



3rd French national report
on implementation of the obligations of the

Convention on nuclear safety

- Issued for the 2005 Peer review meeting -

English version – Original report in French

July 2004

Table of contents

| | |
|---|-----------|
| INTRODUCTION | 5 |
| 1. General introduction..... | 5 |
| 2. Main changes with respect to the 2 nd French report..... | 7 |
| 2.1 Changes in nuclear safety supervision in 2002 | 7 |
| 2.2 Changes in the content of the third report with respect to the second report..... | 7 |
| 2.3 Topical safety issues in France in 2004..... | 7 |
| 3. Nuclear national policy and practices..... | 12 |
| 3.1 General policy..... | 12 |
| 3.2 Nuclear power plants | 12 |
| 3.3 Nuclear research reactors | 13 |
| 3.4 Regulatory framework..... | 13 |
| A. GENERAL PROVISIONS..... | 15 |
| 4. Article 4 : Implementing measures..... | 15 |
| 5. Article 5 : Reporting | 15 |
| 6. Article 6 : Existing nuclear installations | 15 |
| 6.1 Nuclear installation in France | 15 |
| 6.2 Safety assessments..... | 15 |
| 6.3 Main safety improvements to nuclear power reactors..... | 16 |
| 6.4 Main safety improvement for nuclear research reactors | 20 |
| B. LEGISLATION AND REGULATION..... | 23 |
| 7. Article 7 : Legislative and regulatory framework..... | 23 |
| 7.1 Legislative and regulatory framework | 23 |
| 7.2 Basic Nuclear Installations regulations | 25 |
| 7.3 Basic Nuclear Installation supervision | 28 |
| 8. Article 8 : Regulatory body..... | 37 |
| 8.1 The Nuclear Safety Authority (ASN) | 37 |
| 8.2 The other supervision players..... | 43 |
| 9. Article 9 : Responsibility of the licence holder | 46 |
| C. GENERAL SAFETY CONSIDERATION..... | 47 |
| 10. Article 10 : Priority to safety | 47 |
| 10.1 Regulatory requests..... | 47 |
| 10.2 Measures taken for power reactors | 47 |
| 10.3 Measures taken for research reactors | 49 |
| 10.4 Analysis by the regulator | 50 |
| 11. Article 11 : Financial and human resources | 51 |
| 11.1 Regulatory request | 51 |
| 11.2 Resources allocated to safety in nuclear power plants | 51 |
| 11.3 Resources allocated to safety in research reactors | 52 |
| 11.4 Analysis by the regulator | 53 |
| 12. Article 12 : Human factors..... | 55 |
| 12.1 Regulatory requests..... | 55 |
| 12.2 Steps taken concerning human factors in EDF nuclear power plants..... | 55 |
| 12.3 Steps taken concerning human factors in research reactors | 57 |
| 12.4 Analysis by the regulator | 58 |

Content

| | |
|--|------------|
| 13. Article 13 : Quality assurance..... | 61 |
| 13.1 Regulatory requests..... | 61 |
| 13.2 EDF's quality assurance policy and programme | 61 |
| 13.3 Quality assurance policy and programme in research reactors | 63 |
| 13.4 Analysis by the regulator..... | 65 |
| 14. Article 14 : Assessment and verification of safety | 67 |
| 14.1 Regulatory requests..... | 67 |
| 14.2 Safety reviews and verifications carried out at nuclear power plants | 69 |
| 14.3 Safety reviews and verifications carried out on research reactors | 72 |
| 14.4 Analysis by the regulator..... | 73 |
| 15. Article 15 : Radiation protection | 75 |
| 15.1 Radiation protection regulation | 75 |
| 15.2 Measures taken by EDF in the field of radiation protection | 80 |
| 15.3 Measure taken in the field of radiation protection for research reactors..... | 83 |
| 15.4 Regulatory surveillance in the radiation protection field | 85 |
| 15.5 Summary of regulatory monitoring and checks | 86 |
| 16. Article 16 : Emergency preparedness | 88 |
| 16.1 General emergency response provisions..... | 88 |
| 16.2 The role and organisation of the ASN | 91 |
| 16.3 The role and organisation of the operators | 94 |
| 16.4 Accident simulation drills..... | 100 |
| 16.5 Lessons learned : development in nuclear emergency provisions | 101 |
| D. SAFETY OF INSTALLATIONS | 105 |
| 17. Article 17 : Siting | 105 |
| 17.1 Regulatory request..... | 105 |
| 17.2 The situation during the period in question | 105 |
| 18. Article 18 : Design and construction | 107 |
| 18.1 Licensing process | 107 |
| 18.2 Presentation of current projects | 109 |
| 19. Article 19 : Operation..... | 111 |
| 19.1 Licensing process and regulations | 111 |
| 19.2 Measures taken by EDF | 116 |
| 19.3 Measures taken for research reactors | 124 |
| 19.4 Analysis by the regulator of nuclear reactor operation | 126 |
| 19.5 Operational safety review by international organisations | 131 |
| 20 Planned activities to improve safety | 133 |
| 20.1 National measures | 133 |
| 20.2 International co-operation measures..... | 134 |
| APPENDICES..... | 143 |
| Appendix 1 – List and location of nuclear reactors in France | 143 |
| Appendix 2 – Main legislative and regulatory texts | 147 |
| Appendix 3 - Organisation of the nuclear reactor operators | 151 |
| Appendix 4 – Monitoring the environment..... | 156 |
| Appendix 5 - References | 165 |
| Appendix 6 – List of main abbreviations..... | 166 |

INTRODUCTION

1. General introduction

1.1 Subject of the report

The Convention on Nuclear Safety, hereinafter referred to as “the Convention”, is one of the results of international discussions initiated in 1992 with the aim of proposing binding international obligations regarding nuclear safety. France signed the Convention on 20 September 1994, on the first day it was opened for signature on the occasion of the General Conference of the IAEA. France approved the Convention on 13 September 1995 and it entered into force on 24 October 1996.

For many years, France has been participating in international initiatives to enhance nuclear safety and considers the Convention on Nuclear Safety to be an important step in this direction. The areas covered by the Convention have long been part of the French approach to nuclear safety.

This report, the third one of its kind, is issued in compliance with Article 5 of the Convention on Nuclear Safety and presents the measures taken by France to meet each of the obligations of the Convention.

1.2 Facilities concerned

As such, the Convention on Nuclear Safety applies to nuclear power reactors and so most of this report deals with measures taken to ensure their safety. However, for this third report, a number of considerations led France also to present the measures taken concerning all research reactors, with a "graded approach" tailored to their size where appropriate.

First of all, research reactors are subject to the same general regulations as power reactors with regard to nuclear safety and radiation protection. Furthermore, the most powerful research reactor, which is also intended for producing power, was already included in the previous French report. Secondly, within the first report under the Joint Convention on the safety of spent fuel management and on the safety of radioactive waste management, to which France is a party, the measures taken for research reactors in these areas were already presented. Finally the IAEA Board of Governors, on which France has a seat, in March 2004 approved the Code of Conduct on the safety of research reactors, which incorporates most of the provisions of the present Convention.

1.3 Report authors

This report was produced by the Nuclear Safety Authority (ASN), which ensured the necessary coordination, together with the Institute for Radiation Protection and Nuclear Safety (IRSN) as well as the nuclear power reactor operators, Electricité de France (EDF), the Atomic Energy Commission (CEA) and the Laue - Langevin Institute (ILL). The final version was completed in July 2004 after consultation with the French parties concerned.

1.4 Structure of the report

For this report, France took account of the experience acquired with its first two reports: this report is a stand-alone document based mainly on existing documents and reflecting the viewpoints of the various stakeholders (Regulatory authority 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 body of the regulations, followed by a presentation by the operators of the steps taken to meet the regulations and finally, an analysis by the regulator of the steps taken by the operators.

Introduction

The report is structured according to the guidelines for national reports, as modified during the 2002 peer review meeting. The presentation is made "Article by Article", each being the subject of a different chapter, at the beginning of which the corresponding text of the Convention is repeated in a shadow box. The current introduction highlights the main changes since the second national report together with France's nuclear energy policy. Part A deals with the general provisions (Articles 4 to 6). Part B summarizes the legislation and regulations (Articles 7 to 9). Part C is devoted to general safety considerations (Articles 10 to 16). Part D discusses the safety of the installations (Articles 17 to 19). Finally, the conclusion gives indications on future trends in the field of nuclear safety in France, including the measures for international cooperation. The report is supplemented by a number of appendices.

