safety analysis report must be submitted in support of the authorisation decree application. This text also states that a provisional safety analysis report must be supplied in support of the pre-commissioning test application and finally that a final safety analysis report must be provided in support of the final commissioning application, as mentioned in paragraph E.2.2.

The measures taken by the operators to comply with these regulations are presented in paragraph G.2.2, which deals with existing facilities.

The Nuclear Safety Authority checks implementation of these regulations through the analyses and inspections it conducts, as specified in paragraphs E.2.2.6 and E.2.2.7.

Any operating license given to a facility (valid for spent fuel or waste storage facilities) contains a limit date for final commissioning, which must take place after a few years of operation and after assessment of the safety analysis report and the general operating rules.

After this time, the license is no longer valid and a further application process has to 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 a spent fuel management facility are prepared and updated, as necessary, using information obtained during the operating lifetime of that facility, and are reviewed by the regulatory body.

G.6.1 The authorisation process

The description of the general regulations for BNIs, which include spent fuel management facilities, is given in detail in paragraphs E.2.2.4 and E.2.2.5, with regard to the operating authorisation.

G.6.2 BNI operator practices

G.6.2.1 CEA + ILL operational safety practices

Authorisations are issued to the CEA in accordance with the procedures described in E.2. Operating safety is guaranteed in conformity with the general and particular regulations and is subject to periodic safety reviews, as described in § G.2.2.1.

The quality and sustainability of technological and engineering support are guaranteed by the quality undertakings described in § F.3.2.2 and by the human and material resources described in § F.2.2.2. With regard to decommissioning, the practice was described in section F.6.

The safety reference systems for the CEA's facilities are first of all established to obtain authorisation for commissioning and updating in the event of modifications or during periodic safety reviews. They comprise a safety analysis report describing the radioactive materials used, the facility itself and its environment, the planned safety measures, general operating rules also drawn up by the operator, along with technical requirements imposed by the Nuclear Safety Authority: these reference systems define operating envelopes authorised by the Nuclear Safety Authority, beyond which operation must not deviate.

The basic documents of the safety reference system are supplemented by a set of procedures and operating instructions drafted by the operators and designed to describe operations in the field which are consistent with the safety reference system and its operating envelope.

Incidents occurring in the CEA's facilities are declared to the Nuclear Safety Authority in real time. These incidents are then analysed, involving identification of their underlying causes and definition of the corrective and preventive actions to be put in place to prevent them happening again. The incident report is produced and transmitted to the ASN within 2 months. In 1999, the CEA set up a "central experience feedback file" giving all parties concerned access to the same incident information, along with an incident analysis guide drafted to harmonise the incident reports, help with their assessment and codify the results. By analysing the incident reports, the CEA draws conclusions of use for improving the safety of its facilities, identifying generic safety weak points, defining targeted areas of progress and ensuring dissemination as extensively as possible.

G.6.2.2 COGEMA operational safety practices

Authorisations are issued to COGEMA in accordance with the procedures described in section E.2. Operations are conducted in conformity with the general and specific regulations, as described in § G.2.2.2. The quality and sustainability of technological and engineering support are guaranteed by the quality undertakings described in § F.3.2.3 and by the human and material resources described in § F.2.2.3 enabling COGEMA to maintain its industrial know-how in the subsidiaries under its control. With regard to decommissioning, the practice was described in section F.6.

Significant safety incidents are declared to the ASN and other national authorities within 24 hours, in accordance with the requirements (see § E.2.2.4.5). Also in accordance with the requirements, an incident report comprising an initial analysis is sent to the ASN within two months. If the analysis requires further time, an additional analysis is submitted subsequently.

Use of quality assurance procedures ensures the traceability of operational data, which are examined in real time to check that safety requirements are met and if necessary, to make the necessary changes (see § G.2.2.2).

Decommissioning plans are drawn up as and when necessary, before operation ceases, when final shutdown of a facility is envisaged. In addition to the benefit gained from the latest available technologies at the time of decommissioning, it is also desirable to have access to the operators' knowledge of the life of the installation when drawing up this plan and, in primarily chemical facilities, when carrying out the majority of clean-up operations, generally conducted using the normal maintenance procedures and process reagents.

G.6.2.3 EDF operational safety practices

The authorisations are issued to EDF in accordance with the procedures described in section E.2. Operations are conducted in conformity with the general and specific regulations, as described in § G.2.2.3. The quality and sustainability of technological and engineering support are guaranteed by the quality undertakings described in § F.3.2.4 and by the human and material resources described in § F.2.2.4. With regard to decommissioning, the practice was described in section F.6.

It must be mentioned here that a description of the arrangements taken by EDF for operation of its nuclear reactors is given in France's CNS report, article 19, and recalled in the bibliography (see § L.7.1).

G.6.3 ASN analysis

Through its analysis, inspection and possible penalties system, the ASN permanently ensures that the operators comply with the general regulations for BNIs, which include spent fuel management facilities and which, with regard to their operation, are presented in paragraphs E.2.2.4 and E.2.2.5.

G.7 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 today, no spent fuel is officially designated for disposal. The reference is reprocessing of spent fuels. However, it is envisaged that certain spent fuel elements will not be reprocessed and, within the framework of programmes defined by the law of 30 December 1991 on radioactive waste management (see § B.4.1), studies into the possibility of disposal in deep geological formations for high level, long-lived waste are also examining the possibility of direct disposal of spent fuel. In its sizing inventory model, Andra in particular considered the possibility of disposing of spent fuel according to scenarios in which the operator EDF would not reprocess the entire inventory of spent fuels.

As part of the research process initiated by the law of 30 December 1991, Andra is assessing the consequences of a possible spent fuel repository project, whether UOX fuel or MOX fuel, in a deep geological formation. The behaviour of these packages was estimated in the 2001 Clay dossier and will be reassessed in the 2005 Clay dossier submitted in June 2005 by Andra. These fresh assessments will take account of the experiments conducted in the Bure laboratory at a depth of 450 m in the Callovo-Oxfordian clay stratum.

Section H– SAFETY OF RADIOACTIVE WASTE MANAGEMENT (Art. 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 generation;

vii) aim to avoid imposing undue burdens on future generations.

H.1.1 ASN requirements concerning BNIs

In France, all basic nuclear installations are likely to manage radioactive waste. For this reason, they are subject to the currently applicable general safety requirements, which were described in detail in section E.2.2. It must be also reminded here the National Plan for Radioactive Waste Management and Recoverable Materials presented in § B.4.1.

H.1.2 Measures taken by BNI operators

H.1.2.1 Steps taken by the producers CEA+ILL, COGEMA, EDF

Waste management in basic nuclear installations comprises the following main phases:

- "waste zoning" (see § B.4.5);
- collection;
- sorting;
- characterisation;
- treatment;
- storage;
- shipment.

Management of waste, be it radioactive or conventional, is in conformity with French regulations covering the disposal of waste and recovery of materials. Collection is a sensitive phase in waste management in nuclear facilities.

Waste is collected selectively, either directly during normal operation, or by personnel on the work sites. As of the collection phase, the physical management of radioactive waste must be clearly segregated at all levels from that of conventional waste.

Sorting operations take particular account of the specific nature of the processing, packaging, shipment, disposal or recycling channels applicable to the waste. Waste is generally sorted according to its physico-chemical form (pre-characterisation), which in particular involves isolating waste which is prohibited for surface disposal (or which requires preliminary appropriate processing before it can be placed in this category), separating compactable or incinerable waste from that which is not and, more specifically for radioactive waste, segregating it according to its level of activity and radiochemical composition.

Once sorted, the waste undergoes qualitative and quantitative characterisation: mass, properties and physico-chemical composition, possible radioactive content, and so on. This characterisation is necessary for compliance with the existing regulations and resulting technical specifications, in particular with regard to treatment, packaging, disposal and recycling processes.

Waste is only shipped for disposal or recycling to industrial facilities that are authorised to receive such waste. However, the aim is to ship waste through these channels as early as possible, in order to minimise interim storage on the production sites. Special provisions apply to the transport of radioactive waste in accordance with shipment regulations.

Traceability of the steps involved in waste management must be guaranteed, from characterisation up to their place of disposal or recycling.

The channels for melting metal waste and incinerating solid incinerable and liquid waste, have been operational since 1999. They can handle low-level waste (steel, clothing, items resulting from maintenance or dismantling) prior to surface disposal.

Finally, the management of each type of waste is described and analysed in the "waste surveys" conducted by each production site, in order to look for ways to improve and optimise, and establish a reference system.

All the "waste surveys" by the establishments of the AREVA group and EDF were completed in 2002 (in compliance with the guide issued by the DGSNR), and submitted to the director of the DGSNR in accordance with the order of 31 December 1999, section V, articles 20 and 21.

On the basis of this reference system, each operator produces an annual management report for its waste, in a format specified in the DGSNR specifications. It sends this report to the DGSNR and to the DRIRE with local competence. This information is accessible to the public, unless covered by industrial or defence confidentiality.

H.1.2.2 Removal of waste to Andra and CENTRACO

The radioactive waste shipment programmes are drawn up and monitored after discussion by all entities concerned and notification of the shippers, with due regard to the different disposal channels available: melting and incineration at CENTRACO, Aube repository. The quality of these shipments is monitored.

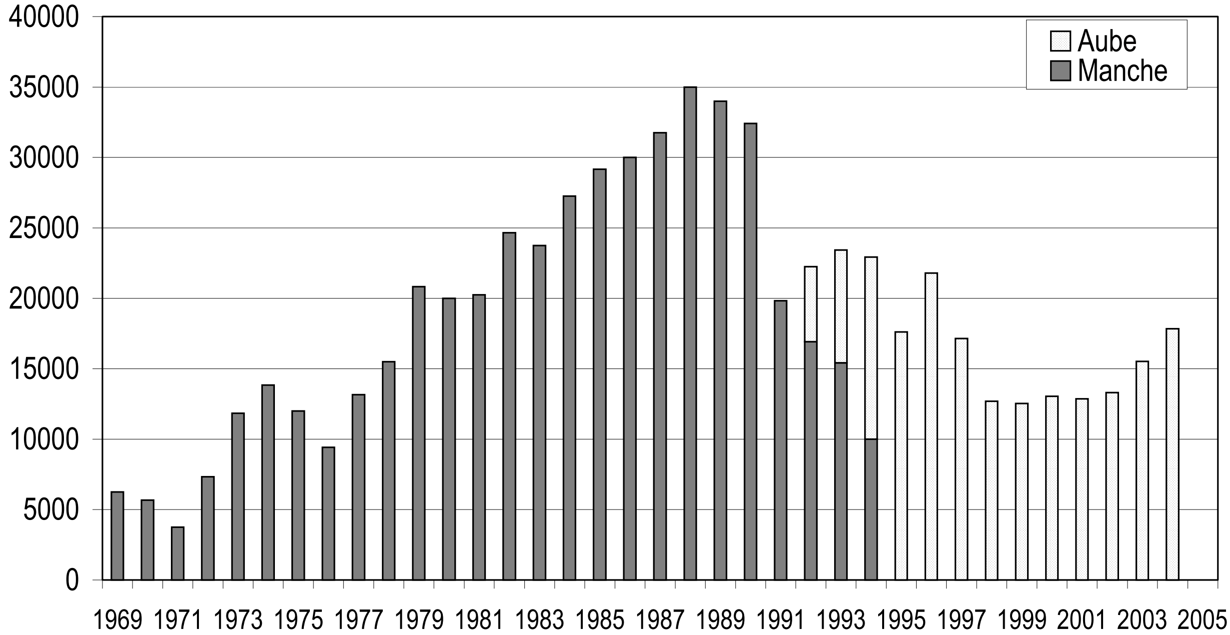
H.1.2.3 Measures taken by Andra

The radiation protection goals of Andra were described in paragraph F.4.2.1.1. They are based on current regulations and set dose criteria that are as low as reasonably achievable, in particular for the long-term, corresponding to a fraction of the maximum dose allowed by the current regulations.

With regard to the hazards linked to the potential chemical toxicity of the waste, and in compliance with the recommendations of basic safety rules III.2.e and III.2.f, Andra asks the producers to quantify the presence in the waste of elements covered by the regulations applicable to special industrial waste or water quality regulations. These elements are then the subject of disposal impact assessments. Specific action is also undertaken to reduce their quantity in the packages delivered, in particular with respect to lead.

Reducing the volume of waste delivered is an objective common to the waste generators and to Andra. This enables the size of the repository to be reduced and is chiefly obtained by efficient packaging processes (compacting, incineration) and by control of the materials brought into the regulated areas of the facilities. The following graph shows the evolution of deliveries of packages of low and intermediate level and short-lived waste since 1969.

Waste volumes (m3) delivered to the Manche and to the Aube repositories



After a regular rise in deliveries corresponding to expansion of the French electric nuclear programme, which in 1988 led to a maximum of 35,000 m^3 delivered, package traffic then fell to a value of between 10,000 and 15,000 m^3 per year in about fifteen years, as a result of new waste management policies implemented by the producers. However, it should be noted that preparation for dismantling (Marcoule UP1 plants, EDF gas-graphite reactors, etc) has since 2003 led to a significant rise in the volume of packages being sent to the Aube repository. The Aube repository was initially scheduled to operate for about thirty years, but this should now last at least fifty years.

As regards the interdependencies between the various steps in radioactive waste management, one must first of all point out that prior to opening of a repository, Andra lays down specifications applicable to the waste or the waste packages, setting the conditions to be met by the waste and waste packages before they can be accepted in the repository. The constraints set by Andra are designed to guarantee the short, medium and long-term safety of the repository and constitute a reference system for the waste producers when defining a new type of package. They in particular concern the prevention of biological, chemical, fire and criticality hazards. During operation of the facility, the "approval process" run by Andra is implemented for each type of waste package proposed by the producer, in order to guarantee that this type of package complies with Andra's specifications.

This approach was applied for low and intermediate level, short-lived waste received by the Manche repository. It is used in the Aube repository, with the design of the packages being based on the Andra specifications, consistent with basic safety rule III.2.e. Any type of waste package received in the Aube repository must have been approved prior to disposal.

A specific but similar process is employed for the Morvilliers very low level waste repository (which is not covered by BNI regulations).

It should also be pointed out that overall radiation protection optimisation considerations, from the work site generating the waste up to the repository which receives it, have led to the use of very large sized packages in order to reduce waste cutting operations which entail worker exposure. In 2004, PWR reactor vessel heads were therefore accepted as-is by the Aube repository for packaging in-situ. This type of operation should be repeated, in particular for management of certain dismantling waste.

For high level waste or intermediate level long-lived waste, which is covered by the law of 30 December 1991, the waste packages are designed with reference to basic safety rule III.2.f. The ASN also asks Andra for its opinion before authorising manufacture of a new type of package. Finally, as part of its studies, Andra asked the waste producers to supply "data packages" summarising the characteristics of each type of package produced or for which production is planned. These data packages are the inputs for the disposal feasibility studies.

For the planned disposal of waste containing radium, waste containing graphite or tritiated waste which is not yet packaged, Andra is examining the most appropriate means of packaging at the same time as it is defining the disposal concepts. This work involves close co-operation between Andra and the waste producers.

H.1.3 Case of ICPEs and mining waste

In France, the last uranium mine closed down in 2001. The mining industry therefore no longer produces new waste, but the public and the environment must be protected from the waste produced in the past, particularly the mine tailing and the ore processing residue repositories. These repositories are installations classified on environmental protection grounds.

For industrial, research and medical activities taking place outside the BNI regulatory framework, the general principles for waste management, explained in law 75-633 of 15 July 1975 (article L.541 of the Environment Code) apply: prevent or reduce waste production and toxicity, in particular by acting at the product manufacture and distribution stage, by reusing the waste, by recycling or by any other steps designed to obtain reusable materials or energy from the waste.

A circular from the Minister for Health dated 9 July 2001 specifies the steps to be taken into account when managing waste and effluents resulting from medical care-related activities and industrial and research activities. In addition, requirements may be applied on a case by case basis by the ICPE inspectorate, as and when necessary. Thought is being given to general requirements concerning the correct management of radioactive waste generated by these activities.

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 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 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 Requirements of the regulatory Authorities

With regard to the existing facilities, whether ICPEs or BNIs, a periodic safety review is made possible by the regulations. A frequency of about 10 years is used for the periodic reviews of the most hazardous BNIs and ICPEs.

With regard to ICPEs, it is possible at any moment to update the order authorising the installation by means of additional orders (in practice this takes place at least every ten years for the more important ICPEs). These additional orders are passed after proposal by the ICPE inspectorate and after recommendation from the *département's* Health Council.

For the BNIs, given the potential hazard of the products they contain, the periodic safety review is conducted more systematically and extensively. In the particular case of the older waste interim storage sites, this type of review showed that improvements were necessary.