The main changes between this report and the previous one, for each chapter, are summarized in chapter 2 of the present report.

1.5 Publication of the report

The Convention on Nuclear Safety comprises no obligation regarding public communication of the report stipulated in article 5. 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 thus available, in French and in English, on the Nuclear Safety Authority's website (www.asn.gouv.fr).

2. Main changes with respect to the 2nd French report

2.1 Changes in nuclear safety supervision in 2002

As presented by France during the second Peer Review meeting of the Convention on Nuclear Safety in April 2002, supervision of nuclear safety and supervision of radiation protection were modified in February 2002, that is 4 months after publication of the second French report. The main change, which was presented orally on 16 April 2002 during the second review meeting, consisted in merging the areas of nuclear safety and radiation protection in a single regulatory body. The description of the regulatory framework and of the regulatory body in chapters 7 and 8 of this report therefore presents the current situation.

2.2 Changes in the content of the third report with respect to the second report

Following a number of other Contracting Parties who had already made this voluntary choice for previous reports, France in its turn decided, for the reasons explained in chapter 1, voluntarily to include in this same report the measures taken to ensure the safety of research reactors even if they are not intended for producing power. In addition, with a view to harmonising the presentation with a number of other national reports as they were issued for the second review meeting, the content of the chapters has been slightly revised. Finally paragraphs which had raised questions during the review of the second report now include the answers to these questions and paragraphs dealing with topical issues have been entirely rewritten. The main changes as compared to the previous report, are summarized hereafter.

This chapter 2, which mainly contains the topical safety issues is almost entirely new in relation to chapter 2 of the second report. Chapter 3 is an update of chapter 1 of the second report. Chapters 4 and 5 remain unchanged with respect to the second report. Chapter 6 however now deals with the main measures taken to improve reactor safety in France, which was in chapter 14 of the second report together with the safety assessments, as Article 6 deals with the safety of existing installations.

Chapter 7, dealing with safety regulations, contains very few changes in relation to chapter 7 of the second report. However chapter 8, dealing with the regulatory body, is entirely reworked in order to present the organisation resulting from the 2002 reform. Chapter 9 is for its part almost identical to chapter 9 of the second report.

Chapters 10 to 13 consist in an update of the same chapters of the second report, clarifying the issues raised during the review meeting, and contain no fundamental changes apart from the extension to include research reactors. In addition to being updated, chapter 14, has been slimmed down with the transfer of the description of main reactor modifications to chapter 6. Chapter 15 has been updated with regard to radiation protection regulations. Chapter 16 differs little from the previous chapter 16, with the exception of the changes regarding the Authority in charge of coordination in the event of a nuclear emergency.

Chapters 17 to 19 consist mainly in an update of the same chapters of the second report, taking into account the questions received and the extension to include research reactors.

Finally chapter 20 now contains the international cooperative measures, which were the subject of a chapter 3 in France's second report, following the planned measures for improving safety at the national level both by the regulator and by the operators.

2.3 Topical safety issues in France in 2004

Since the review meeting of the previous report (April 2002), no major event related to nuclear safety has occurred in France. The installations under Nuclear Safety Authority supervision experienced no

significant events. Only two generic incidents on reactors have been rated at INES level 2 since then. These recent years the Nuclear Safety Authority has therefore devote considerable efforts to developing its radiation protection action. It has also continued work into long-term safety, the main areas of which are mentioned hereafter.

2.3.1 Safety and market competition

The law of 10 February 2000 concerning modernisation and development of the public electricity service considerably modifies the domestic electricity market in France. While stipulating EDF's public service commitments, the law, which transposes a European directive on the internal electricity market, places EDF in particular, in a competitive situation for energy production and its supply to the larger customers. A debate began and is indeed continuing on the potential safety impact of electricity market trends and the new methods implemented or foreseen by the operator and on the actions to be implemented by the ASN in this domain.

Operator globalisation was apparent within EDF through the important organisational changes conducted in 2002. The concern with cost control is today stressed more by the operator in its dealings with the ASN. At the beginning of 2003, EDF informed the ASN of its aim to develop cost-benefit type approaches, allowing both technical and economic constraints and safety objectives to be considered in engineering decisions and the relevance of the various options to be assessed.

Faced with the various challenges related to this approach, the ASN identified the main areas for efforts in the coming years. The first area is the development of supervising and monitoring tools for the early detection of possible drift. The second area deals with the implementation of a more frank and responsible dialogue with the operator about the economic issues. The third area is the implementation of a clarified and reinforced legal framework. The draft law related to transparency and security in nuclear activities aims to improve this aspect. The fourth area consists in developing international exchanges between nuclear safety Authorities to move toward harmonisation of requirements, given the internationalisation of operators and the advent of a competitive power market.

Finally, it should be mentioned that most research installations are operated by large public organisations, whose resources are dependent on the State's budget situation, itself within a broader competitive market picture. The ASN must be watchful that budget constraints have no detrimental consequences on safety or radiation protection in the operation of these installations.

2.3.2 Fuel rod leaktightness

Losses of fuel rod leaktightness by wearing at the bottom level spacer grid were observed in 2001 and 2002 on 1300 MWe units, with a high number of rods affected in Cattenom 3 and Nogent 2. The loss of leaktightness, caused by fretting, occurred generally during the third irradiation cycle. Most of the affected assemblies were of the Framatome AFA2GL design. Similar problems have been discovered on ENUSA assemblies as well as in American reactors.

The wearing phenomenon is due to fuel rod vibration induced by hydraulic loading at the foot of the assembly and a drop in the effectiveness of the springs under the effect of irradiation. Understanding this phenomenon has allowed relatively precise computer modelling of the flow induced vibration behaviour of the rod, which clearly highlights the predominant influence on the wear of the initial rod mounting conditions and the transverse flow at the lower level. This transverse flow is mainly the result of redistribution of the lower plenum and assembly feet flows.

To solve this issue, Framatome proposed a design modification using the AFA3GLR product (AFA3GL with double lower spacer grid), the efficiency of which had been confirmed with an endurance test in a research test loop. This new design, which is close to the initial design, was introduced into the reactor in September 2002. The RFA design Westinghouse assemblies loaded in 2003 have also undergone

design modifications aimed at eliminating these wear problems, in particular with the addition of a reinforcement spacer grid in the lower part (P-grid).

The radiochemical specifications of the primary system were revised in order to allow differentiation between situations caused by the fretting phenomena from those related to other causes occurring randomly (loose part, manufacturing defect, etc.).

2.3.3 Sump filters used for safety injection and containment spray water recirculation systems

The risk of clogging of sump filters on the power reactor safety injection systems and containment building spray systems was reassessed in 2003 in the light of the recent works and tests conducted by IRSN.

This reassessment is the consequence of the 1992 event on the Barsebäck 2 BWR in Sweden, which led to a review of the amount, physical nature and behaviour of thermal insulation debris. It initially appeared that only BWR were concerned, particularly because of a different reactor building design and smaller filters. However test and analyses were continued and it appears that clogging phenomena are likely to occur on PWRs if there are certain combinations of the many influential parameters such as break size, level of disintegration of thermal insulation fibres by break jetting, combination with other entrained debris or products.

These reassessments have led the ASN to ask EDF to state its position concerning the clogging risk before the end of 2003 for all types of nuclear power plants. EDF confirmed that considering these new scenarios indicates that current margins are no longer sufficient, in particular with regard to hypothetical large break type scenarios.

Although the filters equipping EDF units have a larger surface area than for other PWRs, EDF decided, for the 900 MWe reactors to begin major modifications, in order to restore the margins for all the postulated scenarios. These modifications were initiated within the framework of the third periodic safety review of the 900 MWe units but will be carried out independently of and in advance of the ten yearly outages. A review is currently being carried out to decide on whether or not they should be extended to the 1300 MWe and 1450 MWe reactors, which have larger filter surfaces.

2.3.4 The importance of human and organisational factors

As underlined by the root analysis of a number of events which occurred on reactors in recent years, human and organisational factors are an important area for safety improvement. The ASN therefore has undertaken a methodical review of the extent to which the operators consider these factors, in particular for nuclear power reactors. For that purpose a safety management inspections system was set up and annual meetings of the Advisory committee for nuclear reactors have been organised on this topic.

EDF, for its part, is implementing a policy of direct inclusion of human and organisational factors in all its nuclear reactor design and operation activities. Therefore, through its " safety – radiation protection – availability – environment observatory ", EDF pays special attention to the quality of its decision-making processes and ensures that the main priority remains safety.

2.3.5 Changes in nuclear reactor fuel and fuel management

Changes in the fuels used in nuclear reactors have implications for the plant in which they are produced or reprocessed, the installations in which they are stored and for radioactive substance transport. It is then necessary, from the technical viewpoint, to make sure that these changes are consistent with the safety of the corresponding operations and, in regulatory terms, with the plant authorisation decrees, the liquid and gaseous release and water intake licences, the technical requirements and the regulations for the transport of radioactive materials.

The ASN asked EDF to present a study of the consequences of the envisaged changes for fuel on the fuel cycle installations in terms of safety (containment, criticality, removal of residual heat in normal and accident conditions) and of radiation protection (use of reprocessed uranium and plutonium at the front end of the fuel cycle). For the ASN, using this 10-years forward-looking approach, the goal is to ensure that the options proposed by the operators are not redhibitory and immediately to identify the issues for which justifications or authorisation applications will be needed, as and when appropriate.

The study presented by EDF was reviewed by the Advisory Committees for waste and for laboratories and plants, with the involvement of members from the Advisory Committee for nuclear reactors, in July 2002. The ASN adopted a position based on this review and informed EDF that the new fuel management options did not in principle seem to include any redhibitory aspects, although the long-term technical management solutions were not completely defined.

Since 2001, the Nuclear Safety Authority has been working on drafting a ministerial order concerning nuclear fuel and its in-pile operation. In 2002, the draft was submitted for comments to EDF, to the Institute for radiation protection and nuclear safety and to the various fuel assembly designers and manufacturers. The ASN took account of all comments received during the course of 2003 and intends to produce a new version of its draft order with the aim of presenting it to the Advisory Committee for nuclear reactors at the end of 2004.

2.3.6 Extreme weather conditions

What is striking about 2003, is that in a single year nuclear installations were affected by two types of extreme weather conditions: the heat wave and drought in the summer followed by flooding in the autumn. In the first case, safety was not at issue, in that none of the safety-related operating limits in the installations was reached or exceeded, but release temperature limits, which may affect the environment had to be temporarily modified to allow plant operation to continue and avoid power cuts. In the second case, safety was not at issue either. It is clear that the work done following the late 1999 flooding on the Blayais NPP has borne fruit, since no nuclear installation was actually flooded. However, the exceptional flow rates of the rivers and the materials they were carrying led to clogging of water intakes at two plants, requiring EDF to shut down four units as a precautionary measure. The probable rise in the number of such weather events in the coming years means that even greater emphasis will have to be placed on prevention of their potential consequences.

Generally speaking, national and international operating feedback is showing weather-related problems the scale, frequency and nature of which raise questions concerning the initial design of the installations.

Thus, certain exceptional phenomena, whether or not related to climate change, are causing EDF and the ASN to be particularly vigilant on this subject. Hazards related to storms, snow, tornadoes, heat sink drying up, frazil ice, high heat sink water temperature, high air temperature, lightning and forest fires will be reassessed within the framework of the third ten-yearly outages for the 900 MWe series. The resistance of the plant to these hazards will have to be reviewed.

2.3.7 Radiation protection

The increasing consideration given to radiation protection and environmental protection concerns has allowed EDF to improve its results in these areas in recent years. Although the Nuclear Safety Authority feels that EDF has made progress in the collective dose management during maintenance operations and on the whole acknowledges an improvement in working methods related to radiation protection, it believes that there is still room for improvement with regard to international best practices, especially in the way that dosimetry, contamination and waste are managed on work sites. However work in progress should enable the improvements to be continued.

2.3.8 Periodic safety reviews, power reactor ageing and plant life management

The existing French nuclear fleet is standardised, allowing particularly effective operating feedback between various reactors but creating an obligation to anticipate any risk of occurrence of generic defects. This first of all concerns the problem of ageing: the issues of ageing are today more clearly recognised and would seem to be coming under control, for both the primary system and for the civil engineering side. Preparation for the 900 MWe third ten-yearly outage is underway but the time-frame of the files prepared by EDF is still limited to 40 years at a same time when EDF is talking about the possibility of extending the life of some power plants beyond that. Conformity checks, the permanent research for problems by the engineering divisions, the tests and checks conducted during the ten-yearly outages are an opportunity to gain a clear picture of the current safety of the installations. This proactive approach must therefore continue and will lead to back-fitting work, for which the completion dates must be both justified in terms of safety and realistic in terms of implementation.

The operator must also aim to improve safety through periodic safety reviews which compare the reactors with the most recent standards (on this point, see chapter 14). With reactor commissioning work now completed in France, the work done on the EPR reactor project and the information collected on recent and future reactors have been used to define the orientations of the reassessment associated with the third 10-yearly outages for the 900 MWe series. This is also why ASN will be continuing to update the basic safety rules and develop probabilistic safety studies, within the framework of a realistic approach to risk reduction.

2.3.9 Reactor replacement

The oldest research reactors operated by CEA and built in the 1960s and 1970s will have to be gradually shut down, mainly for technological and material ageing reasons. In addition a number of other European research reactors are also nearing the end of their service life. The CEA has therefore decided to build a new research reactor at Cadarache, the Jules Horowitz reactor, to replace them. In 2003, the ASN already assessed the safety options of this project.

With regard to power reactors and following a debate on French energy policy orientations, the Parliament in June 2004 declared itself in favour of building an EPR reactor. The EPR is an evolutionary pressurised water reactor project developed jointly by French and German operators and utilities (Framatome ANP, EDF and a German electricity consortium). In terms of safety this project involves greater defence in depth than existing plants. In 2003, industry continued to examine the reactor project, in particular the choices for design and construction of the main components of the primary system, the design of specific systems, the radiological consequences of accidents, the probabilistic safety studies and the mechanical construction code. In 2003 and 2004 the ASN continued its review of the project safety studies, in particular relying on the Advisory Committee for nuclear reactors and on foreign experts.

The Finnish decision to order an EPR reactor also makes improved cooperation between the Nuclear Safety Authorities necessary in order to coordinate the technical assessment work of this reactor project as far as possible. As a result of this, the ASN is taking an early look on certain detailed studies on which there are still technical issues.

3. Nuclear national policy and practices

3.1 General policy

The first governmental decision in the field of nuclear energy was in 1945 to create the Commissariat à l'énergie atomique (CEA), a public research organisation. The first French experimental reactor went critical in December 1948, paving the way for the construction of other research reactors and then of nuclear power reactors.

The French nuclear power reactors within the scope of the Convention were built and are operated by a single operator, Electricité de France (EDF). The research reactors currently operating, including the Phenix research power reactor, were built and are operated by the Commissariat à l'énergie atomique (CEA), with the exception of one which is operated by the Laue-Langevin Institute.

French energy policy is defined by the government and is supervised by the Ministry for Industry.

The regulation and supervision of nuclear safety and radiation protection are carried out by the Nuclear Safety Authority, which is described in Chapter 8.

3.2 Nuclear power plants

As all the fuel has been unloaded from the first generation of natural uranium gas-cooled and heavy water power reactors, as well as from the first pressurised water reactor and from the fast neutron Superphenix reactor, they are not within the scope of this Convention.

The nuclear power plants covered by the Convention are for the most part, the 58 pressurised water reactors (PWR), which were connected to the grid between 1977 and 1999 and are currently all in operation.

In 2003 the PWR reactors supplied approximately 80% of the electricity generated in France. They are located into 19 nuclear power generation sites (NPPs), which are on the whole similar. All are equipped with two to six reactors of the same type (pressurised water reactors), giving a total of 58 reactors, built by the same company, Framatome. The following categories are usually referred to (See location map in appendix A.1):

- the thirty-four 900 MWe reactors including:
 - the CP0 series, comprising the 2 Fessenheim reactors and the four Le Bugey reactors (units 2 to 5),
 - the CPY series, comprising the other 900 MWe reactors, which can be subdivided into CP1 (18 reactors at Dampierre, Gravelines, le Blayais and le Tricastin) and CP2 (10 reactors at Chinon, Cruas and Saint-Laurent-des-Eaux) ;
- the twenty 1300 MWe reactors including:
 - the P4 series, comprising 8 reactors at Paluel, Flamanville and Saint-Alban,
 - the P'4 series, comprising 12 1300 MWe reactors at Belleville, Cattenom, Golfech, Nogent and Penly ;
- the N4 series, comprising four 1450 MWe reactors: two at Chooz and two at Civaux.