H.2.2 Measures taken by BNI operators

H.2.2.1 Measures taken by Andra

The Manche repository was operated from 1969 to 1994. During this period, both regulations and safety principles changed. The first editions of the basic safety rules I.2 and III.2.e dated from 1982 and 1985. Andra concentrated on adapting its operating methods to changes in the regulations. For past practices which no longer complied with current regulations, Andra checked that they were still compatible with the safety objectives, during the periodic safety reviews. In particular, a complete safety review was conducted in 1995 to coincide with the transition of the Manche repository to the surveillance phase, which was analysed in accordance with currently applicable procedures for creation of a basic nuclear installation and which also involved a public inquiry. This review was brought up to date in 1999 following an investigation ordered by the French government into the situation of the Manche repository. It will be updated on the basis of experience feedback from the first ten years of surveillance of the repository.

For the planned fifty years of operation of the Aube repository, a similar upgrade process is followed. In particular the authorisation decree will be updated to take account of changes in effluent regulations (see § F.4.2.1.3), and the safety assessment produced in 1996 and 1997 following the first 5 years of operation of the repository. The updated Aube repository (CSA) safety analysis report was sent to the ASN at the end of 2004.

H.2.2.2 Measures taken by the CEA + ILL

Former waste originates from various practices at a time when the current channels were not available. It is often similar to current waste, but given the diversity of interim storage conditions and the changes to the waste management methods, there are particular problems with recovery, characterisation and treatment.

This primarily concerns:

- solid waste, generally placed in drums stored in shafts, cells or pits;
- solid waste buried underground in various forms (loose under a vinyl envelope, in metal drums, in concrete hulls);
- aqueous and organic liquid waste, contained in vessels, cylinders or drums.

After undergoing specific treatment, they will pass through the normal channels.

The programme for recovery of this waste concerns on the one hand the "denuclearisation" of the Fontenay-aux-Roses and Grenoble centres (see § F.6.2.1), and clean-up of BNI 56 in the Cadarache centre. The aim is, after sorting of the waste, to send it either to the Aube repository, or to the Andra VLL Waste repository, or to the CEDRA interim storage facility in Cadarache. All of these operations must be completed around 2015.

H.2.2.3 Measures taken by COGEMA: recovery of the old waste from La Hague

Unlike with the new UP 2-800 and UP 3-A plants, some of the waste produced during operation of the UP 2-400 plant was stored pending final packaging.

Some facilities already in operation will be able in the future to handle most of the waste from UP 2-400.

COGEMA has set up the ORCADE project, the role of which is to ensure successful recovery and packaging of the "legacy" waste present on the Hague site.

Practically, all fission products have today been vitrified.

Research and development work has been conducted into processing of the sludge from the STE2 building, in particular to determine the recovery and transfer procedures. The recovery and packaging process proposed by COGEMA is to incorporate these sludges into bitumen, based on the process employed in the STE3 building. The beginning of industrial testing of this bituminisation operation should precede an active production phase, although the aim is to limit the number of drums produced: COGEMA's objective is a maximum of 40,000 drums.

COGEMA envisages processing the hulls and end-pieces contained in the HAO silo and the S1, S2 and S3 pools, by compacting in the ACC building. An initial step consists in characterisation of these hulls and end-pieces for subsequent recovery, sorting and transfer of the waste to the packaging units.

COGEMA is currently developing a mechanical system for recovering the waste from silos 115 and 130 and is working on characterisation of this waste. After a study phase, recovery operations should begin in about 2010.

H.2.2.4 Measures taken by EDF

H.2.2.4.1 Packaging and disposal of waste on the operating EDF sites

For several years, the EDF nuclear power plants have been required to store certain waste, whether or not packaged, in their own facilities owing to: :

- the lack of appropriate treatment or disposal channels,
- changes to the technical specifications of the repositories, which can no longer accept certain old packages;
- finally, various regulatory changes have led to changes in certain practices (halt in disposal of waste considered to be "non-radioactive" in the conventional waste disposal channels) or blockage of certain packages on the production sites (shipping criteria not met).

This situation has changed for the better, particularly as a result of:

- commissioning in 1999 of SOCODEI's CENTRACO plant (see paragraph B.5.1.1). This facility uses incineration to eliminate waste with a high calorific potential but which in general is only slightly contaminated (oils, solvents) and for which there was no disposal channel.
- commissioning in 2003 of the very low level (VLL) waste repository managed by Andra. This repository can accept resins that are only slightly contaminated (steam generator blowdowns), iodine traps, earth and rubble, etc.

In addition, as previously mentioned, EDF has built and commissioned dedicated, regulated areas on its 19 NPPs for very low level wastes (VLL areas) pending removal for disposal.

This enables the LLW/ILW waste intended for the Aube repository and stored in specifically designed areas (BAC/BTE) to be separated from the very low level waste intended for the VLL waste repository (on the VLL areas).

A number of actions are continuing:

- reduction in the quantities of concrete hulls and drums present in the BAC and BTE, by optimising the entire "shipping" process and taking account of the need for removal to the Aube repository as early as possible (action in progress);
- development of a specific packaging for transporting certain type B package containers to the Aube repository;
- the search for disposal channels for particular waste: neon tubes, sludges, lead;
- providing the sites with calculation methods for improving the radiological inventories for certain waste.

H.2.2.4.2 Packaging and disposal of waste on EDF sites being dismantled

Correct dismantling of the 9 shut down EDF reactors requires strict management of the waste produced by these operations and the availability of treatment channels for this waste.

EDF therefore estimates that 700,000 to 800,000 tons of waste will be produced by the current dismantling of the 9 reactors today shut down. Most of this, some 500,000 to 600,000 tons, will consist of cleaned concrete and rubble, which will mainly be used to fill the holes left in the site by the facilities once dismantled. The remaining 200,000 tons constitute nuclear waste for which the disposal channels either exist or have to be created. They can be divided into:

- 130 to 140,000 tons of very low level waste, for which the Morvilliers VLL repository in the Aube *département* has been available since August 2003;
- about 50,000 tons of low or intermediate level waste, for which the Aube repository is available;
- nearly 20,000 tons of graphite for which a channel and disposal solution need to be developed by Andra and the Nuclear Safety Authority by 2008-2010 to allow dismantling of the GGR reactors;
- about 1000 to 2000 tons of intermediate level, long-lived waste, which will be stored pending opening of a dedicated disposal facility.

With the creation of an engineering unit dedicated to dismantling, EDF has acquired the skills it needs to define and implement the various packaging and disposal channels for the various types of waste to be produced by the dismantling of its reactors.

H.2.3 Analysis by the ASN concerning BNIs

For the facilities in operation, the principle of the periodic safety review (see § G.2.1) guarantees that the safety of the facilities has been examined in the light of the most recent knowledge and regulations.

The waste repositories which are no longer in operation retain their ICPE or BNI status and are thus subject to the same requirements. In particular the condition of the facility is periodically reviewed and if justified, the need for a possible intervention is examined.

A national inventory of polluted sites is kept up to date and the need for any intervention is examined in the light of the potential health consequences and the priority that must be given to the polluted sites as a whole (chemical or radioactive).

There is no activity concentration level below which the sites are automatically cleared from all institutional supervision. This clearance is on a case by case basis, taking account of the possible reuse of the site and the recommendations of the various stakeholders involved.

As a result of their previous activities, whether industrial or research, COGEMA, the CEA and EDF have stored radioactive waste on certain sites (La Hague, Saclay, Marcoule, Cadarache, Chinon, le Bugey, Saint-Laurent-des-Eaux). This interim storage took place in accordance with the regulations and rules of good practice applicable at the time. The lack of or the age of the packaging of this waste and the initially envisaged lifetime of these stores, combined with the ever-stricter safety requirements since then, means that this waste must be recovered for long-term packaging.

Current or future actions are therefore of several types:

- study of new treatment and packaging methods;
- precise characterisation of the old waste;
- implementation of treatment and packaging facilities conforming to current facility and packaging safety criteria; these could be new facilities or renovated facilities, such as the CEA's effluent processing stations;
- recovery of the waste by installing specific processing equipment or facilities (La Hague sludge recovery facility, recovery of hulls and end-pieces from the HAO silo, recovery of waste from silos 115 and 130, equipment for treatment old waste from the Cadarache storage "trenches" and pits);
- deployment of storage facilities designed for a lifetime compatible with the development of long-term solutions which will follow on from research work into the management of high level or intermediate level and long-lived radioactive waste.

Among the old waste, the ASN is particularly interested in that for which there is currently no appropriate disposal channel. The future of this waste is being discussed by the working group in charge of drafting the National Plan for Management of Radioactive Waste and Recoverable Materials.

This group is examining possible solutions for disposal of the following waste:

- tritiated waste which, as it contains tritium, is hard to contain inside a waste package. Its disposal in the Aube repository could only be envisaged if the quantity of tritium present in the packages is low or if the tritium is effectively contained. Although Andra has agreed in principle to accepting a few packages of tritiated waste, the results of the studies conducted by the CEA mean that it will be unable to accept all the tritiated waste which, according to Andra's estimates, would lead to tritium marking of the repository environment. The only channel for most of this waste is thus for the time being interim storage in special installations to allow radioactive decay of its content.

- graphite waste containing a large proportion of long-lived radionuclides, making it impossible to dispose of it in the Aube repository. For this waste, Andra is currently looking at several appropriate disposal concepts.

Pending recovery of the waste, the ASN ensures that the often ageing facilities in which it is stored are adequately supervised and sufficient remediation measures are taken to meet current safety criteria. In the more problematical cases, it may be necessary to find an alternative facility.

With regard to management of the sources covered by the authorisations issued by the ASN, they are permanently monitored by their owner, who must at all times be able to state where they are by means of an inventory, whenever requested by the Authority. For sealed sources, this monitoring is backed up by an annual examination of the conditions of use of the sources by an approved organisation, with the results of this examination being sent to the Authority, to back up a renewal application. The traceability of sources, which are contained in a national inventory held by the IRSN, is partly based on the periodic production of a record of their movements drawn up by their suppliers (see § F.2.5 and Section J. for source lifetime expiry).

H.2.4 The case of old non-BNI waste

Current policy and practices concerning this waste were presented in the general framework in sections B.4 and B.5.

For ICPEs; the regulations allow the authorities to review the licenses to improve the working of old installations such as mining waste storage facilities.

Contaminated soils from former sites from the 1940s to 1960s have been inventoried and characterised with the methodology used for any type of pollution.

As a precaution, even if no contamination could be measured after dismantling, the ASN requests that utilisation restrictions be put in place.

No universal soil contamination limit has been set, because the principle of case by case assessment would seem to be more appropriate, in particular given the fact that the public's perception of nuclear and chemical hazards is an important factor.

For contaminated soils, a case by case study must be conducted and approved by the ASN. The ASN asks for site utilisation restrictions in order to limit future uses and ensure that the future owners are informed. This is done by means of an encumbrance.

For all types of waste, the responsible party is designated (designated as producer of the waste). Interim storage takes place under the responsibility of the waste producer. In France, there are facilities able to take contaminated soils.

For certain specific cases, in which no responsible entity can be found, there are administrative and financial guarantee mechanisms.

H.3 Siting of proposed facilities (Article 13)

1. Each Contracting Party shall take the 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 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 concerning BNIs

General BNI regulations apply to radioactive waste management facilities, which are classified as basic nuclear installations. In this respect, the operating license for an underground laboratory must be accompanied by a geological and hydrogeological survey.

The Environment Code sets the legal framework for underground laboratories. It requires that any project be discussed with elected officials and the populations, as determined by decree. In addition, the building and operating permits for undergrounds laboratories are only given after an environmental impact assessment, public inquiry and opinion of the *Conseil d'Etat* (highest administrative court in France).

Reserves are created to facilitate integration of the laboratories into the economic domain and increase the transparency of the research done. The law encourages the creation of joint interest groupings to help finance this research. Moreover, on each site, local information committees are set up, comprising representatives of the State, elected officials and members of associations.

These committees, chaired by the Prefects, are informed of the research programmes and can refer to the CNE or request a second assessment.

It must be mentioned that the Government requested the creation of the National Plan for Management of Radioactive Waste and Recoverable Material which will offer a clear picture of the waste categories, management methods and objectives with regard to the existing or potential disposal channels.

Jointly with the administrations, industry and representatives of civil society, this plan will enable the public to be informed and make it easier to gain acceptance of the repository.

Furthermore, under the terms of Euratom article 37 a country that envisages building such a site must consult the neighbouring countries likely to be concerned by the planned site. For France, this is mentioned in article 5 of decree 77-1141 as amended by decree 2003-787 of 1 August 2003, which entered into force on 1 November 2003.

The law of 30 December 1991 asks that no later than 2006, the Government present Parliament with a report on the siting studies conducted plus, if necessary, a bill authorising creation of a high level waste repository.

Should Parliament approve such a decision, a technical assessment would be carried out. The regulatory framework - dedicated process or general BNI regime - for such an application has yet to be defined. In any case, discussions and participation by the public will be a necessary feature of the procedure.

H.3.2 Measures taken by the BNI operators

H.3.2.1 Measures taken by Andra

The characteristics of the environment of a disposal facility site are essential data, as the geological environment constitutes a containment barrier for the facility which comes into play when the integrity of the artificial barriers (waste package, repository structure) can no longer be guaranteed. This situation is examined more closely when evaluating the long-term impact of the disposal facility, which is included in the files submitted to back up applications for creation authorisations and which are the subject of a public inquiry, in conformity with the regulations.

This inquiry took place in 1986 when the Aube repository was opened, in 2000 when the Manche repository entered the surveillance phase and in 2002 when the very low level waste repository was opened in Morvilliers.

The Aube repository has a local information committee (CLI) and the Manche repository a surveillance committee (CSCM) on which the elected representatives from the communes adjoining the repositories have seats. The VLL waste disposal facility will have an equivalent structure. Andra periodically presents the safety reviews from the repositories to these committees, with attendance by representatives of the local DSNR.

In addition, ASN declarations of safety-related events in a repository are simultaneously forwarded to the chair of the competent committee and to the elected representatives of the communes in which the sites are located.

Information brochures are regularly published by Andra and distributed to the local residents. Finally, the public can obtain information on safety questions from the visitor reception buildings in each repository.

Finally, for creation of the Aube repository, a dossier concerning discharges from the centre was submitted on 23 May 1991 to the European Commission under article 37 of the EURATOM treaty covering discharges, and received a favourable opinion on 12 November 1991. This dossier was updated as part of the examination of the liquid and gaseous radioactive discharge permit request filed in June 2002 (see § F.4.2.1.3) and was transmitted to the European Commission in application of article 37 of the Euratom treaty.

In the same way, the transition of the Manche repository to the surveillance phase was compared to creation of a new basic nuclear installation and hence, a dossier was transmitted to the European Commission for this centre on 29 March 2000 under the same article 37 of the EURATOM treaty on discharges, and received a favourable opinion on 19 October 2000.

H.3.2.2 Measures taken by the CEA

The CEDRA facility currently being built at the Cadarache Centre comprises an interim storage facility capable of taking existing stocks plus 30 years of current production. Prior to the public inquiry, the CEA conducted an extensive information campaign in the local communities, through meetings of the Cadarache local information committee. The facility authorisation application was submitted to a public inquiry in the summer of 2002. After a favourable opinion from the Inquiry Commissioner, the authorisation decree was published in October 2004.

Other public inquiries for other facilities have also taken place in recent years: this is the case for STELLA, the new liquid effluent processing facility at the CEA Saclay centre.

H.3.3 ASN analysis concerning BNIs

The ASN ensures total compliance with the relevant regulations through examination of the dossiers submitted by the operators.

H.3.4 Case of ICPEs and mining waste

Environmental acceptability is the guiding principle of the regulations applicable to installations classified on environmental protection grounds. The requirements must ensure that any hazard to the vicinity is eliminated and that the environment is protected. The approach followed must thus be based on environmental sensitivity.

In the case of installations subject to authorisation, in accordance with European directives, the authorisation application must comprise an impact assessment, the aim of which is to analyse the impact of the project on the environment. Its content must be commensurate with the scale of the planned works and the foreseeable consequences. The impact assessment must comprise:

- an analysis of the initial status of the site and the environment, in particular concerning natural resources, material goods and the cultural heritage likely to be affected by the project;
- an analysis of the direct and indirect, temporary and permanent effects of the installation on the environment;
- the reasons for which, in particular in the light of environmental concerns, the project was chosen from among the possible solutions;
- the measures envisaged by the applicant to eliminate, restrict and if possible remediate any inconveniences created by the installation.