Despite the overall standardisation of the French nuclear power reactor fleet, certain technological innovations were introduced as design and construction of the plants proceeded.

The CPY series differs from the Bugey and Fessenheim reactors (CP0 series) in the building design and in the addition of an intermediate cooling system between the circuit for containment spraying in the event of an accident and that containing river water. It also provides for a more flexible reactor control.

The design of the 1300 MWe reactor primary and secondary systems, core protection devices and plant buildings differs considerably from that of the CPY series. The power increase is matched by the addition of a fourth steam generator, providing greater cooling capacity than for the 900 MWe reactors equipped with three steam generators. Moreover, the reactor containment consists of a double concrete-walled structure, instead of the single wall design with steel liner adopted for the 900 MWe series.

The P4 series differs slightly from the P4 series, notably with regard to the fuel building and primary and secondary piping. Finally, the N4 series differs from the previous series in the design of more compact steam generators and the primary pump, and in the computerised instrumentation and control system.

3.3 Nuclear research reactors

This report also describes the steps taken concerning the safety of research reactors, as they are subject to the same regulations as nuclear power reactors in France, even though they are not formally within the scope of this Convention.

There are 11 research reactors, of various types in operation in France, with a thermal power ranging from 0.100 kW to 350 MW and commissioned between 1964 and 1978. The largest of them, the Phenix reactor is a fast neutron power reactor which is located at the CEA Valrho Centre in Marcoule. Designed for a thermal power of 563 MW, it has been running at a power of 350 MW since 1993.

Nine of the other research reactors are located in the CEA's centres in Cadarache and Saclay. Finally the High Flux Reactor is located at the Laue-Langevin Institute near the CEA centre in Grenoble.

3.4 Regulatory framework

The decree describing how nuclear safety was to be supervised in France was issued in 1963, just before the first nuclear power plant was commissioned. It established an Interministerial Commission for Basic Nuclear Installations (BNIs), which has to be consulted by the competent ministries in the context of the application for construction, modification or decommissioning decrees for these installations. Formerly, the safety of nuclear reactors, which were closely linked to research, was supervised by the CEA.

A Central Service for the safety of nuclear installations was created in 1973 and in 1991 became the Directorate for the safety of nuclear installations. For civilian nuclear installations, it was tasked with drafting regulations, supervising their application, managing licensing procedures and implementing emergency response in the event of incidents or accidents. In 1976, the CEA departments in charge of nuclear safety and radiation protection were grouped into an Institute for Nuclear Safety and Protection, with a degree of autonomy within the CEA, and which acted as a technical support organisation for the Nuclear Safety Authority.

In addition a Central Service for protection against ionising radiation was set up in 1966, and in 1994 became the Office for protection against ionising radiation. It was tasked with performing all measurements, analyses or controls making it possible to determine the amount of radioactivity or ionising radiation in various media where their occurrence can present a hazard for the health of the public or workers. It supervised compliance with the regulatory requirements for radiation protection.

February 2002 saw the creation of the Directorate General for Nuclear Safety and Radiation Protection which, with the support of the Divisions for Nuclear Safety and Radiation Protection within the Regional directorates for research, industry and the environment, constitute the new Nuclear Safety Authority (ASN), in charge of the Nuclear Safety and the Radiation Protection. At the same time the former technical support organisations of the regulatory authorities concerning both nuclear safety (IPSN) and radiation protection (OPRI) were merged into a single entity responsible with technical assessment and research: the Institute for Radiation Protection and Nuclear Safety (IRSN).

A. GENERAL PROVISIONS

4. Article 4 : Implementing measures

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.

This report presents the legislative, regulatory and administrative measures and other provisions necessary for France to fulfil the obligations of the Convention.

5. Article 5 : Reporting

Each Contracting Party shall submit for review, prior to each meeting referred to in Article 20, a report on the measures it has taken to implement each of the obligations of this Convention.

This report is the third French report issued in compliance with Article 5 of the Convention.

6. Article 6 : Existing nuclear installations

Each Contracting Party shall take the appropriate steps to ensure that the safety of nuclear installations existing at the time the Convention enters into force for that Contracting Party is reviewed as soon as possible. When necessary in the context of this Convention, the Contracting Party shall ensure that all reasonably practicable improvements are made as a matter of urgency to upgrade the safety of the nuclear installation. If such upgrading cannot be achieved, plans should be implemented to shut down the nuclear installation as soon as practically possible. The timing of the shut-down may take into account the whole energy context and possible alternatives as well as the social, environmental and economic impact.

6.1 Nuclear installation in France

The 58 pressurised water reactors used to generate electricity lie at the heart of the nuclear industry in France. These reactors are operated by a single operator Electricité de France (EDF). Another feature is the standardisation of the nuclear power plant fleet, with a large number of technically similar reactors, justifying a "generic" presentation. One fast neutron reactor, used for research and producing electricity, is operated by CEA. Nine other research reactors are operated by CEA and another one is operated by the Laue-Langevin Institute. A list of nuclear reactors in operation in France is given in Appendix 1, together with a location map.

The principles of the Convention have been applied to the safety of these installations since their design stage.

6.2 Safety assessments

Before a nuclear reactor is commissioned, the ASN performs all the necessary safety assessments at the various stages of installation design, construction and pre-commissioning tests, in accordance with the regulations described in Chapters 7 and 17 to 19. Moreover, in order to guarantee that safety is maintained, or even improved taking into account new knowledge, safety reassessments are regularly performed by nuclear reactor operators at the request of the ASN, as provided for in the regulations in force in France (decree 63-1228 of 11 December 1963, Article 5 § II). The safety reassessment process is described in Chapter 14. The main safety improvements made to nuclear reactors since the previous French report are summarised in the following paragraphs.

6.3 Main safety improvements to nuclear power reactors

6.3.1 Major equipment and procedural changes

The safety of reactor units is evaluated via periodic re-assessments or through analysis of specific subjects. In some cases, this leads to modifications of the nuclear units. In most cases, these modifications are divided into batches, with each batch being implemented in the units of the series concerned. An initial unit, referred to as a "first-of-series", serves as a prototype. Grouping modifications in this way promotes better industrialisation, by ensuring that such processes as planning, updating documents and training operators can be implemented more easily. As far as possible, the modification batches are implemented during ten-yearly outages, so as to reduce the impact on availability. Modifications recently implemented or decided include measures aimed at:

- Improving the protection of reactor units against potentially damaging external factors; such measures include protection against extreme cold weather or improvements in the seismic resistance of equipment that is not safety-classified but which is liable to damage classified equipment in the event of an earthquake.
- Completing a number of reactor fleet upgrade; this mainly concerns upgrading of equipment linked to qualification for post-accident atmosphere conditions, and the fire fighting plan.
- Improving severe accident situations mitigation by introducing a containment building pressure sensor with an extended range, which can be used to monitor containment pressure until the filter venting system is opened, or installing hydrogen passive autocatalytic recombiners, guaranteeing the resistance of the containment building following a severe accident.
- Anticipating the obsolescence of certain equipment, mainly instrumentation and control. This involves switching to digital technology for the neutron surveillance system in the Fessenheim and Bugey plants, or renovating the in-core instrumentation system of the 1300 MWe reactors.
- Taking account of operating feedback, in particular by modifying pipe systems that are sensitive to vibrations, or improving the quality of control compressed air. This modification is consistent with safety objectives with higher levels of autonomy, but also addresses availability and cost concerns by avoiding failures in actuators due to oxide particles.
- Establishing usable margins for new fuel management strategies or improving the service provided to the grid. This includes automatically shutting down the primary pumps on the 900 MWe series or improving the 1300 MWe computer assisted operation, leading to more efficient monitoring of xenon levels and thus more efficient plant operation.
- Reducing the probability of damage to fuel by acting on the accident sequences highlighted by the PSAs. This includes diversifying emergency reactor trip signals in an attempt to reduce the probability of an ATWS, the test pump supply logic designed to prevent the risk of common mode failure of the backed-up switchboards, or modifications to the instrumentation and control of the volumetric and chemical control system discharge line. This category could also include measures to increase the reliability of the storage pool makeup water supply, thereby eliminating the risk that stored assemblies could be uncovered even in cases where the pool would boil for a prolonged period.
- Reducing the potential for abnormal loading of equipment, including in accident situations. This includes modifying the emergency feedwater supply logic for steam generators in the 1300 MWe series, to reduce the risks of water being drawn from the secondary system and liquid being released in the event of a steam generator tube rupture, or improvement of vacuumisation of the primary system at start-up, thereby limiting start-up transients which can damage the primary pump seals. This also has the effect of significantly raising availability levels.

- Improving certain aspects of reactor unit performance, such as availability, while maintaining or improving safety and radiation protection. Modifications to the fuel handling chain result in a substantial rise in availability (44 hours on a unit outage) but should also reduce the criticality risks during refuelling. Optimisation of primary system purification with an increase in flow rates together with the use of additional filters offers potential gains on the outage critical path, which can be supplemented by dosimetric gains by reducing the source term in normal operations.

6.3.2 Protection against flooding

Following the partial flooding of the Blayais site in December 1999, EDF has begun work to reassess and protect sites against the external flooding hazard. The flooding risk reassessment for a specific site is characterised using a methodology which was reviewed during a meeting of the Advisory Committee for nuclear reactors held on 20 December 2001 and is the subject of a file specific to each site.

The reassessment of the flooding hazard, of which a first version submitted by EDF is currently under review by ASN, includes:

- the revision of the maximum design flood level (CMS) ¹;
- the additional hazards liable to lead to site flooding such as heavy rains, burst of water storage structures, the rise in the groundwater, etc;
- specific application to reactors, which takes into account the work carried out to provide protection from a high maximum design flood level and from other hazards.

At the request of the ASN, EDF has committed itself on a June 2004 deadline for providing the final version of the files for the sites most sensitive to this hazard and on a December 2004 deadline for the others.

To date the Belleville, Le Bugey and Chooz sites are faced with a new, higher maximum design flood level, requiring study of protective measures. The ASN has already approved implementation of the provisions proposed by EDF for Belleville.

EDF also made a commitment to the deadlines for performing the work made necessary by this reassessment. In particular upgrading of the protections against the maximum design flood level shall be completed by the end of 2006 and the work on waterproofing underground structures will be completed by the end of 2008.

6.3.3 Protection against earthquake

In May 2001, the DGSNR adopted a new Basic Safety Rule (RFS-2001-01) concerning determination of seismic hazards for ground level Basic Nuclear Installations. One year later, EDF presented to the ASN the ground motion response spectra associated with Safe Shutdown Earthquakes (SSE) and Operating Basis Earthquakes (OBE), reassessed in the light of this new Basic Safety Rule. Certain spectra reveal that for high frequencies some values can be higher than in the reactor design basis spectra used. These spectra will be used for seismic reassessment as part of the third 10-yearly outage programme for the 900 MWe reactors and during the second 10-yearly outage programme for the 1300 MWe reactors.

¹ This level is the water level to be considered in the design and sizing of the protections depending on the site location. The design scenarios are primarily the thousand year return flood levels for river sites, plus 15%, and a tide coefficient of 120 combined with a 120 km/h winds for coastal sites.

6.3.4 Protection of the environment

For several years now, particular attention has been focused on the chronic or accidental environmental impacts of conventional or nuclear industries. The Interministerial Order of 31 December 1999 stipulates the general terms and conditions to be complied with by BNIs as regards environmental protection. It supplements the texts specific to each plant on this subject, i.e. the release licences or the operating licences for installations classified on environmental protection grounds located on plant sites.

More specifically, in addition to general rules pertaining to incident and accident prevention (staff training, safety instructions, plant maintenance provisions, etc.) the order stipulates objectives to be attained in areas such as protection against fire, lightning, noise or accidental water pollution.

Concerning accidental water pollution, EDF has undertaken specific studies on several technical matters in order to prevent this pollution with products dangerous for the environment or by water used in fire-fighting. Significant backfitting work is planned, in particular with regard to water retention works and products transfer areas.

In addition, upgrading for compliance with lightning protection standards means that the necessary backfitting works to be completed by the end of 2004.

Finally, a number of Legionnaire's disease outbreaks occurred in 2003, in air-conditioning installations not operated by EDF, and highlighted the potentially serious effects. Although there are currently no regulations governing BNIs in that field, EDF regularly measures the levels of the bacteria responsible for Legionnaire's disease in its installations.

The EDF Group is implementing a "Legionnaire's" action plan, piloted by the Medical Studies Service, which covers the following main issues:

- improvements in measuring techniques,
- reductions in the source term of the Legionnaire's bacteria,
- preventative and remedial treatment of systems,
- modelling of concentrations in cooling tower plumes.

Scientific studies carried out by EDF in the field of "Legionnaire's" risk prevention were presented to the relevant Ministries at the end of 2003.

Concerning the wider initiative aimed at making progress on environmental issues, EDF undertook a proactive approach to obtaining ISO 14001 certification. The EDF Group obtained ISO 14001 certification in April 2002. At the end of 2003, almost all units of the Nuclear Generation, Nuclear Engineering and Nuclear Fuels Divisions also obtained this certification. A follow-up audit has already been carried out on several of them, and drew no comments likely to raise doubts over the certification.

6.3.5 Fire Protection

The first step in dealing with the fire hazard in nuclear power plants is prevention. It should be noted that the Order of 31 December 1999, which applies specifically to Basic Nuclear Installations, regulates fire prevention in particular.

Minimising the consequences of fire then rests on the fire sectors principle. In this respect, the ASN ensures that work progresses on the fire action plan drawn up by EDF to improve the construction related provisions of the 900 MWe and 1300 MWe reactors, for which it set itself the completion deadline of 2006 in a decision dated 12 September 2000. Beyond these works to be completed by the end of 2006, the ASN also asked EDF, as part of the 900 MWe reactors third 10-yearly safety review, to further improve fire protection in these reactors by identifying and dealing with the residual weaknesses:

- using the results of a probabilistic fire safety assessment supplementing the deterministic approach used hitherto ;

- by reassessing the existing margins between the qualification of in-situ fire walls and the duration of the fires likely to occur in the buildings.

The Order of 31 December 1999 also sets environmental protection requirements (retention of fire-fighting water, containment of toxic smoke, etc.). In response to these new requirements EDF produced hazard analyses and proposals for modernising its installations, in particular those which do not contain equipment of importance for reactor safety (therefore not included in the fire action plan) but in which a fire would be likely to have direct environmental consequences (for instance in the radioactive waste processing and storage buildings). These studies are under review by the Nuclear Safety Authority and its technical support organisation.

The effectiveness of the operator's action plan to improve the responsiveness and competence of the intervention teams in the event of a fire is being assessed by the ASN notably through an increased number of "fire exercises" performed during inspections, some of which are unannounced. Following a first ASN report, the operator proposed improvements to the fire fighting system, notably with regard to the reliability of fire detection and the rapidity of intervention.

6.3.6 Controlling criticality risks

The programme of studies initiated at EDF by the Criticality Review in November 2000, which was intended to reassess all criticality risks during fuel handling and storage operations, has been continued. The safety requirements reference system resulting from these studies was sent to the ASN at the beginning of 2003, and is currently being examined. New studies have been carried out on fuel assembly repair, but also on the damage suffered in the event of a hypothetical fall.

Awareness sessions have been held at all nuclear power plants, to ensure that core operation engineers are familiar with the findings of studies conducted on criticality risks since 2001.

Studies carried out to assess the potential benefits of extra source level chains have shown that, in the short term, no method of monitoring reactivity would provide a means of detecting a refuelling error. The role of source level chains has therefore been clarified and thought is being given to redefining the way they are set, so that they can be usefully employed to reduce needless constraints on the operator.

Concerning the risk of positioning an assembly in a in-core location inconsistent with the refuelling plan, the nuclear plants now implement procedures aimed at limiting the consequences of any error. These measures include refuelling in "snake" mode, and provisions for extra checks to reduce the associated risk. A study is currently under way to assess the reliability gains that might be made by using a camera in the reactor building, depending on how it is used.