The authorisation application must also comprise a hazard analysis. It in particular contains a description of the accidents which could occur, in particular under the effect of foreseeable external causes given the planned location, and a presentation of the hazards that could be posed by the installation in the event of an accident.

The content of the hazard and impact assessments, and all aspects of the authorisation application file, are made public and submitted to the populations concerned by the project within the framework of a public inquiry.

With regard to mining residues, the general regulations of the mining industries set specific rules for management of radioactive products with a uranium content higher than 0.03%. In practice, small quantities of mine tailings are concerned by this rule, because at times when the uranium price was high, most of the ore containing more than 0.03% had undergone leaching. The only case that exceeds this limit would seem to be poor ore containing 0.07% uranium disposed of in Lodève.

The mining residue disposal operations are the responsibility of the Prefects. The requirements in particular concern effluent discharges and inspection of the facilities and their environment. Not only the radiological impacts, but also the physical and chemical impacts have to be taken into account, according to the geological characteristics of the ore storage area.

Each mining establishment has its own characteristics. Most French sites contain low levels of heavy metals in the tailings. However, a few sites do produce leaching solutions, in which case waste water treatment is carried out.

H.4 Design and construction of facilities (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 Case of BNIs

For radioactive waste management facilities, which are basic nuclear installations, the definition of which was specified in paragraph E.2., the BNI general regulations apply.

The description of the BNI general regulations, which include the design and construction of spent fuel management facilities, was presented in paragraph E.2.2.3.2 with regard to procedures, paragraph E.2.2.5 with regard to technical rules and paragraph E.2.2.4 with regard to discharges.

The storage facility safety studies guarantee that the technologies used in the design and construction of the facilities are based on experience, testing and analysis.

With regard to the technical measures for decommissioning a basic nuclear installation, the circular appended to decree 73-278 of 13 March 1973 recalls that these must be described in a specific chapter of the safety analysis report to be submitted in support of the authorisation decree application mentioned in paragraph E.2.2.3.2.1.

The operator is asked explicitly to demonstrate that it has taken the necessary measures to facilitate future dismantling, taking account of French and foreign experience in this field. This demonstration must be included in the documents submitted to the ASN.

No exhaustive dismantling programme is required, given the very long lifetimes of these facilities.

The Nuclear Safety Authority checks implementation of these regulations through the analyses and inspections it conducts, as specified in paragraphs E.2.2.6 and E.2.2.7.

H.4.2 Case of ICPEs

For radioactive waste management facilities which are installations classified on environmental protection grounds, the general ICPE regulations apply. The description of these regulations with respect to design and construction, was presented in paragraph E.2.3.1.

The regulatory authority checks implementation of these regulations through the analyses and inspections it conducts, as specified in paragraph E.2.3.2.

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 concerning BNIs

For radioactive waste management facilities, which are basic nuclear installations, the BNI general regulations apply and their description regarding the safety assessment was presented in paragraph E.2.2.3.1.

In particular, the circular associated with decree 73-278 of 13 March 1973 stipulates that a preliminary safety analysis report must be submitted in support of the authorisation decree application. This text also states that a provisional safety analysis report must be supplied in support of the pre-commissioning test application and finally that a final safety analysis report must be provided in support of the final commissioning application, as mentioned in paragraph E.2.2.

There is no time limit on the authorisations granted to nuclear facilities.

However, a periodic safety review must be carried out every 10 years and can lead to decisions being made concerning the future of the facility.

For the particular case of a surface repository, following closure, a 10-year surveillance phase is required, following which a safety review is conducted to find out whether the facility can enter a more passive surveillance phase. There is no time limit for this phase, although the safety studies consider intrusion scenarios after 300 years.

The safety demonstration assessed before commissioning and then periodically every 10 years comprises 3 parts:

- safety demonstration for the operational phase

- safety demonstration for the surveillance phase with institutional supervision for 300 years

- safety demonstration for the theoretical situation without institutional supervision 300 years after closure

In each phase, conventional design and sizing scenarios are used. For example, for a 300 year storage facility, construction of a road, of a sports field, of housing, a well, and so on.

To authorise the surveillance phase, the safety of the last 2 phases is assessed, taking account of the actual inventory of waste stored.

For other storage sites which are today at the planning stage, the approach is comparable. However, the duration of the surveillance phase must be defined and must not exceed 300 years.

H.5.2 Measures taken by BNI operators

H.5.2.1 Andra practices

For the Manche and Aube repositories, which are basic nuclear installations, Andra has complied and continues to comply with the applicable regulations.

For creation of the Aube repository, the safety and environmental assessments concerned not only the operating phase, but also the surveillance phase not exceeding 300 years, and the post-surveillance phase. The design of the disposal structures and the specifications applicable to waste packages take account of the modifications necessary for transition of the repository to the surveillance phase.

As mentioned in paragraph H.2.2.1, the preparation for transition of the Manche repository to the surveillance phase was carried out using the same provisions as for creation of a new BNI.

The periodic safety reviews for the radioactive waste disposal facilities were presented in paragraph H.2.2.1.

H.5.2.2 Practices of other operators

Radioactive waste management facilities are basic nuclear installations, in the same way as spent fuel management facilities, and are thus subject to the same regulations. Consequently, the practices of the CEA, COGEMA and EDF - which possess both types of installations - in terms of safety assessment of radioactive waste management facilities - are identical to those used for spent fuel management facilities, described in section G.2.2.

H.5.3 ASN analysis concerning BNIs

Radioactive waste management facilities are not covered by specific BNI regulations. Their impact and safety are assessed prior to granting of their authorisation (see § E.2.2). In the case of disposal facilities, the long-term safety of the facility is part of the safety demonstration made as of the design and authorisation of the facility.

H.5.4 Case of ICPEs and mining waste

The assessment of the design choices made by the operator and the assessment of the impacts and hazards associated with an installation classified on environmental protection grounds that is subject to authorisation, or a mining waste disposal facility, are analysed during examination of the results of the impact and hazard assessments (see § F.5.3.2 and § H.3.4).

The objective of the operators and personnel responsible for administrative surveillance was not to leave excessive long-term site surveillance or maintenance constraints in place.

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 characterization 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 concerning BNIs

For radioactive waste management facilities which are basic nuclear installations, the general BNI regulations apply and their description in terms of operation is presented in paragraph E.2.2.4.

As for the other nuclear facilities, events and incidents must be declared to the ASN. The declaration criteria are recalled in the following table:

BNI incident declaration criteria
Events of nuclear or other origin, leading to death or serious injury and in particular requiring that the injured be taken to a hospital, when the origin of the injuries is directly related to the safety of the facility (falls, work site or traffic accidents for example).
Activation of a safeguard system: manual or automatic, unintentional or intentional activation of a safeguard system, except for intentional activation resulting from scheduled actions.
Events leading to:
- exceeding of one or more safety limits as defined in the safety reference system or facility authorisation decree;
- common mode failure on systems that are important for safety.

Internal or external hazard in the facilities: occurrence of an external phenomenon of natural origin or linked to human activity, or internal flooding, fire or other phenomenon likely to have significant consequences or affect the availability of equipment involved in a function that is important for safety.
Actual or attempted malicious act likely to affect the safety of the facility.
Events disabling all the barriers placed between the hazardous substances and persons and leading to dispersal of these substances. This in particular concerns incidents, other than deliberate action, which did lead or could have led to dispersal of radioactivity or exposure of persons to serious consequences inside or outside the facility, at a level that is significant given the limits set by the regulations.
Events which, although not affecting all barriers, led or could have led to significant dispersal of hazardous substances or significant exposure of persons to ionising radiation, inside or outside the facility.
Faults, deterioration or failures which affected an essential safety function, which did or could have had significant consequences, whether detected during operation or during a facility outage.
Event not meeting the above criteria and affecting an important safety function which is repetitive and for which the cause has not been identified or which constitutes early warning signs of an accident.
Any other event likely to affect the safety of the facility and felt to be significant by the operator or by the Nuclear Safety Authority.

The operator must provide a detailed report comprising technical analyses, a human factors part, and a cause tree. The ASN ensures that it is exhaustive and uses it for a cross-functional analysis between the various operators.

During the ten-yearly safety reviews, experience feedback from all incidents in France and abroad is assessed in order to propose any safety improvements.

H.6.2 Measures taken by BNI operators

H.6.2.1 Andra's operating safety practices

For its installations covered by the BNI regulations, Andra follows the procedures described in paragraph E.2. They in particular apply to commissioning of these facilities and to the declaration of events significant to safety.

The general operating rules (RGE) define the normal envelope within which the repositories are operated. They are established by Andra in conformity with the general regulations, the regulations specific to each facility (in particular the authorisation decree) and the technical requirements notified by the ASN. The RGE are subject to formal approval by the ASN.

Environmental monitoring plans are also drawn up by Andra and stipulate the measurements taken in or around the repositories to check their impact and the frequency of these measurements. They are also the subject of critical examination by the ASN prior to implementation.

These steps are taken not only in the operating Aube repository, but also in the Manche repository, now in the surveillance phase.

Generally speaking, all the activities performed by Andra, in particular operation, maintenance and surveillance of the disposal facilities, are carried out according to established procedures, in conformity with the quality system set up by Andra (see § F.3.2.1). The organisation of the Agency aims to maintain the necessary scientific and technical skills in all areas related to the safety of its facilities (see § F.2.2.1).

At least every six months, Andra sends the ASN a report on the operations carried out in the disposal facilities. These reports describe the origin and quantities of waste packages delivered and stored and the main significant operational events. Monthly environmental monitoring bulletins are issued containing the measurement results and annual interpretation reviews.

Finally, Andra produces an annual summary of the package approvals it has issued, enclosing the corresponding back-up dossiers in accordance with the process described in paragraph H.1.2.1; these dossiers mention the waste characterisation procedures employed by the producers to meet disposal safety needs. Andra produces reports on the quality of packaging of this waste, for each of the waste production sites. These reports contain information gathered during process audits conducted by Andra in the waste producers' facilities, during computer checks on the specifications of each package to be delivered, during checks on the packages delivered to the Aube repository and finally, during destructive and non-destructive tests performed on delivered packages. Quality report meetings are organised with the producers.

All this information is used when updating the safety documents, in terms of both the short-term safety and the medium to long-term safety of the disposal facilities. It may lead to changes in the operating conditions.

The experience acquired with the Manche repository currently in the surveillance phase, is helping with preparation for the transition to surveillance of the Aube repository, although this should not happen for about another fifty years (see § H.1.2.3).

H.6.2.2 CEA, AREVA and EDF practices

Radioactive waste management facilities are basic nuclear installations, in the same way as spent fuel management facilities, and are thus subject to the same regulations. Consequently, the practices of the CEA, AREVA and EDF – which possess both types of facility – in terms of the operating safety of radioactive waste management facilities, are identical to those employed for spent fuel management facilities, described in paragraph G.6.2.

H.6.3 ASN analysis concerning BNIs

The provisions described in paragraph E.2.2 concerning BNI regulations aim to meet the objectives of article 16. Monitoring of the steps taken by the operators, in particular through frequent inspections and periodic safety reviews, guarantee that the regulations are implemented.

H.6.4 Case of ICPEs and mining waste

In the case of installations classified on environmental protection grounds, the steps to be taken for operation, maintenance and monitoring as well as any required at the time of decommissioning, are set by technical requirements incorporated into the Prefect's order (see § E.2.3.1).

With regard to mining waste, as all facilities are no longer in operation, practices concerning closure are presented in paragraph 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 The case of waste from BNIs or ICPEs

The first disposal facility in France to have entered the surveillance phase (final closure as defined under the terms of the Convention) is the Manche repository, described in paragraph B.5.4.1.

Andra applied for the corresponding authorisation in 1995. Following the public inquiry into this application, which led to a favourable opinion, a commission was tasked by the government with assessing the situation of the Manche repository and submitting its opinion on the impact of the repository on the environment. Andra was then asked to submit a new application taking account of the recommendations of this commission.

In September 1998, Andra therefore submitted a new application for authorisation to make the transition to the surveillance phase, completed in 1999. The safety documents produced to back up this application were submitted to the ASN, which officially approved them in January 1999.

At the request of the ASN, Andra in December 1997 also submitted a discharge permit application, revised in 1999.

These two applications were submitted to the public inquiry from 2 February to 17 April 2000 (inquiry extended until 17 May in the case of the application for authorisation to make the transition to the surveillance phase). The Inquiry Committee issued a favourable opinion on 6 June 2000 concerning each of these applications, but with three reservations concerning the transition to the surveillance phase. These reservations respectively concern the extension to ten years of the first surveillance phase of the repository, examination of reinforced monitoring resources in the proximity of the structures with the highest potential hazards, and implementation of a programme of inspections and maintenance of the drains collecting the water circulating through the facility.

After the public inquiry, jointly with the various ministerial services concerned and taking account of the recommendations of the public Inquiry Committee, the ASN prepared a draft authorisation for transition to the surveillance phase, amending the initial authorisation decree of 1969, and a draft discharge authorisation order. The draft decree was examined in early 2001 by the Inter-ministerial BNI committee and submitted at the end of 2002 to the Manche *département* health council. The discharge authorisation order and the decree authorising the transition to the surveillance phase were published on 11 January 2003.

The surveillance mechanism put in place should allow the following:

- check on the correct behaviour of the disposal system;
- detection of any abnormal situation or development in order to locate the origin, identify the causes and initiate the necessary corrective action;
- assessment of the radiological and chemical impact of the facility on the population and the environment and monitoring of any evolution.

In the surveillance plan, the operator describes all steps taken to attain the objectives defined above. It sends the ASN a yearly report concerning application of this surveillance plan and presents its interpretation of the results obtained.

Every year, a summary of this plan is made public. This summary is sent out to the local information and surveillance committee of the Manche repository.

H.7.2 Case of mining waste

The objective of the operators and personnel responsible for administrative surveillance was not to leave excessive long-term site surveillance or maintenance constraints in place.

Site rehabilitation has until now been designed and carried out so that after an active surveillance period of 5 to 10 years, surveillance of these sites could be considerably scaled down. Mine tailing with uranium content of less than 0.03% is also used to cover over more active residues resulting from chemical processing.

At the Bois Noirs site, the long-term formula is still being examined and its priority concern is the chemical processing residue and, to a lesser extent, the water overflowing from the mine works.

After cessation of operations, mining sites have to undertake work in conformity with the decisions of the Prefect. This work must be such as to control the long term hazards by choosing robust and durable structures. The Prefect first of all asks for an active monitoring system to be set up to confirm that the impact remains at acceptable levels.

On the basis of experience feedback from this monitoring, active surveillance may be scaled down to passive surveillance

The long-term acceptability is examined in the light of realistic degraded situation scenarios (loss of watertightness of the embankment, degradation of the covering layer, mining works, residential construction, etc.)

One major aspect of the surveillance system is institutional supervision, the aim of which is to ensure that possible changes to the land will not affect hazard management.

This institutional supervision of the soil and water consists of:

- restrictions on the occupation or utilisation of the site (irrigation, cultivation, livestock breeding, housebuilding, bathing, etc.)

- imposed actions (surveillance, maintenance, etc.)

- precautions required (excavation work, pipe laying, etc.)

- access restrictions.

Information is accessible to the public and is contained in legal documents. In the event of a major hazard, the Prefect may decide to implement a mining hazards prevention plan (PPRM).

Mining residues comprise ore containing uranium. They therefore contain daughter products of uranium at equilibrium. Once the process has extracted 90 to 95% of the uranium, the residues contain elements of the thorium 230 chain and in particular radon 226 and various isotopes of radon.

The various radionuclides and radon are included in the impact assessments and site surveillance 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 authorized 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 utilized;

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 authorize 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;

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;

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 Transboundary transport authorisation

For France, transboundary movement of spent fuels and radioactive waste primarily concern the spent fuel reprocessing operations performed in the La Hague plant on behalf of German, Japanese, Belgian, Swiss and Dutch customers.

France is committed to the principle whereby each nuclear power plant operator is responsible for the waste it generates, a principle it has incorporated into the law of 30 December 1991. Article 3 of this law states that "disposal in France of imported radioactive waste, even if reprocessed in France, is prohibited beyond the technical time-frame required by this treatment".

The spent fuel reprocessing contracts with foreign nuclear power companies thus comprise a clause stipulating return of the wastes to their country of origin. This waste is packaged in a form allowing safe transport and interim storage offering protection of both the environment and public health. These contracts are reinforced by inter-governmental agreements guaranteeing return of the waste. France ensures that the countries of destination of the waste abide by the obligations of § 1 of article 27 of the Joint Convention.

With regard to the organisation of transboundary movement, France abides by the extensive international, European and national safety, transport, security, physical protection and public order regulations.