International operating feedback on fuel loading practices has shown that measures taken by foreign operators to take account of the criticality risk, following the Dampierre 4 incident on 2 April 2001 or other in-core assembly positioning errors, have not resulted in any modifications to equipment.

This event has led EDF to modify its handling procedure and to increase the boron concentration during refuelling of the reactors of the CPY series so as to reinforce the reliability of operations while limiting the criticality hazards.

6.3.7 Safety of spent fuel storage

Developments in operating practices tend to increase the residual power of fuels likely to be stored in the spent fuel decay pool, therefore reducing intervention times in the event of a total loss of coolant. This observation led EDF and the ASN to look again at the safety of fuel storage in fuel buildings. The dossier submitted by EDF for approval by the ASN covers the various issues linked to an incidental loss of water inventory or cooling, notably:

- the resistance of various components to the temperature and humidity conditions resulting from pool boiling, ensuring that restart is possible after repairs,
- the feasibility of an auxiliary supply of water to the pool, taking into account the access possibilities, to eliminate the possibility of leaving assemblies uncovered,
- the management of any leaks of water from the pool, even if it has been shown to be properly watertight.

This dossier was submitted for appraisal by the Advisory Committee for nuclear reactors. It led to the conclusion that, provided the planned additional measures were taken by EDF, there was simply a residual risk that assemblies would be left uncovered. Additional work was requested in order to check that there was no risk linked to possible rapid drainage of the pool.

6.4 Main safety improvement for nuclear research reactors

6.4.1 The Phenix reactor

Phenix was built and is operated by the CEA in association with EDF, and is a prototype reactor for demonstration of the technology known as fast neutron. It is located on the Valrho site in Marcoule (in the Gard department). Its construction began in 1968 and it first went critical on 31 August 1973. Its design power is 563 MWth (250 MW electrical).

In 1995, after more than 20 years operation, the ASN wanted to obtain an overall review of reactor safety. The safety review essentially achieved the following objectives:

- demonstrate the good condition of structures participating in the control of the core reactivity; conical shell supporting the reactor core, core cover plug containing the control rods, main vessel hangers,
- carry out non-destructive tests to demonstrate that the power plant is in good condition, covering the sodium systems, fuel storage unit, steam generators. Ten-yearly maintenance of other components and systems was also carried out,
- improve safety of the core and the primary system: addition of a control rod, installation of a modern, high capacity measurements recording unit, installation of measurement rods in the hot leg and the cold leg,
- bring the power station up to current seismic standards: reinforcement of all buildings, replacement of two emergency cooling systems,
- limit the risks of a severe sodium fire or a conventional fire: installation of partitions between the secondary systems and water-steam systems, reinforcement of the resistance of steam generator chests, installation of mechanical systems to limit the movement of "high energy" steam pipes, implementation of a fire action plan,
- repair or replace defective components in secondary systems, primary pumps, steam generator modules, intermediate exchangers.

Drawing on accumulated operating, the CEA simultaneously carried out a large number of refurbishment operations that will enable continued operation with enhanced safety and availability of the installation.

At the same time, regulation testing was carried out on pressure vessels (steam generators, steam reservoirs, gas reservoirs, etc.) and maintenance and inspection were carried out on the turbine generator unit, the 225 kV substation, diesels, and so on.

Phenix safety review was used to gain the maximum amount of information about the behaviour and ageing of structural components of the core and the different systems in the installation and to estimate the impact on the reactor life.

All this work and these modifications have brought the reactor up to the required safety level so that the planned experimental irradiation campaigns can be carried out.

The ASN checked all actions, and its technical support organisation analysed all files presented.

The positive conclusions of the Advisory Committee for nuclear reactors in October 2002 enabled the Nuclear Safety Authority to authorise resumption of the Phenix power plant operation at normal power in January 2003. The plant's 51st operating cycle began in June 2003.

6.4.2 Other research reactors

The other research reactors are also the subject of a periodic safety review, in principle every ten years. Of the subjects examined, the following two generic topics are regularly discussed:

- installation earthquake resistance, given the significant scientific advances in recent decades, which have changed the way nuclear installations perceive this hazard,
- the ageing of installations, particularly concerning electrical and electronic equipment, the replacement of which by modern technologies can create compatibility and reliability problems.

Generally speaking, the ASN is particularly attentive to the ageing of installations and to ensuring that the operator finally shuts down the installations before they become excessively obsolete.

Information about works initiated on these others research reactors is presented in chapter 14 concerning periodic safety assessment.

B. LEGISLATION AND REGULATION

7. Article 7 : Legislative and regulatory framework

1. Each Contracting Party shall establish and maintain a legislative and regulatory framework to govern the safety of nuclear installations.

2. The legislative and regulatory framework shall provide for:

- i) the establishment of applicable national safety requirements and regulations,*
- ii) a system of licensing with regard to nuclear installations and the prohibition of the operation of a nuclear installation without a licence,*
- iii) a system of regulatory inspection and assessment of nuclear installations to ascertain compliance with applicable regulations and the terms of licences,*
- iv) the enforcement of applicable regulations and of the terms of licences, including suspension, modification or revocation.*

7.1 Legislative and regulatory framework

The legal basis regulating the safety of nuclear installations in France is the law 61-842 of 2 August 1961 as amended. Article 1 of this law, detailed in article 8, states that industrial premises operated or owned by a natural or legal person shall be operated or used as to satisfy the requirements stemming from implementation of the law aimed at preventing, in particular, pollutions of any type which compromise public health or security. Article 2 of this law defines the framework in which the corresponding regulation may be established (licence, limits, supervision, prohibition, prosecution). Articles 3 and 4 of this law define the framework of the supervision by the Public Authorities. Article 5 to 7 provide for criminal penalties in the event of any breach of its provisions.

The organisation for nuclear safety in France relies therefore on the principle of the prime responsibility of the operator, which states that the responsibility for a hazardous activity lies primarily with whoever undertakes or performs it (operator of a Basic Nuclear Installation, radioactive material consignor, radioactive source user, etc.) and not with Public Authorities or other players. Therefore, the decree 63-1228 of 11 December 1963, as amended, concerning nuclear installations, taken for the implementation of this law constitutes the basis of the nuclear safety regulations. Its article 2 defines the Basic Nuclear Installations (BNI) which are subjected to the above mentioned regulations and which in particular comprise all civilian nuclear reactors, intended for power production or for research. Article 3 defines the requested licences (creation, operation, shutdown, decommissioning) and article 4 specifies the conditions for the plant authorisation (supply of safety reports, of general operating rules and of emergency plans). Article 5 defines the conditions for modifications and for periodic safety reviews and stipulates the notification of incidents or accidents. Article 6 specifies the cases where a new licence is needed. Articles 7 to 10 define the role and the composition of the Interministerial commission for basic nuclear installations which gives its opinion on applications for BNI authorisation or modification and on requirements specific to each type of installation. This commission also gives its opinion and makes proposals on the drafting of regulations and implementation of regulations concerning these installations. Article 11 defines the conditions for the supervision and the inspection of the safety of these installations. Article 12 provides for penalties for anyone operating a BNI without licence, in breach of the technical requirements notified to the Public Authorities, modifying the installation without authorisation or omitting to report any accidents or incidents to the Authorities.

The Public Authorities have the duty of making sure that this responsibility is assumed in full, in compliance with the above mentioned principles and the regulatory texts issued for their

implementation. Decree 2002-255 of 22 February 2002, modifying decree 93-1272 of 1 December 1993, created for that purpose a Directorate General for Nuclear Safety and Radiation Protection (DGSNR), which has taken the place of previously existing regulatory bodies, and its duties are specified in its article 17:

I. – The Directorate General for Nuclear Safety and Radiation Protection drafts, proposes and implements governmental policy concerning nuclear safety, with the exception of aspects concerning defence-related nuclear installations and activities. For application of these provisions, nuclear safety is defined as the set of technical provisions and organisational measures related to the design, construction, operation, shutdown and decommissioning of the installations comprising an ionising radiation source as well as to the transportation of radioactive materials, with the aim of preventing accidents and limiting consequences.