It in particular abides by directive 92/3/Euratom, transposed into French law by a decree of 22 September 1994, corresponding to the obligations of the Convention. On this point, and as early as 1994 the French authorities went further than the provisions of this directive and anticipated those of the Joint Convention (article 27, § 1, i) by requiring the consent of the State of destination, even if outside the limits of the European Community.

Transboundary movement with European countries mainly uses rail. Sea routes are used for Japan as port infrastructures appropriate to the level of nuclear safety required have been built on both sides. No significant incident compromising safety, security or radiation protection has been notified in recent years during these shipments.

It should be noted that in compliance with § 2 of article 27 of the Joint Convention, France has never authorised a shipment of spent fuel or radioactive waste to a destination situated south of latitude 60 degrees south.

France is particularly committed to compliance with all aspects of the provisions of article 27 of the Joint Convention concerning transports. It voluntarily supplements them through a policy of transparency, comprising an exchange of information and dialogue, in particular with the general public and society as a whole. It in particular applies these maritime shipment provisions to coastal states along the shipping routes, along with diplomatic information campaigns.

The law of 31 December 1991 prohibits the disposal in France of all foreign waste and only allows storage of such waste for the time necessary for the treatment activity envisaged. Foreign waste may only be imported for treatment provided that this waste and any by-products generated are returned to the country of origin within a time-frame compatible with the technical treatment conditions.

I.2 Supervision of transport safety

I.2.1 Organisation of the supervision of safe transport of nuclear materials

The Nuclear Safety Authority (ASN) has since 12 June 1997 been responsible for regulations pertaining to the safe transport of radioactive and fissile materials for civil use and for supervision of their application. Its powers in this field were confirmed by decree 2002-255 of 22 February 2002 which created the Directorate General for Nuclear Safety and Radiation Protection.

It should be noted that the radioactive material transport regulations have two separate objectives:

– security, or physical protection, consists in preventing the loss, disappearance, theft and misuse of nuclear materials (usable for weapons), for which the Defence High Official, attached to the Minister for the Economy, Finance and Industry, is the responsible authority;

– for its part, safety consists in controlling the radiation, contamination and criticality hazards involved in radioactive and fissile material transportation, ensuring that man and the environment undergo no ill effects. Safety supervision is the responsibility of the ASN.

In application of the decree of 5 July 2001, supervision of the transport of radioactive and fissile materials for national security purposes falls to the Delegate for Nuclear Safety and Radiation Protection for activities and installations concerned by National Defence provisions (DSND).

In the context of supervision of the safe transportation of radioactive and fissile materials, the ASN is responsible for:

– defining technical regulations and monitoring their application;

– accomplishing authorisation procedures (approval of packages and organisations);

– organising and implementing inspection procedures;

– proposing and organising information of the public.

In addition, the ASN can act within the context of emergency plans defined by the authorities to deal with an accident.

I.2.2 Radioactive materials transport regulations

Unlike the technical safety regulations for plants, which are specific to each State, an international basis has been defined by the International Atomic Energy Agency (IAEA) for transportation safety.

This basis has been used for the definition of the modal safety regulations currently in force: the ADR agreement on road haulage, the RID regulations for transport by rail, the ADNR regulations for inland waterway transport, the IMDG code for sea transport and the technical instructions of the ICAO for air transport. These modal regulations have been fully transposed into French law and have been implemented by interministerial orders. In this context, the ASN has frequent contacts with the government departments dealing with the different modes of transport (Directorate for Inland Transport, Directorate for Maritime Affairs and Seafarers, Directorate General for Civil Aviation) and has a representative at the Interministerial Committee on the Transport of Dangerous Goods (CITMD).

Transport safety is based on three main factors:

– first and foremost, on the engineered toughness of the packages,

– on transport reliability and certain specially equipped vehicles,

– on an efficient emergency response in the event of an accident.

Regulations are based on IAEA recommendations, which specify package performance criteria. The safety functions to be assured are containment, radiation protection, prevention of thermal hazards and criticality.

The degree of safety of the packages is adapted to the potential harmfulness of the material transported. For each type of package (excepted packages, industrial type packages, type A packages, type B packages, type C packages), the regulations define the associated safety requirements, together with test standards to be reached.

The regulations concerning transport safety applicable to spent fuel and waste resulting from treatment of these materials, is consistent with that applicable to radioactive materials, which constitute a hazardous materials category (class 7). The regulations applicable to these hazardous materials and the definition of the various categories are established by the UN and its specialised institutions. In the case of radioactive materials, competence lies with the IAEA.

To ensure absolute consistency with the specifications and make certain that the operators are fully aware of their obligations, responsibility for safety lies with the operator requesting transport, barring any other duly formalised arrangement.

The ASN is the competent authority for the safe transport of radioactive materials. It supervises the drafting and application of the technical regulations. Other public organisations also play a role:

- the IRSN as technical support body for certain governmental authorities, through analysis of the dossiers

- the Ministry for the Interior, which defines the off site emergency plans to be implemented by the Prefects.

With regard to spent fuel, France is not concerned by the obligations arising from article 27.1iv because it primarily imports spent fuel intended for reprocessing in France, at La Hague. Nonetheless, these contracts are covered by international agreements between the French Government and the other governments concerned.

With regard to the transport of radioactive waste, the obligations must conform to the regulations concerning safety, transport, security, physical protection and maintaining law and order. These regulations are derived from national and international laws and from the requirements defined by the IAEA after consultation with the various international bodies in charge of transport safety issues. In particular, articles 13,15 and 25 of the decree of 22 September 1994, transposing directive Euratom 92/3, stipulate that before authorising a transboundary movement of radioactive waste, the competent French authority must ensure that this transport has been approved by the authorities of the country of destination.

The law of 25 July 1980 and the various related texts, including the decree of 12 May 1981 and the ministerial order of 26 March 1983 are designed to prevent theft or misappropriation of nuclear materials contained in a facility or a shipment. This applies to fuel transports.

To achieve this, these texts require that the owners and transporters obtain a general authorisation beforehand. They are in particular asked to take measures to protect the material they collect or transport and to comply with inspection requirements.

The Defence High Official reporting to the Ministry for Industry is responsible for implementing these legal and statutory provisions. In this context, he has access to a special department : the CMN (nuclear and sensitive materials control centre).

For the performance of this task, this department relies on the assistance and technical expertise of the IRSN. For transports, the IRSN is responsible for organising and monitoring nuclear transports under its own authority.

In this context, a duly authorised transporter must provide the IRSN with a notice describing the conditions of each operation: nature and quantity of material transported, places of departure and arrival, route and schedule, border crossing points. After examination, this dossier is transmitted to the CMN, for a final decision by the Defence High Official (HFD).

The transport operation itself is supervised by the IRSN. To ensure this, the transporter provides contact between the convoy and the IRSN in order to keep it informed at all times of any event likely to delay or compromise the operation, and to inform the HFD.

If circumstances so warrant, the Minister for the Interior may decide whether transport can take place in the specified conditions. This decision implies close co-operation between the CMN and the police authorities.

For radioactive materials containing no radioactive waste, the general safety measures apply.

I.2.3 Inspection of radioactive material transports

The ASN has implemented inspection provisions involving the DRIREs at local level, in similar fashion to the procedures already adopted for basic nuclear installations.

These organisational arrangements allow inspections to be carried out on the sites of designers, manufacturers, users, carriers, consignors and their subcontractors and enable package quality to be monitored between two authorisation extensions. In this connection, the 5th sub-directorate of the DGSNR (BCCN) has been entrusted with manufacturing supervision of type B packages since 1998.

Training sessions for "transport" inspectors were renewed in 2004. They will be periodically provided to maintain inspector qualification.

From both the regulatory and practical standpoints, it is important to ensure good cohesion with other supervisory authorities responsible, notably, for the inspection of transport vehicles, for labour inspection in the transport sector or for the protection of nuclear materials. These authorities may have to prohibit transport operations further to observation of regulatory non-conformities.

Since 1998, more than 400 inspections have been carried out in this field.

I.2.4 Radioactive material transport incidents

The circular letter of 28 August 2003, sent out by the ASN to all consignors and carriers, redefines the incident and accident declaration criteria initially sent out in the circular of 7 May 1999. It also reuses the incident report model proposed in the ADR and RID orders.

All transport discrepancies are thus declared to the ASN. Apart from this declaration, a detailed incident report must be sent to the Authority within two months. Events concerning regulatory nonconformities but which do not impair the safety function are not concerned by this report. In the case of contamination, an analysis report is to be sent to the ASN within two months.

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

In 2002, France asked the IAEA to organise a mission to assess its radioactive materials transport organisation and its implementation of international regulations. The TranSAS (Transport Safety Appraisal Service) mission ran from 29 March to 8 April 2004. The mission team comprised fourteen experts from nine different countries (Canada, Egypt, Germany, Great Britain, Ireland, Japan, New Zealand, Panama and the United States of America,) plus two IAEA experts and a technical writer. The mission issued three general types of comments:

- recommendations for areas in which the Authority needs to make improvements in compliance with the international regulations;
- suggestions for areas in which the Authority could improve its efficiency;
- best practices that could act as a model for other competent Authorities in the field of radioactive materials transport.

The report is available on the ASN's website and in particular contains three recommendations, sixteen suggestions and twelve best practices. The general conclusion is that the international regulations are implemented in accordance with the IAEA's requirements and that improvement is however possible, in particular concerning updating of guides and procedures as well as in formal proof that all the requirements have indeed been met.

The recommendations concern:

- development of an appropriate programme for packages that have not been approved;
- revision of the agreement with the IRSN, developing a specification stipulating the scope and recording of the appraisal work done concerning the package approvals;
- revision of the appraisal procedures in order to formalise proof that all the requirements of the regulations have been met for the approved packages, special arrangements and shipment approvals.

The best practices in particular concern transport by sea, preparation for emergency situations, inspection and protocols with the other administrations in charge of the various modes of transport.

The ASN is devoting particular attention to implementing the recommendations of this mission. This mainly consists in formalising existing practices in documentary form.

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 requirements

The general regulatory framework for sources is described in paragraph F.4.1.2.3 Sealed sources are returned to the supplier once no longer used or no later than ten years after the date of initial authorisation by the IRSN on the corresponding supply form, barring official prolongation of the utilisation authorisation.

This prolongation is in particular to be assessed on the basis of the source construction process, the quality of its construction and the conditions in which it has been used, as well as according to the extent to which the condition and leaktightness of the source can be checked.

J.2 Role of the CEA

In the past, the CEA was one of the main suppliers of sources in France. In this capacity it manages the sources returned to it by industry, hospitals, etc. The CEA also stores in its own facilities a large number of disused sources, which were handed over to Andra by the public authorities. This leads to a wide variety of sources, which sometimes have to be recovered from remote countries and which often require characterisation owing to the lack or inadequacy of the documentation normally associated with these sources.

The inventory of the CEA's radioactive sources is monitored via a database supplied with data by the units in possession of the sources. This database now indicates the status of the source (in use or disused) and the disposal channel when known, or the interim storage conditions pending a final appropriate disposal solution (surface repository, deep geologic disposal, etc.).

Disused sources are dealt with in the appropriate disposal channels, after a procedure currently under preparation in France, to downgrade sources to waste.

The spirit of the CEA disused source strategy is thus comparable to that defined for management of radioactive waste.

Section K– PLANNED ACTIVITIES TO IMPROVE SAFETY

K.1 National measures

K.1.1 Objectives of the Nuclear Safety Authority

France is committed to constantly improving the safety of its spent fuel management facilities and its radioactive waste management facilities. With this in mind, the priority goals of the Regulatory Authority are:

- to complete the PNGDR-MV, drafted jointly with all parties concerned and with the public as a whole, covering all waste categories and identifying those which do not yet have an appropriate disposal channel;
- to encourage resolute continuation of research into final management solutions for waste currently without a disposal channel, in particular high level waste.

Moreover, with regard to BNIs, the objectives of the Nuclear Safety Authority concern the following points:

- to ensure continued recovery of old waste stored in unsatisfactory conditions;
- through regulatory texts, to formalise requirements and administrative practices as yet not covered, in order to maintain the Nuclear Safety Authority's clear and strong position once market deregulation increases the economic stresses on the operators;
- to ensure that the safety of activities related to spent fuel and waste management continues to be dealt with on an equal footing with activities related to reactors, on the one hand through implementation of the "quality" order and on the other by promoting development of the safety culture around these activities;
- to improve consideration of human factors and organisational problems by the operators, as these problems are often the cause of incidents;

K.1.2 Objectives of the operators

In 2001, Andra signed a contract with the State consolidating the general framework of its actions and defining the goals to be achieved during the period 2001 to 2004. Safety is directly and indirectly at the heart of these goals:

- to increase operating safety requirements, on the one hand by making the personnel and contractors more aware of the issues and on the other by improving systems and procedures;
- to build and then operate new operational disposal solutions (commissioning in 2003 of the very low level waste repository, definition by 2003 of safe concepts for the disposal of radium-containing waste and graphite waste);
- to propose management channels for waste generated by small nuclear producers which today has no management solution, by continuing development of interim storage likely to offer complete coverage of requirements by 2004;
- to continue inventory improvement work, as well as definition of specifications and quality control of packages, to be able to accept package types not covered so far.

After expiry in 2004 of the four-year contract with the State, a new one is being drafted for the period 2005 / 2008. In this new contract, provision will be made to take account of the decisions to be taken by Parliament in compliance with the requirements of the law of December 1991.

The CEA also signed a contract with the State, in which development of the safety and security culture, which demands strict compliance with rules in this field, remains one of the CEA's key priorities.

Personnel training and awareness efforts are made, aimed at strengthening the safety, radiation protection and nuclear safety culture of the personnel, as is the drive for progress, on which the facilities safety policy is based and which involves the responsibility of the entire hierarchical line - in terms of defining objectives and financial resources.

In the field of radiation protection, the CEA - for whom the health of its workers and outside contractors is an absolute priority - is strengthening its concrete measures for reduction and forward-looking management of exposure, a process in which the employees concerned are fully involved (Alara approach - As Low As Reasonably Achievable).

For nuclear safety, the CEA is developing a policy aimed at boosting public confidence on the basis of:

- transparency (knowledge of the past; quantified reduction targets for the effluent, discharges and waste produced; clarification of safety objectives per facility, improved prevention by learning lessons from operating incidents), through a process of sustained internal communication;

- quality (ISO 9000 and ISO 14000 certification as a nuclear operator; installation of prediction and reporting tools, indicators with an integrated information system);

- competence (networks of centres of expertise and recognised experts);

- initiative and independence (which in particular requires a sliding 5-year plan for safety and security improvements, at the initiative of the operator).

The other operators do not have a formal framework for their undertakings, comparable to this contract with the State. Nonetheless, as mentioned earlier, they are committed to providing an in-depth response to a variety of concerns, such as quality, safety, security, environmental impact, economic results and social well-being. These were expressed in F.3.2 which deals with quality.

Industry hopes to see complete disposal channels created and is participating in this both technically and financially. A channel was recently created for VLL very low level waste. Industry hopes to see the same happen for radium-containing, tritiated and graphite waste. It is taking part in the technical side of the process to choose the disposal solutions. As regards HLW and ILW-LL waste, it is supporting the programmes set up under the terms of the 1991 law (article L 542 of the Environment Code) and has spent more than €2 bn in this area. It is hoping to see decisions confirming the responsibility of the current generation in ensuring complete long-term management of this waste.

K.2 International co-operation measures

K.2.1 Co-operation between the safety authorities and their technical support bodies

The regulatory aspects of safety and radiation protection lead to numerous exchanges and extensive international co-operation. Within the framework of international organisations, the national safety authorities compare their approaches and methodologies to define safety goals which benefit from shared experience learned from the operation of nuclear facilities in the various countries.

The international actions of the French Nuclear Safety Authority have grown both with international bodies, such as the International Atomic Energy Agency (IAEA), the OECD's Nuclear Energy Agency (NEA), the European Union and nuclear regulators' associations (INRA, WENRA, FRAREG), and within the framework of frequent bilateral meetings with more than about fifteen foreign safety authorities.

The WENRA association brings together the Western European nuclear safety authorities (17 countries having power plants). This association has set itself the goal of providing European institutions with an independent assessment of safety and its supervision in the candidates for accession to the European Union, and to develop a common approach to nuclear safety and its supervision within the European Union.

With regard to harmonisation work, and even though there is nothing to indicate that safety as stipulated in the current requirements in each of the countries is inadequate, the WENRA members consider that their goal is constant improvement of safety. To achieve this, a working group was set up to examine the main differences in safety requirements, from a deterministic or probabilistic design up to safety management and safety culture, for the power reactors currently in operation. A second working group was recently set up to harmonise the radioactive waste safety approaches.