II. – The Directorate General for Nuclear Safety and Radiation Protection drafts and proposes governmental policy concerning radiation protection and implements it within its field of competence. For application of these provisions, radiation protection is defined as the set of rules, procedures and prevention and supervision means designed to prevent or reduce the harmful effects of ionising radiation produced on persons directly or indirectly, including through harm to the environment.

/// – The Directorate General for Nuclear Safety and Radiation Protection is responsible, within its field of competence, for:

- 1. Preparing and implementing any measures related to the safety of basic nuclear installations, in particular in preparing the corresponding technical regulations and supervising their application;*
- 2. Preparing and implementing any measures related to the safety of transportation of radioactive or fissile material for civilian use, in particular, in consultation with the departments of the Minister for transports, by preparing the corresponding technical regulations and supervising their application;*
- 3. Preparing and implementing, in consultation with the other competent administrations, any measures aimed at preventing or limiting the health hazards linked to exposure to ionising radiation, in particular by preparing the technical regulations concerning radiation protection, except with regard to the protection of workers against ionising radiation, and supervising their application;*
- 4. Organising safety inspections of basic nuclear installations and, jointly with the competent departments of the Minister for transports, of transportation of radioactive or fissile material for civilian use;*
- 5. Without prejudice to the inspections provided for in the Labour Code and the Environment Code, organising the radiation protection inspections specified in the Public Health Code and by the above mentioned law of 2 August 1961 and its implementing texts, and steering all inspections contributing to radiation protection supervision in the industrial, medical and research fields, including monitoring of sources of ionising radiation used in these fields;*
- 6. Organising a continuous radiation protection watch, in particular radiological monitoring of the environment nationwide;*
- 7. Monitoring gaseous and liquid effluent releases and waste from basic nuclear installations;*
- 8. Proposing, coordinating and implementing governmental policy concerning the regulation and supervision of radioactive waste management;*
- 9. Collecting any information about research and development works conducted in the field of nuclear safety and radiation protection;*
- 10. Together with the other competent administrations, in particular the departments in charge of civil security, participating in the definition and implementation of an emergency technical organisation in the event of an accident on a basic nuclear installation or during a transport of radioactive material, or more*

generally of any accident the nature of which is likely to affect the health of the people by exposure to ionising radiation, occurring in France or likely to affect the French territory;

11. Collecting any information in the field of nuclear safety and radiation protection and concerning measures taken in this field in France or abroad and to disseminate this information to the relevant administrations;

12. Contributing to information of the public on issues related to nuclear safety and radiation protection ;

The duties mentioned in 3 and 5 above are, as applicable, conducted jointly with the staff of the Labour Inspectorate mentioned in articles L. 611-1, L. 611-4 and L. 611-6 of the Labour Code and the other competent inspectorates and administrations.

In consultation with the departments of the Minister for foreign affairs, the Directorate General for Nuclear Safety and Radiation Protection prepares and proposes, in its fields of competence, the French positions to be put forward during international and community discussions.

In the exercise of its duties, it may undertake or delegate any necessary studies.

IV. – The Directorate General for Nuclear Safety and Radiation Protection handles secretarial services for the High Council for nuclear safety and information, the Interministerial commission for basic nuclear installations, the interministerial commission for artificial radio-elements and the radiation protection section of the High council for public health in France.

V. – In consultation with the other competent administrations, the Directorate General for Nuclear Safety and Radiation Protection, within its field of competence, guides, organises and supervises, the activities of the State's devolved departments concerned. It orients and coordinates their actions and handles planning of the resources they will be needing.

A draft law on transparency and security in the nuclear field was tabled before Parliament in 2002. This draft first of all gives the key definitions and the main principles to be implemented regarding nuclear activities. These principles are enshrined to various degrees in current regulations or legislation: they are the principles of responsibility, justification, optimisation, limitation, precaution and participation. This draft also organises transparency in the nuclear field. The draft then revises the administrative regime governing nuclear installations, and clarifies and reinforces the inspection system and applicable penalties system. Finally this draft creates a new inspection regime specialised in the field of radiation protection.

The legal framework for radiation protection, which was recently updated at transposition of directives 96/29/Euratom and 97/43/Euratom, is presented together with the corresponding regulations in Chapter 15.

7.2 Basic Nuclear Installations regulations

In addition to the generally applied regulations such as those concerning radiation protection described in chapter 15 or those pertaining to labour law and environmental protection, Basic Nuclear Installations (BNIs) are subjected to two particular types of regulations:

- licensing procedures,
- technical rules.

Facilities covered by regulations for installations classified on environmental protection grounds (ICPE) are required to comply with specific procedures when located within the perimeter of a BNI.

7.2.1 Licensing procedures

The unlicensed operation of a nuclear installation is prohibited by French law and the relevant regulations. In this context, BNIs are regulated by decree 63-1228 of 11 December 1963 amended for

implementing law 61-842 of 2 August 1961 amended, concerning the abatement of atmospheric pollution and offensive odour. This decree notably provides for an authorisation decree procedure followed by a series of licences issued at key points in the plant's lifetime: fuel loading or pre-commissioning stages, start-up of normal operation, decommissioning, dismantling. It also enables the ministers in charge of nuclear safety to ask the operator at any time to conduct a safety review of an installation.

BNIs must also comply with the requirements of decree 95-540 of 4 May 1995, implementing both the above-mentioned law of 2 August 1961 and law 92-3 of 3 January 1992 amended concerning water (articles L.210-1 to L.217-1 of the Environment Code). This decree stipulates the authorisation procedure for liquid and gaseous effluent release and water intake for these installations.

An operator who operates a plant either without having obtained the requisite licences or in breach of these licences lays itself open to legal or administrative sanctions, as stipulated mainly in articles 12 and 13 of the above-mentioned decree of 11 December 1963 regarding the authorisation decree and in Articles 22 to 30 of the 3 January 1992 law on water (articles L.216-1 to L.216-13 of the Environment Code), with regard to effluent release and water intake.

Application of these various procedures starts with siting and plant design and terminates with the final dismantling. A detailed presentation of the procedures is given in Chapters 17 to 19.

7.2.2 Technical rules

Technical rules and practices on nuclear safety are ranked in a series of texts. They are summarised below in increasing order of detail. The first are very general regulatory texts, covering a broad scope but without attention to technical details. The last texts however, concern detailed specific topics. Their legal form is more flexible.

7.2.2.1 General technical regulation

The general technical regulations, based on article 10a of the previously mentioned decree of 11 December 1963, currently cover four major subjects: pressure vessels, quality organisation, BNI water intake and effluent release and external hazards and detrimental effects related to BNI operation.

BNIs comprise two types of pressure vessels; those which are specifically nuclear, in other words those which contain radioactive products, and those which are more conventional and which are not specific to nuclear installations.

The ministerial order of 26 February 1974 applies to the particular case of the construction of the main primary system of EDF's PWRs. In service inspection of the main primary system and the main secondary systems of PWRs are covered by the interministerial order of 10 November 1999. The Bourgogne DRIRE (BCCN) has particular responsibility for supervising application of these orders.

The regulations for conventional pressure vessels apply to the other pressure vessels. As for quality, the ministerial order and circular of 10 August 1984 stipulate the general rules for quality assurance and organisation to be followed by operators at the BNI design, construction and operating stages.

BNI water intake and effluent release which in application of the procedure decree of 4 May 1995, discussed above, are subject to the joint authorisation of the Ministers for Health, Industry and the Environment are henceforth circumscribed by technical rules within the framework of a ministerial order signed by the above ministers on 26 November 1999 (Official Gazette of 5 January 2000). This text, which replaces several 1976 ministerial orders, comprises requirements which in particular concern proactive reduction of water intake and effluent release, reinforcement of analysis resources and inspections and the transmission of relevant information to the various government departments and the general public. Its implementation is detailed in an interministerial circular of 17 January 2002,

particularly with regard to the targets and application of the new regulations, depending on whether an initial application or a modification is being dealt with.

Finally, on 31 December 1999, the Ministers for Industry and for the Environment signed an order (published in the Official Gazette on 15 February 2000), prescribing the general technical regulations for the prevention and limitation of external hazards and detrimental effects related to BNI operation, apart from water intake and effluent release issues. The gradual implementation of these provisions will ensure that environmental protection considerations are fully taken into account by the operators, on a level comparable to that required for non-nuclear industrial installations.