In the field of safe management of radioactive waste and safe management of spent fuel, the international relations of the IRSN, the Nuclear Safety Authority's technical support body, are mainly organised around the following areas of development:

- comprehension of the processes governing transfers of radioactive materials in the geosphere and reaching a consensus on technical questions;
- development of international co-operation on subjects concerning spent fuel and deep geologic disposal of radioactive waste;
- research into deep earthquakes and their consequences on the circulation of underground water;
- studies into the prediction of seismic movements (mainly within European projects such as "Dissemination of Strong Motion Data", PRESAP, simulation of strong motion predictive maps, and CORSEIS);
- development of instrumentation resources;
- modelling of all phenomena of importance for repositories and of the potential dosimetric impact of these installations;
- assistance to the Eastern European countries (European Phare / Tacis programmes and EBRD projects concerning the safety of storage facilities and the safe disposal of waste from the Chernobyl plant).

The IRSN's main partners are:

- GRS (Germany) and AVN (Belgium), in the field of analysing repository safety and modelling of long-term behaviour,
- NAGRA (Switzerland) for studies into underground work on a deep geologic repository for high level long-lived waste,
- JAERI (Japan) for waste disposal safety actions,
- SSTC (Ukraine) and SEC-NRS (Russia) for improved management of waste and spent fuels,
- CIST (Europe + Armenia) to define a possible underground repository site.

Work to expand knowledge and to perfect assessment tools is also being done at an international level. The IRSN has therefore taken part or is still taking part in various programmes:

- BORIS (CE) to study the injection of liquid effluents into the sub-soil in Krasnoyarsk, as part of the European programme,
- BENCHPAR (CE) programme for cross-comparison of methods to model thermo-hydro-mechanical effects in deep geologic formation disposal facilities,
- EVEREST, SPA and BENIPA and NFPRO for overall modelling of transfers in a geological medium and the role of the different confinement barriers;

as well as international working groups set up to draft technical recommendations, guides and standards for radioactive waste and spent fuel. As an example, we could mention the IAEA's methodology guide for the use of historical and archaeological data on earthquakes, and the "Clay-Club" group of experts of the NEA's Radioactive Waste Management Committee (RWMC) for management of radioactive waste and deep geologic disposal.

K.2.2 Co-operation between operators

K.2.2.1 Andra international co-operation

The international aspect is an important part of Andra's activities, as radioactive waste management cannot simply be considered at a national level. It is essential to compare Andra approach with those adopted abroad and to benefit from experience feedback from foreign partners, but also to mobilise high-level scientific expertise in the Agency's programmes and projects. In this respect, Andra has set itself a number of goals:

- to promote contacts and co-operation with its foreign partners. Andra is committed to presenting its projects and methods internationally, in order to compare them with those from other countries concerned by the subject. It therefore integrates its research activities into projects with its European partners, in particular through joint research and development programmes. It opens up its programmes and facilities to its foreign partners, for example the Meuse-Haute-Marne laboratory working on deep geologic disposal of high level, long-lived waste. In 1996, it had its low and intermediate level, short-lived waste management approach assessed by the IAEA (WATRAP exercise);
- representation on the leading international bodies: European co-ordinating bodies, OECD/NEA, IAEA;
- a scientific, technical, economic watch, which is a structured activity within Andra;
- occasional skills valorisation missions.

Two peer reviews were organised under the auspices of the OECD's Nuclear Energy Agency. The first one concerned the 2001 version of the clay dossier, while the second one is in progress and concerns the 2005 version of the clay dossier prior to its submission to the Government.

As part of the European Commission's framework research programme, Andra is actively participating in projects devoted to management of high level radioactive waste, and more particularly the problems involved in disposal in deep geologic formations. Examples of this are the ESDRED project (Andra as leader), the NF Pro project and the Funmigg project.

K.2.2.2 CEA international co-operation

As an organisation for scientific and technical research in the nuclear field, the CEA is developing its activities in all areas concerned, in particular safety; these activities lead to numerous international co-operation programmes.

In terms of the safety of its own facilities, it is participating in the European Commission's community research programme as well as in the work done by the NEA and the IAEA into management of spent fuel and radioactive waste. It has also set up regular exchanges with several similar foreign organisations: these exchanges concern on the one hand operational experience from the facilities (particularly in Great Britain and Belgium) and in particular the lessons learned from incidents (with in addition to these two countries, the United States of America and Japan), and on the other, research into packaging and the long-term behaviour of the waste packages.

K.2.2.3 COGEMA international co-operation

COGEMA takes part in international actions in the field of repository and storage engineering comprising a safety aspect. This is for example the case of contracts covering the design of surface facilities for the Yucca Mountain disposal site in America. Other actions consist in designing and building spent fuel storage facilities (COVRA in the Netherlands) or spent fuel storage containers (Nuhoms in the USA, etc.).

COGEMA also takes part in effluent working groups, such as OSPAR and MARINA II.

Finally, a large number of exchanges are organised between COGEMA and the Nuclear Safety Authorities of COGEMA's customer countries, in particular with regard to the knowledge of the waste packages produced by COGEMA. These packages thus constitute international "standards", in that they are used as the basic data in numerous geologic formation repository concepts (in Germany, Japan, Belgium, Switzerland, etc.).

K.2.2.4 EDF international co-operation

EDF is firmly committed to using international experience feedback as a way of leveraging optimisation of the performance of its nuclear fleet.

The first area for EDF's international co-operation is exchange of experience. Twinning operations between French nuclear plants and foreign plants constitute the main framework for these exchanges and allow direct exchange of information between operators of different cultures, working in different environments. These exchanges for example concern specific activities such as the quality of unit outages or radiological cleanness and contribute to the flow of information concerning the management of safety and competitiveness.

A second area concerns collaboration with international institutions. With regard to the IAEA, EDF takes part in work performed on safety standards and guides and on incident analysis (IRS) and is a participant in the OSART delegations to assess the safety of nuclear facilities, both in France and abroad. With regard to WANO (World Association of Nuclear Operators), EDF is involved in a number of programmes and is also a participant in the 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, with sharing of databases. EDF also monitors the work of the NEA, EPRI, INPO, NRC, etc.

A third area concerns consulting and services for other operators, co-operation agreements (South Africa, China), assistance in various technical fields (training, engineering, chemistry, etc.) and partnerships (Eastern Europe).

Section L – APPENDICES

Of the facilities concerned by the management of radioactive waste or the management of spent fuel, as presented in section D, the more important ones which belong to the basic nuclear installations category as defined in paragraph E.1.1, are distributed around France as shown on the following map:

Location of basic nuclear installations in France

It should be noted that the BNIs include the two repositories for LL/ILW short-lived radioactive waste mentioned in this report:

- The Manche repository, located at Digulleville near Beaumont - La Hague (50)
- The Aube repository, located at Soulaines (10)

The VLL waste repository in Morvilliers (10) which is an ICPE, is close to Soulaines.

L.1 Spent fuel management facilities as at 30/06/2005

L.1.1 Facilities generating spent fuel

Spent fuel is generated or likely to be generated in the following basic nuclear installations:

No. BNI	NAME AND LOCATION OF THE INSTALLATION	Operator	Type of installation	Declared on:	Authorised on:	Official Gazette (O.G.) of:	REMARKS
18	ULYSSE (Saclay) 91191 Gif-sur-Yvette Cedex	CEA	Reactor	27.05.64			
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	
42	EOLE (Cadarache) 13115 Saint-Paul-lez-Durance	CEA	Reactor		23.06.65	28 and 29.06.65	
67	HIGH FLUX REACTOR (HFR) 38041 Grenoble Cedex	Max von Laue Paul Langevin Institute	Reactor		19.06.69 05.12.94	22.06.69 06.12.94	Modification to perimeter: decree of 12.12.88 (O.G. of 16.12.88)
71	PHÉNIX POWER PLANT (Marcoule) 30205 Bagnols-sur-Cèze	CEA	Reactor		31.12.69	09.01.70	
75	FESSENHEIM NUCLEAR POWER PLANT (reactors 1 and 2) 68740 Fessenheim	EDF	Reactors		03.02.72	10.02.72	Modification to perimeter: decree of 10.12.85 (O.G. of 18.12.85)
78	BUGEY NUCLEAR POWER PLANT (reactors 2 and 3) 01980 Loyettes	EDF	Reactors		20.11.72	26.11.72	Modification to perimeter: decree of 10.12.85 (O.G. of 18.12.85)
84	DAMPIERRE NUCLEAR POWER PLANT (reactors 1 and 2) 45570 Ouzouer-sur-Loire	EDF	Reactors		14.06.76	19.06.76	
85	DAMPIERRE NUCLEAR POWER PLANT (reactors 3 and 4) 45570 Ouzouer-sur-Loire	EDF	Reactors		14.06.76	19.06.76	
86	BLAYAIS NUCLEAR POWER PLANT (reactors 1 and 2) 33820 Saint-Ciers-sur-Gironde	EDF	Reactors		14.06.76	19.06.76	
87	TRICASTIN NUCLEAR POWER PLANT (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 (O.G. of 18.12.85)
88	TRICASTIN NUCLEAR POWER PLANT (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 (O.G. of 18.12.85)
89	BUGEY NUCLEAR POWER PLANT (reactors 4 and 5) 01980 Loyettes	EDF	Reactors		27.07.76	17.08.76	Modification to perimeter: decree of 10.12.85 (O.G. of 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 (O.G. of 10.11.91)
95	MINERVE (Cadarache) 13115 Saint-Paul-lez-Durance	CEA	Reactor		21.09.77	27.09.77	
96	GRAVELINES NUCLEAR POWER PLANT (reactors 1 and 2) 59820 Gravelines	EDF	Reactors		24.10.77	26.10.77	
97	GRAVELINES NUCLEAR POWER PLANT (reactors 3 and 4) 59820 Gravelines	EDF	Reactors		24.10.77	26.10.77	
100	ST-LAURENT NUCLEAR POWER PLANT (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	

No. BNI	NAME AND LOCATION OF THE INSTALLATION	Operator	Type of installation	Declared on:	Authorised on:	Official Gazette (O.G.) of:	REMARKS
103	PALUEL NUCLEAR POWER PLANT (reactor 1) 76450 Cany-Barville	EDF	Reactor		10.11.78	14.11.78	
104	PALUEL NUCLEAR POWER PLANT (reactor 2) 76450 Cany-Barville	EDF	Reactor		10.11.78	14.11.78	
107	CHINON NUCLEAR POWER PLANT (reactors B1 and B2) 37420 Avoine	EDF	Reactors		04.12.79	08.12.79	Modification: decree of 21.07.98 (O.G. of 26.07.98)
108	FLAMANVILLE NUCLEAR POWER PLANT (reactor 1) 50830 Flamanville	EDF	Reactor		21.12.79	26.12.79	
109	FLAMANVILLE NUCLEAR POWER PLANT (reactor 2) 50830 Flamanville	EDF	Reactor		21.12.79	26.12.79	
110	BLAYAIS NUCLEAR POWER PLANT (reactors 3 and 4) 33820 Saint-Ciers-sur-Gironde	EDF	Reactors		05.02.80	14.02.80	
111	CRUAS NUCLEAR POWER PLANT (reactors 1 and 2) 07350 Cruas	EDF	Reactors		08.12.80	31.12.80	Modification to perimeter: decree of 10.12.85 (O.G. of 18.12.85)
112	CRUAS NUCLEAR POWER PLANT (reactors 3 and 4) 07350 Cruas	EDF	Reactors		08.12.80	31.12.80	
114	PALUEL NUCLEAR POWER PLANT (reactor 3) 76450 Cany-Barville	EDF	Reactor		03.04.81	05.04.81	
115	PALUEL NUCLEAR POWER PLANT (reactor 4) 76450 Cany-Barville	EDF	Reactor		03.04.81	05.04.81	
119	SAINT-ALBAN - SAINT-MAURICE NUCLEAR POWER PLANT (reactor 1) 38550 Le Péage-de-Roussillon	EDF	Reactor		12.11.81	15.11.81	
120	SAINT-ALBAN - SAINT-MAURICE NUCLEAR POWER PLANT (reactor 2) 38550 Le Péage-de-Roussillon	EDF	Reactor		12.11.81	15.11.81	
122	GRAVELINES NUCLEAR POWER PLANT (reactors 5 and 6) 59820 Gravelines	EDF	Reactors		18.12.81	20.12.81	Modification to perimeter: decree of 10.12.85 (O.G. of 18.12.85)
124	CATTENOM NUCLEAR POWER PLANT (reactor 1) 57570 Cattenom	EDF	Reactor		24.06.82	26.06.82	
125	CATTENOM NUCLEAR POWER PLANT (reactor 2) 57570 Cattenom	EDF	Reactor		24.06.82	26.06.82	
126	CATTENOM NUCLEAR POWER PLANT (reactor 3) 57570 Cattenom	EDF	Reactor		24.06.82	26.06.82	
127	BELLEVILLE NUCLEAR POWER PLANT (reactor 1) 18240 Léré	EDF	Reactor		15.09.82	16.09.82	
128	BELLEVILLE NUCLEAR POWER PLANT (reactor 2) 18240 Léré	EDF	Reactor		15.09.82	16.09.82	
129	NOGENT NUCLEAR POWER PLANT (reactor 1) 10400 Nogent-sur-Seine	EDF	Reactor		28.09.82	30.09.82	Modification to perimeter: decree of 10.12.85 (O.G. of 18.12.85)
130	NOGENT NUCLEAR POWER PLANT (reactor 2) 10400 Nogent-sur-Seine	EDF	Reactor		28.09.82	30.09.82	Modification to perimeter: decree of 10.12.85 (O.G. of 18.12.85)
132	CHINON NUCLEAR POWER PLANT (reactors B3 and B4) 37420 Avoine	EDF	Reactors		07.10.82	10.10.82	Modification: decree of 21.07.98 (O.G. of 26.07.98)
135	GOLFECH NUCLEAR POWER PLANT (reactor 1) 82400 Golfech	EDF	Reactor		03.03.83	06.03.83	
136	PENLY NUCLEAR POWER PLANT (reactor 1) 76370 Neuville-lès-Dieppe	EDF	Reactor		23.02.83	26.02.83	

No. BNI	NAME AND LOCATION OF THE INSTALLATION	Operator	Type of installation	Declared on:	Authorised on:	Official Gazette (O.G.) of:	REMARKS
137	CATTENOM NUCLEAR POWER PLANT (reactor 4) 57570 Cattenom	EDF	Reactor		29.02.84	03.03.84	
139	CHOOZ B NUCLEAR POWER PLANT (reactor 1) 08600 Givet	EDF	Reactor		09.10.84	13.10.84	Postponement of commissioning: decrees of 18.10.93 (O.G. of 23.10.93) and of 11.06.99 (O.G. of 18.06.99)
140	PENLY NUCLEAR POWER PLANT (reactor 2) 76370 Neuville-lès-Dieppe	EDF	Reactor		09.10.84	13.10.84	
142	GOLFECH NUCLEAR POWER PLANT (reactor 2) 82400 Golfech	EDF	Reactor		31.07.85	07.08.85	
144	CHOOZ B NUCLEAR POWER PLANT (reactor 2) 08600 Givet	EDF	Reactor		18.02.86	25.02.86	Postponement of commissioning: decrees of 18.10.93 (O.G. of 23.10.93) and of 11.06.99 (O.G. of 18.06.99)
158	CIVAUX NUCLEAR POWER PLANT (reactor 1) BP 1 86320 Civaux	EDF	Reactor		06.12.93	12.12.93	Postponement of commissioning: decree of 11.06.99 (O.G. of 18.06.99)
159	CIVAUX NUCLEAR POWER PLANT (reactor 2) BP 1 86320 Civaux	EDF	Reactor		06.12.93	12.12.93	Postponement of commissioning: decree of 11.06.99 (O.G. of 18.06.99)

L.1.2 Spent fuel interim storage or reprocessing facilities

The spent fuel is stored or reprocessed in the following basic nuclear installations:

No. BNI	NAME AND LOCATION OF THE INSTALLATION	Operator	Type of installation	Declared on:	Authorised on:	Official Gazette (O.G.) of:	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 Former reactor decommissioned 19.12.75. Modification: decree of 04.09.89 04.09.89 (O.G. of 08.09.89)
33	SPENT FUEL REPROCESSING PLANT (UP2 and AT1) (La Hague) 50107 Cherbourg	COGEMA	Radioactive substance transformation plant	27.05.64			Modification: decree of 17.01.74 (O.G. of 05.02.74) Change of operator: decree of 09.08.78 (O.G. of 19.08.78)
47	ELAN II B SHOP (La Hague) 50107 Cherbourg	COGEMA	Radioactive substance transformation plant		03.11.67	09.11.67	Change of operator: decree of 09.08.78 (O.G. of 19.08.78)
50	LABORATOIRE D'ESSAIS SUR COMBUSTIBLES IRRADIÉS (LECI) (Saclay) 91191 Gif-sur-Yvette Cedex	CEA	Facility using radioactive substance	08.01.68			Modification: decree of 30.05.00 (O.G. of 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 (O.G. of 08.09.89)
56	RADIOACTIVE WASTE INTERIM STORAGE UNIT (Cadarache) 13115 Saint-Paul-lez-Durance	CEA	Radioactive substance storage facility	08.01.68			

No. BNI	NAME AND LOCATION OF THE INSTALLATION	Operator	Type of installation	Declared on:	Authorised on:	Official Gazette (O.G.) of:	REMARKS
72	SOLID RADWASTE MANAGEMENT ZONE (Saclay) 91191 Gif-sur-Yvette Cedex	CEA	Radioactive substance interim storage or warehousing facility		14.06.71	22.06.71	
80	HIGH ACTIVITY OXIDE SHOP (HAO) (La Hague) 50107 Cherbourg	COGEMA	Radioactive substance transformation plant		17.01.74	05.02.74	Change of operator: decree of 09.08.78 (O.G. of 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 (O.G. of 31.07.85) Postponement of commissioning: decree of 25.07.86 (O.G. of 26.07.86) Final shutdown and change of operator: decree of 30.12.98 (O.G. of 31.12.98)
94	IRRADIATED MATERIAL WORKSHOP (Chinon) 37420 Avoine	EDF	Facility using radioactive substance	29.01.64			Modification: decree of 15.04.85 (O.G. of 19.04.85)
116	UP3-A PWR SPENT FUEL REPROCESSING PLANT (La Hague) 50107 Cherbourg	COGEMA	Radioactive substance transformation plant		12.05.81	16.05.81	Postponement of commissioning: decree of 28.03.89 (O.G. of 07.04.89) Modification: decree of 18.01.93 (O.G. of 24.01.93)
117	UP2-800 PWR SPENT FUEL REPROCESSING PLANT (La Hague) 50107 Cherbourg	COGEMA	Radioactive substance transformation plant		12.05.81	16.05.81	Postponement of commissioning: decree of 28.03.89 (O.G. of 07.04.89) Modification: decree of 18.01.93 (O.G. of 24.01.93)
141	ON-SITE SPENT FUEL STORAGE UNIT (Creys-Malville) 38510 Morestel	EDF	Radioactive substance interim storage or warehousing facility		24.07.85	31.07.85	Postponement of commissioning: decree of 28.07.93 (O.G. of 29.07.93) Change of operator: decree of 30.12.98 (O.G. of 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	Postponement of commissioning: decree of 22.07.99 (O.G. of 23.07.99)

L.2 Radioactive waste management facilities as at 30/06/2005

L.2.1 The other basic nuclear installations generating radioactive waste

Apart from the basic nuclear installations which manage radioactive fuels, mentioned in section L.1, radioactive waste is generated in the following BNIs:

No. BNI	NAME AND LOCATION OF THE INSTALLATION	Operator	Type of installation	Declared on:	Authorised on:	Official Gazette (O.G.) of:	REMARKS
19	MÉLUSINE 38041 Grenoble Cedex	CEA	Reactor	27.05.64			Finally shutdown on 30.06.93
20	SILOÉ 38041 Grenoble Cedex	CEA	Reactor	27.05.64			Finally shutdown on 23.12.97
21	SILOETTE 38041 Grenoble Cedex	CEA	Reactor	27.05.64			
25	RAPSODIE/LDAC (Cadarache) 13115 Saint-Paul-lez-Durance	CEA	Reactor	27.05.64			Finally shutdown on 15.04.83
29	ARTIFICIAL RADIONUCLIDE FACTORY (Saclay) 91191 Gif-sur-Yvette Cedex	CEA (Oris-Industrie)	Radioactive substance fabrication or transformation plant	27.05.64			
32	ATELIER DE TECHNOLOGIE DU PLUTONIUM (ATPu) (Cadarache) 13115 Saint-Paul-lez-Durance	CEA	Radioactive substance fabrication or transformation 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 NUCLEAR POWER PLANT (reactor 1) 01980 Loyettes	EDF	Reactor		22.11.68	24.11.68	Modification to perimeter: decree of 10.12.85 (O.G. of 18.12.85) Reactor finally shutdown on 27.05.94. Final shutdown decree of 30.08.96 (O.G. of 07.09.96)
46	ST-LAURENT-DES-EAUX NUCLEAR POWER PLANT (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 (O.G. of 18.12.85) Final shutdown decree of 11.04.94 (O.G. of 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 (O.G. of 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 (O.G. of 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 transformation plant	08.01.68			
57	PLUTONIUM CHEMISTRY LABORATORY (LCPu) 92265 Fontenay-aux-Roses Cedex	CEA	Facility using radioactive substance	08.01.68			Cessation of production: 01.07.95

No. BNI	NAME AND LOCATION OF THE INSTALLATION	Operator	Type of installation	Declared on:	Authorised on:	Official Gazette (O.G.) of:	REMARKS
59	PLUTONIUM-BASED FUEL RESEARCH LABORATORY (RM2) 92265 Fontenay-aux-Roses Cedex	CEA	Facility using radioactive substance	08.01.68			Finally 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 (O.G. of 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 the maximum activity level of the ionising source: decree of 15.06.78 (O.G. of 27.06.78) Change of operator: decree of 23.10.95 (O.G. of 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 (O.G. of 19.06.77) decree of 14.10.86 (O.G. of 17.10.86)
93	GEORGES BESSE PLANT FOR ISOTOPE SEPARATION BY GASEOUS DIFFUSION (Eurodif) 26702 Pierrelatte Cedex	EURODIF PRODUCTION	Radioactive substance transformation plant		08.09.77	10.09.77	Modification to perimeter: decree of 22.06.85 (O.G. of 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-RÉGIONAL WAREHOUSE 37420 Avoine	EDF	Storage of new fuel		02.03.78	11.03.78	Modification: decree of 04.06.98 (O.G. of 06.06.98)
102	BUGEY INTER-RÉGIONAL WAREHOUSE 01980 Loyettes	EDF	Storage of new fuel		15.06.78	27.06.78	Modification: decree of 04.06.98 (O.G. of 06.06.98)
105	URANIUM HEXAFLUORIDE PREPARATION PLANT (COMURHEX) 26130 Saint-Paul-Trois-Châteaux	COMURHEX	Radioactive substance transformation 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 (O.G. of 12.07.85) Modification: decree of 02.07.92 (O.G. of 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 (O.G. of 13.06.01)
121	CADARACHE IRRADIATOR (IRCA) 13115 Saint-Paul-lez-Durance	CEA	Facility using radioactive substance		16.12.81	18.12.81	
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 (O.G. of 26.10.85) Final shutdown and dismantling: decree of 22.05.00 (O.G. of 25.05.00)

No. BNI	NAME AND LOCATION OF THE INSTALLATION	Operator	Type of installation	Declared on:	Authorised on:	Official Gazette (O.G.) of:	REMARKS
133	CHINON A1 D 37420 Avoine	EDF	Radioactive substance interim storage or warehousing facility		11.10.82	16.10.82	Former reactor shutdown 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 (O.G. of 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 (O.G. of 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 (O.G. of 31.07.99)
153	CHINON A2 D 37420 Avoine	EDF	Radioactive substance interim storage or warehousing facility		07.02.91	13.02.91	Former reactor shutdown 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 (O.G. of 28.10.95)
155	TU 5 FACILITY BP 16 26701 Pierrelatte	COGEMA	Radioactive substance transformation plant		07.07.92	11.07.92	Modification: decree of 15.09.94 (O.G. of 24.09.94)
156	CHICADE (Cadarache) BP 1 13108 Saint-Paul-lez-Durance Cedex	CEA	R&D laboratory		29.03.93	30.03.93	
157	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 warehousing facility		27.08.96	31.08.96	Former reactor shutdown on 17.03.93
162	MONTS D'ARRÉE EL4 D Brennilis 29218 Huelgoat	EDF	Radioactive substance interim storage or warehousing facility		31.10.96	08.11.96	Former reactor shut down on 31.07.85. Change of operator: decree of 19.09.00 (O.G. of 26.09.00)
163	ARDENNES NUCLEAR POWER PLANT CNA-D 08600 Givet	EDF	Radioactive substance interim storage or warehousing facility		19.03.99	21.03.99	Former reactor shutdown on 17.03.93
164	CEDRA (Cadarache) 13155 St Paul lez Durance	CEA	Conditioning and storing of radioactive materials		04.10.04	05.10.04	

L.2.2 Radioactive waste interim storage or treatment facilities

Apart from the basic nuclear installations in which radioactive waste can be stored or reprocessed, mentioned in section L.1, radioactive waste is stored or reprocessed in the following BNIs:

No. BNI	NAME AND LOCATION OF THE INSTALLATION	Operator	Type of installation	Declared on:	Authorised on:	Official Gazette (O.G.) of:	REMARKS
34	SOLID AND LIQUID WASTE TREATMENT PLANT 92265 Fontenay-aux-Roses Cedex	CEA	Radioactive substance transformation plant	27.05.64			
35	LIQUID WASTE MANAGEMENT ZONE (Saclay) 91191 Gif-sur-Yvette Cedex	CEA	Radioactive substance transformation plant	27.05.64			
36	SOLID AND LIQUID WASTE TREATMENT PLANT 38041 Grenoble Cedex	CEA	Radioactive substance transformation plant	27.05.64			
37	SOLID AND LIQUID WASTE TREATMENT PLANT (Cadarache) 13115 Saint-Paul-lez-Durance	CEA	Radioactive substance transformation plant	27.05.64			
38	SOLID AND LIQUID WASTE TREATMENT PLANT «STE2» (La Hague) 50107 Cherbourg	COGEMA	Radioactive substance transformation plant	27.05.64			Change of operator: decree of 09.08.78 (O.G. of 19.08.78)
66	MANCHE WASTE REPOSITORY (CSM) 50448 Beaumont-Hague	Andra	Radioactive substance storage facility		19.06.69	22.06.69	Start of surveillance period: decree of 10.01.03 (O.G. of 11.01.03)
73	SOLID RADWASTE INTERIM FACILITY 92265 Fontenay-aux-Roses Cedex	CEA	Radioactive substance interim storage or warehousing facility		14.06.71	22.06.71	
74	IRRADIATED GRAPHITE JACKET INTERIM STORAGE FACILITY (St-Laurent-des-Eaux) 41220 La Ferté-St-Cyr	EDF	Radioactive substance interim storage or warehousing facility		14.06.71	22.06.71	Change of operator: decree of 28.06.84 (O.G. of 06.07.84)
118	STE3 SOLID AND LIQUID WASTE TREATMENT FACILITY La Hague 50107 Cherbourg	COGEMA	Radioactive substance transformation plant		12.05.81	16.05.81	Postponement of commissioning: decree of 27.04.88 (O.G. of 03.05.88)
149	AUBE WASTE REPOSITORY (CSA) 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 (O.G. of 26.03.95)
160	CENTRACO Codolet 30200 Bagnols-sur-Cèze	SOCODEI	Radioactive waste and effluent treatment		27.08.96	31.08.96	

L.3 Nuclear facilities in the process of dismantling as at 30/06/2005

L.3.1 List of reactors dismantled or in the process of dismantling

Installation Location	BNI No.	Startup	Final cessation of operation	Power rating (MWTh)	Last regulatory acts	Current status
EL2Saclay	(formerly BNI 13)	1952	1965	2,8	Removed from BNI list	Sealed source
Chinon A1D(ex-Chinon A1)	133 (formerly BNI n° 5)	1963	1973	300	1982 : authorisation decree for containment of Chinon A1 and setting up of waste storage BNI Chinon A1D	Partially dismantled, transformed into BNI for storage of in situ waste (museum)
CESAR Cadarache	(formerly BNI 26)	1964	1974	0,01	1978 : Removed from BNI list	Dismantled
ZOÉ Fontenay-aux-Roses	(formerly BNI 11)	1948	1975	0,25	1978 : 1978 removed from BNI list and classified on environmental protection grounds	Contained (museum)
PEGGY Cadarache	(formerly BNI 23)	1961	1975	0,001	1976 : Removed from BNI list	Dismantled
PEGASE Cadarache	22	1963	1975	35	1980 : decree transforming the reactor into a radioactive substance storage facility (decree amended in 1989)	Partially dismantled, new radioactive storage substance facility
MINERVE Fontenay-aux-Roses	(formerly BNI 12)	1959	1976	0,0001	1977 : Removed from BNI list	Dismantled at Fontenay and reassembled at Cadarache
EL 3Saclay	(formerly BNI 14)	1957	1979	18	1988 : 1978 removed from BNI list and classified on environmental protection grounds	Partially dismantled, containment of remaining structures
NEREIDE Fontenay-aux-Roses	(formerly BNI 10)	1960	1981	0,5	1987 : Removed from BNI list	Dismantled
TRITON Fontenay-aux-Roses	(formerly BNI 10)	1959	1982	6,5	1987 : 1978 removed from BNI list and classified on environmental protection grounds	Dismantled
RAPSODIE Cadarache	25	1967	1983	20 then 40		Dismantling proceeding
MARIUS Cadarache	(formerly BNI 27)	1960 at Marcoule, 1964 at Cadarache	1983	0,0004	1987 : Removed from BNI list	Dismantled
EL-4D(ex-EL4)Brennilis	162 (formerly BNI n° 28)	1966	1985	250	1996 : decree authorising partial dismantling of EL4 and setting up of waste storage BNI EL-4D	Dismantling proceeding
CHINON A2D(ex-Chinon A2)	153 (formerly BNI n° 6)	1965	1985	865	1991 : decree authorising partial dismantling of Chinon A2 and setting up of waste storage BNI Chinon A2D	Partially dismantled, transformed into BNI for storage of in situ waste
MELUSINE Grenoble	19	1958	1988	8		Final shutdown work completed
CHINON A3D(ex-Chinon A3)	161 (formerly BNI n° 7)	1966	1990	1360	1996 : decree authorising partial dismantling of Chinon A3 and setting up of waste storage BNI Chinon A3D	Partially dismantled, transformed into BNI for storage of in situ waste
ST-LAURENT A1	46	1969	1990	1662	1994 : decree authorising final shutdown	Final shutdown work proceeding
CHOOZ AD (ex-Chooz A)	163 (formerly BNI A1, 2, 3)	1967	1991	1040	1999 : decree authorising partial dismantling of Chooz A and setting up of waste storage BNI Chooz AD	Partially dismantled, transformed into BNI for storage of in situ waste
ST-LAURENT A2	46	1971	1992	1801	1994 : decree authorising final shutdown	Final shutdown work proceeding

Installation Location	BNI 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 work proceeding
HARMONIE Cadarache	41	1965	1996	0,001		Final cessation of operation procedures in progress
SILOE Grenoble	21	1963	1997	35		Final cessation of operation procedures in progress
RUS Strasbourg	44	1967	1997	0,1		Final cessation of operation procedures in progress
SUPERPHENIX Creys-Malville	91	1985	1997	3000	1998 : decree authorising final shutdown	Final shutdown work proceeding

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

Plant and site	BNI No.	Type of plant	Startup	Final cessation of operation	Last regulatory acts	Current status
LE BOUCHET	(formerly BNI 30)	Ore treatment facility	1953	1970	Removed from BNI list	Dismantled
ATTILA Fontenay-aux-Roses	57	Reprocessing pilot unit	1966	1975		Dismantled
LCPu Fontenay-aux-Roses	57	Plutonium chemistry laboratory	1966	1995		Dismantling proceeding
ELAN II B la Hague	47	Cs 137 source fabrication plant	1970	1973		Dismantling proceeding
AT1 La Hague	33	FBR fuel reprocessing	1969	1979		Dismantling proceeding
GUEUGNON	(formerly BNI 31)	Ore treatment facility		1980	Removed from BNI list	Dismantled
BAT. 19Fontenay-aux-Roses	(formerly BNI 58)	Plutonium metallurgy unit	1968	1984	1984 : Removed from BNI list	Dismantled
RM2Fontenay-aux-Roses	59	Radio-metallurgy unit	1968	1982		Dismantling proceeding
LCAC Grenoble	(formerly BNI 60)	Fuel analysis	1968	1984	1997 : Removed from BNI list	Dismantled
SATURNE Saclay	48	Accelerator	1958	1997	2002 : decree authorising final shutdown and dismantling	Shut down
SNCS Osmanville	(formerly BNI 152)	Ioniser	1990	1995	2002 : decree authorising final shutdown and dismantling	Dismantling proceeding
ATUE Cadarache	52	Uranium processing plant	1963	1997		Cleanup proceeding
ARAC Saclay	(formerly BNI 81)	Fuel fabrication	1975	1995	1999 : Removed from BNI list	Cleanup completed
ALS Saclay	43	Accelerator	1965	1996		Final cessation of operation procedures in progress
FBFC Pierrelatte	131	Fuel fabrication	1983	1998	2000 : decree authorising final shutdown and dismantling	Dismantling proceeding

L.4 Main legislative and regulatory texts

L.4.1 Laws and regulations

Decree 53-578 of 20 May 1953 – decree concerning the nomenclature of hazardous, insalubrious or noxious establishments.

Law 61-842 of 2 August 1961 – Law on the prevention of atmospheric pollution and odours and amending the Law of 19 December 1917.

Decree 63-1228 of 11 December 1963 – Decree on nuclear facilities.

Decree 73-278 of 13 March 1973 – Decree creating the Higher Council for Nuclear Safety and a Nuclear Facility Central Safety Department.

Law 75-633 of 15 July 1975 – Law on waste disposal and recovery of materials.

Law 76-663 of 19 July 1976 – Law on installations classified on environmental protection grounds.

Decree 77-1133 of 21 September 1977 - Decree implementing Law 76-663 of 19 July 1976 concerning installations classified on environmental protection grounds.

Law 80-572 of 25 July 1980 – Law on the protection and monitoring of nuclear materials.

Ministerial order of 10 August 1984 – Order on the quality of design, construction and operation of basic nuclear installations.

Decree 90-222 of 9 March 1990 – Decree supplementing the general regulations for the mining industries instituted by decree 80-331 of 7 May 1980.

Law 91-1391 of 30 December 1991 – Law on research into radioactive waste management.

Decree 95-540 of 4 May 1995 – Decree on liquid and gaseous discharges from and water intake into basic nuclear installations.

Ministerial order of 11 March 1996 – order setting the limits beyond which plants involved in the preparation, fabrication or transformation of radioactive substances, and facilities intended for the disposal, storage or use of radioactive substances, including waste, are considered to be basic nuclear installations.

Inter-ministerial order of 26 November 1999 – Order laying down the general technical requirements concerning the limits and methods relative to intakes and discharges subject to authorisation, made by basic nuclear installations.

Ministerial order of 31 December 1999 – Order laying down the general technical requirements designed to prevent and limit the harmful effects and external hazards resulting from the operation of basic nuclear installations

Ordinance 2001-270 of 28 March 2001 – Ordinance on transposition of community directives in the field of protection against ionising radiation.

Decree 2002-255 of 22 February 2002 - Decree amending decree 93-1272 of 1 December 1993 and creating a General Directorate for Nuclear Safety and Radiation Protection.

Decree 2002-460 of 04 April 2002 – Decree on the general protection of persons against the hazards of ionising radiation.

Decree 2003-296 of 31 March 2003 – Decree on the protection of workers against the hazards of ionising radiation.

L.4.2 Fundamental safety rules (RFS) within the scope of the Convention

RFS-I.1.a – Inclusion of hazards related 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 installations 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 radioactive waste with short or intermediate half-life and low or intermediate specific activity (8 November 1982 – revision of 19 June 1984).

RFS-I.3.c – Criticality hazard (18 October 1984).

RFS-I.4.a – Fire protection (28 February 1985).

RFS-II.2. – Design and operation of ventilation systems in basic nuclear installations other than nuclear reactors (20 December 1991).

RFS-III.2.a – General provisions applicable to the production, monitoring, treatment, packaging and interim storage of various types of waste 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 the form of 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 water reactors (5 April 1984).

RFS-III.2.d – Special provisions applicable to the production, monitoring, treatment, packaging and interim storage of waste encapsulated in cement and resulting from reprocessing of fuel irradiated in pressurised water reactors (1 February 1985).

RFS-III.2.e – Preconditions 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 works phases for final disposal of radioactive waste in deep geologic formations, in order to ensure safety after the operational life of the repository (1 June 1991).

L.5 Organisation of the main nuclear operators

L.5.1 Organisation of Andra

Andra was created in 1979 as part of the CEA. In 1992 it became an independent establishment run by a Director General responsible for the functional and operational divisions:

The functional divisions are the following:

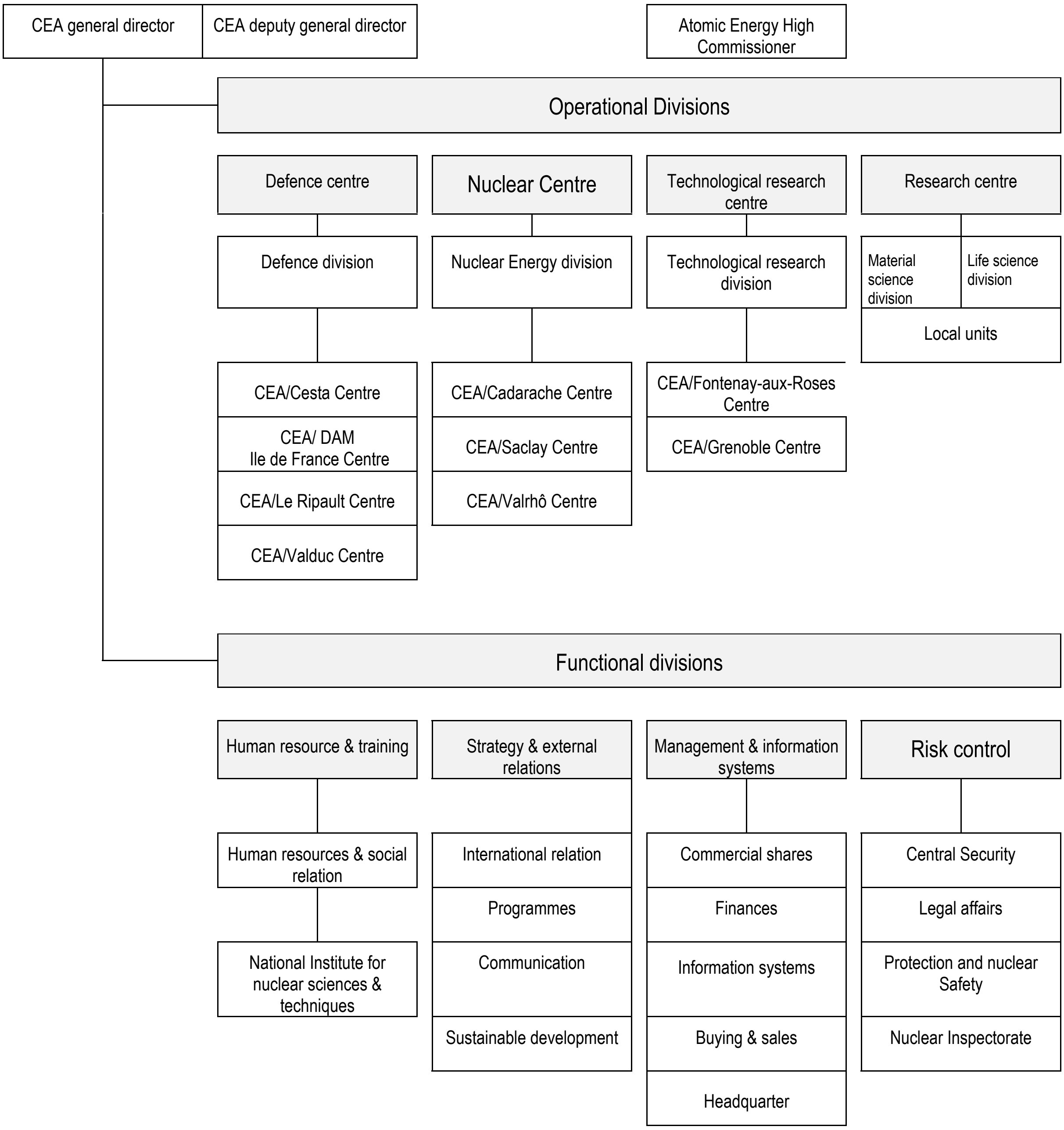
- General Secretariat responsible for buying, management, accounts and legal matters;
- Human resources department;
- Communication department.

The operational divisions are the following:

- Safety, quality and environment department. This department sets guidelines for safety, quality and the environment, implements them and ensures that they are applied by the other Andra units. It is also responsible for inventorying the radioactive waste present in the country;
- Projects department, in charge of Andra projects: feasibility of high-level, long-lived waste disposal, design of repositories for waste containing radium, graphite waste and tritiated waste;
- Scientific department, supporting all Andra activities. The specialities covered are in the fields of geology, hydrogeology, materials science, transfer of radionuclides to the biosphere and to man, as well as mathematical modelling;
- Industrial department, comprising a Customers branch in contact with the waste producers with regard to waste for which there is an available management channel and a Surface repositories branch managing operational facilities or facilities in the industrial deployment phase (including VLLW disposal and disposal of radium-containing waste). Apart from the traditional duties linked to operation of industrial facilities (production, maintenance, etc.), the Surface repositories branch is responsible for radiation protection of the personnel working in them and for monitoring their environment. The Customers branch guarantees that the waste delivered is compliant with the specifications for acceptance by the facilities.

L.5.2 Organisation of the CEA

The CEA, a public research agency created in 1945, reorganised its operational resources in 2001, based around four new "sectors" corresponding to its leading areas of activity, as illustrated in the following organisation chart: nuclear power sector, technical research sector, fundamental research sector and defence sector. Each sector has resources (general management, directorates, specific functional resources), enabling it to develop, plan and monitor all its activities.



The nuclear facilities and activities, which are the subject of this Convention, were grouped into the nuclear power sector (Nuclear power directorate), for all aspects concerning the civilian nuclear industry.

L.5.3 Organisation of COGEMA

COGEMA was created in 1975 out of the former units of the CEA and is currently part of the AREVA group. Its main activity is the front and back ends of the nuclear fuel cycle. The organisation of COGEMA as at 1 January 2003 is illustrated by the following diagram:

CHAIRMAN AND CHIEF EXECUTIVE OFFICER (CEO)

CORPORATE FUNCTIONS

-Environment
-Buying
-Sustainable Development and Continuous Progress
-Human resources
-Dismantling and waste management
-Strategy
-Communication

-Information systems
-Safety-Security-Health
-Finances
-Commercial -Research and Development
-Legal

-

MINES-CHEMISTRY-ENRICHMENT SECTOR	REPROCESSING-RECYCLING-LOGISTICS SECTOR	SERVICES SECTOR
Mines B.U.	Reprocessing B.U.	Engineering B.U.
Chemistry B.U.	Recycling B.U.	Nuclear Instrumentation B.U.
Enrichment B.U.	Logistics B.U.	Consulting and Information Systems B.U.
		Nuclear Clean-up B.U.

B.U. = Business Unit

The nuclear safety general inspectorate function is linked to the Safety-Security-Health Corporate Division.

L.5.4 Organisation of EDF

EDF is the leading electricity generating company in France and the only one to operate nuclear power plants. Within the various divisions and units of its Engineering Production Branch, EDF has direct responsibility for management of process waste and for management of spent fuel. The main components of the Engineering Production Branch linked to the nuclear sector are described below.

L.5.4.1 The Nuclear Generation Division (DPN)

The Nuclear Generation Division has responsibility as nuclear operator of the operational sites, up to final shutdown. The DPN is the client for all generic actions. In this respect it bears the related costs which, with regard to waste, in particular include the fixed costs of the "pre-processing" (mobile units and CENTRACO) and disposal (Aube repository) facilities. The Director of the DPN is the chief contact of the DGSNR director, in particular in the field of waste management for the operating installed base.

L.5.4.2 The nuclear power plants (CNPE)

In accordance with the law of 1975, the NPPs are responsible for their waste (from the place of production up to its destination) and for the quality of the packages they manufacture. They are required to implement the doctrine drawn up for the entire nuclear installed base and to use generic approvals, whenever available. They ensure that the approvals specific to their situation are consistent with the existing national provisions. They call on the services of the national engineering units: CAPE (Active Installed Base Support Centre) and UTO (Corporate Technical Support Department).

L.5.4.3 The national engineering units

They are responsible for:

- support with production of process waste policies.
- support with producing process waste doctrine (internal directives, examination).
- methodological support (zoning, waste surveys, interim storage, regulations, disposal channels, etc.) necessary for implementation of the doctrine.
- technical support for the DPN management in its relations with the Nuclear Safety Authority.
- project management;
- contractual relations with the suppliers of products (packaging, hulls, drums) and materials (dry loads), with SOCODEI for waste packaging (Andra packages, CENTRACO, mobile units), and with Andra;
- management of common packaging resources (mobile units, MERCURE, etc.);
- package approvals, developments, incorporation of experience feedback, obtaining new general approvals.
- support for the sites in measurement of radiological aspects which can affect the environment (effluent, radiological environment monitoring).

L.5.4.4 Nuclear Engineering Division (DIN)

The Nuclear Engineering Division is in charge of defining, designing and building the effluent processing and waste packaging facilities in the NPPs. The DIN is also responsible for facility dismantling operations, as mentioned earlier, and a dedicated engineering department was created for this purpose.

L.5.4.5 Nuclear Fuels Division (DCN)

The Nuclear Fuels Division draws up strategies concerning the back-end of the cycle and disposal of nuclear waste. It manages the contracts for uranium supply and enrichment, for manufacture of UO_2 and MOX fuels, as well as the spent fuel transport, delivery, interim storage and reprocessing contracts signed with COGEMA. It also organises quality monitoring of these activities under the terms of the "Quality Order" of August 1984.

The DCN in particular negotiates and manages the NPPs operating waste transport and disposal contracts. To do this, and based on data supplied by the NPPs and centralised by the DPN, it sends contractual delivery forecasts to the Aube repository and organises rail and road waste shipments, jointly with the DPN. The DCN is responsible for the economics and financial management aspects of the agreements signed with Andra.

L.6 Monitoring the environment

L.6.1 Surveillance stations

L.6.1.1 Téléray network (ambient gamma dose rate)

The ambient dose rate is monitored by the Téléray network comprising 180 stations continuously measuring the ambient gamma radiation. These stations are situated around the country in 81 in prefectures or sub-prefectures or cities, 14 in Paris, 38 on nuclear sites, 16 in airports, and 9 on mountain peaks. This network also comprises 22 recorders abroad and in the overseas territories.

L.6.1.2 Measurement stations and reference stations

Radioactivity monitoring concerns the atmosphere, water, soil, plant life and the food chain. Apart from the 7 reference stations spread around the country and located far from the nuclear sites, the measurement stations are located near the nuclear sites, industrial sites or urban centres, on the major rivers and along the coastline. Their locations are as shown on the following map.

The measurements taken in the reference stations comprise about 3000 annual samples, specified as follows.

Environment	Sample	Analysis
Atmosphere	Integrating dosimeter (6-monthly)	Ambient γ radiation
Aerosols	Filter (daily)	Total β (daily), γ spectrometry (monthly)

Environment	Sample	Analysis
Rainwater	Collector 0.2 m^2 (monthly)	Total β, γ spectrometry, ^{3}H, ^{90}Sr
Soil	Thickness 20 cm (quarterly)	Total β, γ spectrometry, ^{90}Sr
Plants	Harvest 6m^2 (monthly)	Total β, γ spectrometry, ^{90}Sr (annual mix)
Animals	Milk (bi-monthly) Bone (quarterly)	Total β, γspectrometry, ^{89}Sr, ^{90}Sr total β, ^{90}Sr (annual mix)

L.6.1.3 Atmospheric monitoring

Apart from the measurements in the 7 reference stations, the atmosphere is monitored by 35 stations near the nuclear sites and 27 stations near cities. It comprises about 23,000 samples annually and 46,000 measurements, specified as follows.

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

L.6.1.4 Water monitoring

Water monitoring concerns rainwater (28 nuclear sites, 16 weather stations, 7 reference stations), mineral and mains water (nationwide), underground water (dumps and ionisation centres), river water (23 nuclear sites, 6 mining sites, the 5 main rivers), seawater (5 nuclear sites and all coastlines) and waste water (Achères sewerage plant). It comprises about 2,700 samples annually and 8,000 measurements, specified as follows.

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

L.6.1.5 Food-chain monitoring

Food-chain monitoring includes milk (90 departmental co-operatives, 29 nuclear sites and 7 reference stations), wheat (290 silos in 84 *département*s and 26 nuclear sites), particular foodstuffs (fish, honey, bovine thyroids) and 3 canteens. It comprises some 1800 samples and 2400 measurements annually, specified as follows.

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) 2 types (flat and round)	γ spectrometry + total α, total β, K, Ca, ^{90}Sr (annual)
Honey	5 sites including 2 nuclear (annual)	γ spectrometry
Bovine thyroid	2 abattoirs (weekly)	γ spectrometry + ^{131}I
Food and drink	Consumed in 3 canteens for 7 days (monthly)	Total β, Ca, K, ^{90}Sr, U, γ spectrometry ^{226}Ra (annual)

L.6.1.6 Fauna and flora monitoring

Monitoring of the flora and fauna primarily concerns aquatic species along the coastline, but also terrestrial flora around the reference stations and a nuclear site. It comprises about 300 samples and 1700 measurements annually, specified as follows.

Subject	Sample	Analysis
French coastline	- Molluscs (annual) - Crustacea (annual) - Algae (annual) - Marine plants (annual)	Total α, total β, K, ^{90}Sr, γspectrometry ditto + ^{210}Po, U, ^{238}Pu, ^{241}Am ditto ditto + U, Th
Seine Bay	- Molluscs (annual) - Crustacea (annual) - Fish (annual)	Total α, total β, Ca, K, ^{90}Sr, Th, γ spectrometry ditto + ^{210}Po, U, ^{238}Pu, ^{226}Ra ditto
Channel and North Sea	- Fish (annual)	Total α, total β, Ca, K, ^{90}Sr, γ spectrometry
Terrestrial plants	7 reference stations and 1 nuclear site (monthly)	Total β, spectrometry β (Sr + Lanthanides), ^{90}Sr (6-monthly)

L.6.1.7 Monitoring around the nuclear sites

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

The principle of regulation monitoring of BNI environments differs slightly depending on whether one is dealing with a nuclear power plant or a plant or a laboratory. The types of measurements associated with each of the environments monitored are presented in the following two tables.

L.6.1.7.1 Regulatory monitoring of the environment of a nuclear power plant

The principle of regulatory monitoring of the environment around a nuclear power plant can be summarised as follows.

Environment monitored	Samples and checks required of the operator by regulations
Air at ground level	- 4 stations for continuous sampling of atmospheric dust on a fixed filter with daily measurement of the total β - 1 continuous sample under the prevailing wind with weekly measurement of atmospheric tritium
Rain	1 station under the prevailing wind (monthly collector) Measurements: total β and tritium on monthly mix
Ambient γ radiation	- 4 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) - 4 stations with continuous measurement at 5 km (10 nGy/h to 0.5 Gy/h)
Plants	- 2 grass sampling points (monthly check) Measurements: total β, γ spectrometry (+ ^{14}C and C, quarterly) - Main agricultural crops (annual check) Measurements: total β, γspectrometry
Milk	2 sampling points (monthly check) with Measurements: 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 power plants), 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 - Bi-monthly samples at sea (coastal power plants only) with measurement of total β, potassium and tritium - Annual samples of sediments, aquatic fauna and flora with measurement of total β, γ spectrometry
Underground water	- 5 sampling points (monthly check) with measurement of total β, potassium and tritium

L.6.1.7.2 Regulatory monitoring of the environment of a CEA or COGEMA site

The principle of regulatory monitoring of the environment of a laboratory or plant can be summarised as follows.

Environment monitored	Samples and checks required of the operator by regulations
Air at ground level	- 4 stations with continuous sampling of atmospheric dust on fixed filter, with daily measurement of total β - 1 continuous sample with weekly measurement of atmospheric tritium
Rain	- 2 continuous sampling stations including one under the prevailing wind with weekly measurement of total □ and tritium
Ambient □ radiation	- 4 stations with continuous measurement and recording - 10 integrating dosimeters around the site perimeter (monthly reading)
Plants	- 4 grass sampling points (monthly check) - Main agricultural crops (annual check) Measurements: total β, γ spectrometry (+^{3}H and ^{14}C, periodically)
Milk	1 sampling point (monthly check) Measurements: total β, γ spectrometry (+ ^{3}H and ^{14}C periodically)
Liquid discharges reception environment	- At least weekly sampling of the water of the receiving environment with measurement of total α, total β, potassium and tritium - Annual samples of sediments, aquatic fauna and flora with γ spectrometry
Underground water	- 5 sampling points (monthly check) with measurement of total α, total β, potassium and tritium

L.6.2 Measurements in the environment and around the nuclear sites

L.6.2.1 Gaseous discharges from nuclear sites in 2004

The gaseous discharges from the main basic nuclear installations are given, along with their corresponding authorised limits, in the following tables, according to the groups of radioactive product categories specified in the permits in force in 2004.

L.6.2.1.1 Limits and values of gaseous discharges from EDF sites, with original permit

In these permits, established for the nuclear power plant sites on the basis of the 1974 specifications, the gaseous discharges are split into two categories.

Site	Rare gases + tritium		Halogens + aerosols	
	Limit	Discharge	Limit	Discharge
	(TBq)	(TBq)	(GBq)	(GBq)
Le Bugey	2590	3.08	111	0.076
Chooz	330	1.64	11	0.059
Civaux	330	2.45	11	0.066
Creys-Malville	220	0.40	5	0.007
Dampierre-en-Burly	2220	2.23	74	0.062
Fessenheim	1480	1.25	111	0.017
Golfech	1650	2.31	55	0.057
Nogent-sur-Seine	1650	8.70	55	1.83
Penly	1650	4.85	55	0.12
Le Tricastin	2220	3.55	74	0.066

L.6.2.1.2 Limits and values for gaseous discharges from EDF sites with renewed permit

In these new permits established on the basis of the 1995 specifications when renewed for nuclear power plant sites, gaseous discharges are now split into five different categories including C14 which is also measured.

Site	Rare gases		Tritium		Carbon 14		Iodine		Others	
	Limit	Discharge	Limit	Discharge	Limit	Discharge	Limit	Discharge	Limit	Discharge
	(TBq)	(TBq)	(TBq)	(TBq)	(TBq)	(TBq)	(GBq)	(GBq)	(GBq)	(GBq)
Belleville-sur-Loire	45	0.99	5	2.97	1.4	0.46	0.8	0.035	0.8	0.014
Le Blayais	72	1.38	8	0.41	2.2	0.61	1.6	0.032	1.6	0.006
Cattenom	90	2.04	10	7.98	2.8	0.86	1.6	0.167	1.6	0.023
Chinon	72	0.88	8	1.16	2.2	0.57	1.6	0.025	1.6	0.002
Cruas-Meysse	72	2.17	8	0.37	2.2	0.57	1.6	0.072	1.6	0.017
Flamanville	45	0.99	5	2.22	1.4	0.43	0.8	0.042	0.8	0.004
Gravelines	108	9.51	12	2.51	3.3	0.93	2.4	0.406	2.4	0.015
Paluel	90	2.35	10	4.89	2.8	0.76	1.6	0.059	1.6	0.012
Saint-Alban – Saint-Maurice	45	2.34	5	3.74	1.4	0.49	0.8	0.023	0.8	0.017
Saint-Laurent-des-Eaux	36	0.29	4	0.12	1.1	0.31	0.8	0.011	0.8	0.003

L.6.2.1.3 Limits and values of gaseous discharges from the COGEMA La Hague site

The current permit (order of 10 January 2003) subdivided the previous discharge categories and reduced the authorised limits.

Site	Tritium		Artificial alpha emitters		Radioactive iodines		Rare gases	
	Limit	2004 discharges	Limit	2004 discharges	Limit	2004 discharges	Limit	2004 discharges
	(TBq/yr)	(TBq)	(GBq/yr)	(GBq)	(TBq/yr)	(TBq)	(TBq/yr)	(TBq)
La Hague	150	71.3	0. 01	0.0018	0.02	0.00521	470,000	263,000

Site	Carbon 14		Other artificial beta and gamma emitters	
	Limit	2004 discharges	Limit	2004 discharges
	(TBq/yr)	(TBq)	(GBq/yr)	(GBq)
COGEMA La Hague	28	17.3	74	0.143

L.6.2.1.4 Limits and values of gaseous discharges from CEA sites

The current permits comprise two or four categories. depending on the Centres.

Site	Rare gases		Tritium		Halogens		Aerosols	
	Limit	Discharge	Limit	Discharge	Limit	Discharge	Limit	Discharge
	(TBq)	(TBq)	(TBq)	(TBq)	(GBq)	(GBq)	(GBq)	(GBq)
Grenoble	10	0.097	20	0.26	3	0.007	0.3	0.00029
Saclay	750	57.8	550	43.4	20	0.257	40	0.0924
	Rare gases + Tritium				Halogens + Aerosols			
	Limit (TBq)		Discharge (TBq)		Limit (GBq)		Discharge (GBq)	
Cadarache	555		< 150		18.5		< 0.093	

L.6.2.2 Liquid discharges from nuclear sites in 2001

Liquid discharges from the main basic nuclear installations are presented with their corresponding limits. in the following tables according to the radioactive product groupings specified in the permits in force in 2001.

L.6.2.2.1 Limits and values of liquid discharges from EDF sites with the original permit

In these permits. established for the nuclear power plants on the basis of the 1974 specifications. liquid discharges are split into two categories.

Site	Tritium		Others	
	Limit	Discharges	Limit	Discharge
	(TBq)	(TBq)	(GBq)	(GBq)
Le Blayais	111	47	1480	2.4

Le Bugey	185	28	2035	1.9
Cattenom	160	110	2200	1.0
Chinon	110	39	1500	1.4
Chooz	80	39	222	0.7
Civaux	80	16	222	1.7
Creys-Malville	15	0.005	250	0.01
Cruas-Meysse	110	40	1500	0.90
Dampierre-en-Burly	111	35	1480	2.2
Fessenheim	74	23	925	1.3
Golfech	80	49	1100	0.60
Gravelines	166	53	2180	5.9
Nogent-sur-Seine	80	53	1100	1.8
Penly	80	45	100	1.1
Le Tricastin	111	43	1480	1.5

L.6.2.2.2 Limits and values of liquid discharges from EDF site with renewed permit

In these new permits established on the basis of the 1995 specifications when renewed for the nuclear power plant sites liquid discharges are now split into four different categories including C14 which is also measured.

Site	Tritium		Carbon 14		Iodine		Others	
	Limit	Discharges	Limit	Discharge	Limit	Discharge	Limit	Discharge
	(TBq)	(TBq)	(GBq)	(GBq)	(GBq)	(GBq)	(GBq)	(GBq)
Belleville-sur-Loire	60	55.8	400	34.7	0.1	0.02	25	0.4
Le Blayais	80	44.7	600	45.3	0.6	0.02	60	1.7
Cattenom	140	100	380	64.1	0.2	0.03	50	1.3
Chinon	80	38.6	600	43.0	0.6	0.02	60	2.1
Cruas-Meysse	80	42.4	600	42.9	0.6	0.08	60	1.7
Flamanville	60	57.9	400	32.2	0.1	0.02	25	0.7
Gravelines	120	46.6	900	69.4	0.9	0.10	90	2.2
Paluel	120	97.2	800	56.8	0.2	0.04	50	3.7
Saint-Alban – Saint-Maurice	60	54.8	400	36.7	0.1	0.01	25	3.6
Saint-Laurent-des-Eaux	40	25.9	300	23.1	0.3	0.01	30	0.3

L.6.2.2.3 Limits and values of liquid discharges from the COGEMA La Hague site

The current permit (order of 10 January 2003) subdivided the previous discharge categories and reduced the authorised limits.

Site: La Hague

Tritium		Alpha emitters		Strontium 90		Caesium 137		Caesium 134	
Limit	2004 discharges	Limit	2004 discharges	Limit	2004 discharges	Limit	2004 discharges	Limit	2004 discharges
(TBq/yr)	(TBq)	(TBq/yr)	(TBq)	(TBq/yr)	(TBq)	(TBq/yr)	(TBq)	(TBq/yr)	(TBq)
18 500	13 900	0.1	0.017	2	0.14	2	0.79	2	0.064

Carbon 14		Ruthenium 106		Cobalt 60		Radioactive iodines		Other beta and gamma emitters	
Limit	2004 discharges	Limit	2004 discharges	Limit	2004 discharges	Limit	2004 discharges	Limit	2004 discharges
(TBq/yr)	(TBq)	(TBq/yr)	(TBq)	(TBq/yr)	(TBq)	(TBq/yr)	(TBq)	(TBq/yr)	(TBq)
42	8.9	15	6.4	1	0.26	2.6	1.40	30	7.02

L.6.2.2.4 Limits and values of liquid discharges from CEA sites

The current permits concern four Centres and comprise three categories.

Site	Tritium		Alpha emitters		Others	
	Limit	Discharges	Limit	Discharge	Limit	Discharge
	(TBq)	(TBq)	(GBq)	(GBq)	(GBq)	(GBq)
Cadarache	1.85	0.133	0.37	0.027	3.7	0.135
Fontenay-aux-Roses	0.20	0.00033	1.0	0.003	40	0.013
Grenoble	0.50	0.00065	0.10	0.0006	1.0	0.0022
Saclay	7.4	0.121	0.74	< 0.165	37	1.47

Observation of these results confirms the ASN's policy to lower the discharge permits in accordance with the general principle of environmental protection bringing them more into line with the operating requirements of the installations.

L.7 *Bibliography*

L.7.1 Documents

/1/ Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management (JC). September 1997.

/2/ Guidelines concerning national reports as provided by the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management. INFCIRC/603/Rev.1, 3 August 2004

/3/ Public Health Code – Journal officiel de la République française (Official Gazette)[5]

/4/ Environment Code – Journal officiel de la République française

/5/ The safety of nuclear installations in France - laws and regulations - Recueil n°1606 - Les éditions du Journal officiel. 4th edition. May 1999.

/6/ Nuclear safety and radiation protection in France in 2003 - Annual report by the Nuclear Safety Authority. March 2004.

/7/ Nuclear safety and radiation protection in France in 2004 - Annual report by the Nuclear Safety Authority. March 2005

/8/ Inventaire national des déchets radioactifs et des matières valorisables (*national inventory of the radioactive waste and recoverable materials in France*). November 2004.

/9/ Convention on nuclear safety - Third national report on the implementation by France of the obligations of the Convention. September 2004

L.7.2 Web sites

The above documents. or at least the key parts of their content. along with other relevant information on the subject of this report. are available via the Internet. The following sites may in particular be consulted:

Légifrance: www.legifrance.fr

ASN: www.asn.gouv.fr

Andra: www.andra.fr

CEA: www.cea.fr

COGEMA: www.cogema.fr

EDF: www.edf.fr

IAEA: www.iaea.org

[5] A large number of legislative and statutory texts are available on the Web site www.legifrance.fr

L.8 List of the main abbreviations

AEN	The OCDE’s Nuclear Energy Agency
Andra	France's National Agency for Radioactive Waste Management
AREVA	Holding company. shareholder of COGEMA
ASN	Nuclear Safety Authority
BNI	Basic Nuclear Installation
CEA	French Atomic Energy Commission
CENTRACO	Low level waste reprocessing and packaging centre
CIINB	The Inter-ministerial Commission for Basic Nuclear Installations
CNPE	Nuclear Power Plant (EDF)
COGEMA	Compagnie générale des matières nucléaires (French general nuclear materials company)
DARQSI	Directorate for Regional Action on Quality and Industrial Safety
DGEMP	Directorate general for energy and raw materials
DGSNR	The General Directorate for Nuclear Safety and Radiation Protection
DPN	EDF’s Nuclear Generation Division
DPPR	Directorate for the prevention of pollution and hazards
DSND	Defence Nuclear Safety and Radiation Protection Delegate
DRIRE	French regional directorate for industry, research and the environment
DSNR	Nuclear safety and radiation protection departments of the DRIREs
EDF	Electricité de France
EU	European Union
GGR	Graphite gas cooled reactor
GP	Standing group of experts (GPD =standing group of waste experts)
HLW	High level waste
IAEA	The UN’s International Atomic Energy Agency
ICRP	International Commission on Radiological Protection
ICPE	Installations classified on environmental protection grounds
INES	International Nuclear Event Scale
IPSN	CEA’s Institute for Nuclear Protection and Safety (now incorporated into the IRSN)
IRSN	The Institute for Radiation Protection and Nuclear Safety
LL	Long-lived (waste)
LLW	low level waste
MLW	Medium level waste
MOX	Mixed uranium oxide and plutonium based fuel
OPECST	Parliamentary office for the assessment of scientific and technological options
PPI	Offsite emergency plan
PUI	On-site emergency plan
PNGDR-MV	National Plan for Management of Radioactive Waste and Recoverable Materials
PWR	Pressurised water reactor
REX	Experience feedback
RFS	Basic safety rule
RGE	General operating rules
SL	Short-lived (waste)
SOCODEI	Subsidiary of EDF and COGEMA operating the CENTRACO installation
STE	Technical operating specifications
UNGG	Natural uranium gas-graphite reactor
VLLW	Very low level waste
WENRA	Western European Nuclear Regulators Association