The current body of general technical regulations will soon be changing, as the DGSNR is working on broadening the scope of application. Three orders concerning PWRs are thus currently under preparation: one, which is the furthest advanced, concerning fuel, the second dealing with general operating rules, and the third, looking to the longer term and aiming to regulate the safety of the initial design and the periodic safety reviews. Finally, an order concerning nuclear pressure vessels is currently being drafted.

7.2.2.2 Basic safety rules

The ASN issues Basic Safety Rules (RFS) on various technical subjects, concerning both PWRs and other BNIs. These rules constitute recommendations defining the safety aims to be achieved and describing accepted practice the ASN deems compatible with these aims.

They are not, strictly speaking, regulatory documents. A plant operator may decide not to adopt the provisions laid down in a Basic Safety Rule, providing he can demonstrate that the safety aims underlying the rule can be achieved by alternative means, which it has to propose.

Rules laid down in this context are particularly flexible, allowing for technical advances and new know-how.

There are currently about forty Basic Safety Rules, which are listed in appendix 2.

The ASN is continuing the formulation of an RFS concerning short or medium term storage facilities for radioactive waste, effluents and spent fuel. Such installations already exist, their operating periods are frequently extended and their number is regularly increasing. A preliminary draft text was prepared in 2003 and forwarded to the operators for observations. The text taking into account their comments should be presented to the Advisory Committee for radioactive waste in 2004.

Review of RFS I.4.a on fire protection in BNIs other than reactors, began in 1999 and showed that revision of it was necessary to bring it into conformity with the interministerial order of 31 December 1999 previously mentioned.

7.2.2.3 French nuclear industry codes and standards

French regulatory practice with respect to nuclear safety requires the plant operator to submit a document defining the rules, codes and standards it will implement for the design, construction, startup and operation of safety-related equipment.

This gave rise to formulation by the manufacturers of design and construction rules, known as the RCC codes which, for the different categories of equipment involved (civil engineering, mechanical and electrical equipment, fuel, etc.) concern the design, construction and operation stages. Some of these rules have been drawn up and published by the AFCEN (French association for NSSS equipment construction rules), of which EDF and Framatome are members.

All in all, the codes provide a means of both complying with general technical regulations and upholding good industrial practice.

These documents are drawn up by the manufacturers and not by the Safety Authority, which nevertheless examines them in detail, both in their initial and revised versions and may acknowledge their relevance at the time of publication.

The new version of the RCC-E code (design and construction rules for electrical equipment of nuclear islands) was approved by ASN in 2003. The ASN has in particular checked that this fourth edition of the code, superseding the 1993 version, is consistent with Basic Safety Rule II.4.1.a of 15 May 2000 concerning PWR safety classified electrical system software.

The publication in 2000 of a new edition of the RCC-M code (concerning mechanical equipment), led ASN to take a decision on 10 July 2001 (which can be consulted on its web site). By this decision it accepts application of this new edition of the code, with reservations. In response to this decision, AFCEN published the first amendment of the RCC-M code in June 2002. This modification also initiates work to bring the French code into line with the European ETC-M code (EPR Code for Mechanical Components), within the framework of the EPR reactor project. In 2003 the ASN began its review of these modifications and will submit its conclusions in 2004.

With a view to ensuring consistency with the RCC-M code, AFCEN in 1990 undertook the drafting of a set of "Rules for in-service surveillance of mechanical equipment" (RSEM), the first edition of which was available in 1997. Under the impetus of the ASN, EDF undertook to ensure compliance of this code with the ministerial order of 10 November 1999, which gave rise to publication of a new edition of RSEM. This new version was accepted by DGSNR in June 2002 and has been applied to all nuclear power plants since January 2003. Codifying work is continuing in order to complete the code compliance with the order of 10 November 1999 and is the subject of discussions with the DGSNR.

7.3 Basic Nuclear Installation supervision

The purpose of Nuclear Safety Authority supervision is to ensure that all users of ionising radiation fully comply with their responsibilities and obligations with regard to radiation protection. In the case of BNIs, this verification encompasses nuclear safety. This external supervision by no means exempts the user of ionising radiation from organising his own supervision of his activities.

In the particular case of BNIs, ASN supervision involves both inspection of all or part of an installation as well as examination of files, documents and information provided by the operator. This supervision applies to all stages in the life of the installations: design, creation, commissioning, operation, final shutdown, dismantling.

7.3.1 Scope of supervision

7.3.1.1 Nuclear safety supervision

The ASN's supervisory activities cover all elements contributing to plant safety. Supervision thus concerns both the equipment constituting the installations and the people responsible for operation, together with the related working methods and organisational provisions.

The scope of ASN supervision also extends throughout the lifetime of a nuclear plant, from initial design to dismantling, covering construction, commissioning, operation, modifications and final shutdown.

At the design and construction stage, the ASN reviews the safety analysis reports describing and justifying basic design data, equipment design calculations, utilisation and test procedures, and quality organisation provisions made by the prime contractor and its suppliers. The ASN checks also the manufacture of PWR main primary and secondary systems

Once the nuclear installation has started operating, all safety-related modifications made by the operator are subject to ASN approval. In addition to these meeting points necessitated by developments in plant equipment or operating procedures, the ASN requires periodic safety reviews from the operators,

providing opportunities to reinforce safety requirements according to both technological and policy developments and operating feedback.

Nuclear operator compliance with safety reference systems is supervised by regular inspections, either on the nuclear sites or, if necessary, at the Head Office department of the main nuclear operators or at the premises of their suppliers, with a view to checking the correct implementation of safety provisions.

When ASN supervisory actions reveal failures to comply with safety requirements, penalties can be imposed on the operators concerned, in some cases, after service of formal notice. Penalties in such cases may consist in prohibiting restart of a plant or suspending operation until the requisite corrective measures have been taken.

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

Nuclear safety supervision assignments are carried out, within the ASN, by the Directorate General for Nuclear Safety and Radiation Protection (DGSNR) and its Regional Divisions (DSNR) within the Regional Directorates for Industry, Research and the Environment (DRIRE). The DSNRs are entrusted with “on the spot” supervision. They are in permanent contact with the nuclear operators, take charge of most of the inspections carried out on the nuclear sites and provide step by step supervision of the various stages in PWR maintenance and refuelling outages, after which authorisation for restart will depend on the ASN. The DSNRs also examine certain authorisation or waiver applications and conduct an initial examination of incident reports. The DGSNR is responsible for co-ordinating and steering the DSNRs in these areas, deals with all matters of national importance and defines and implements national nuclear safety policy.

7.3.1.2 Radiation protection supervision

Since 22 February 2002, the DGSNR has been responsible for supervising implementation of radiation protection regulations, under the authority of the Minister for Health.

Therefore the ASN ensures application within BNIs of the regulations regarding human protection against ionising radiations. In the same way as for nuclear safety, this action continues for the entire duration of the life of the nuclear installation. It consists in ensuring that the operator takes all provisions for monitoring and limiting the doses received by the people working in the installations.

The ASN ensures that this regulation is complied with by examining specific files and on the occasion of dedicated inspections. In addition, the implementation of criteria common to all operators for the declaration of radiation protection events enables the ASN to be better informed of any abnormal situations which have occurred.

7.3.1.3 BNI design, construction and operation quality

The quality order of 10 August 1984 provides a general framework for the provisions to be made by any BNI operator to produce, obtain and maintain plant and operating quality standards compatible with safety requirements.

The order first requires the operator to specify the intended quality to be defined by specific requirements, then to obtain it by appropriate skills and methods and finally to guarantee it by supervision of compliance with these requirements.

The quality order also requires:

- that detected deviations and incidents be stringently dealt with and that preventive measures be taken;
- that suitable documents testify to results obtained;

- that the operator supervise the service companies used and check compliance with procedures adopted to guarantee quality.

Nuclear installation incident and accident feedback together with inspection findings enable the ASN to use dysfunction analysis to assess compliance with quality order requirements.

7.3.1.4 Pressure vessels

7.3.1.4.1 Current situation

A large number of nuclear plant systems contain pressurised fluids and are consequently subjected to general pressure vessel regulations.

As regards the central government authorities, application of these regulations is monitored by the ASN for nuclear pressure vessels and by the DARPMI (Directorate for Regional Action and Small and Medium-sized enterprises) for other pressure vessels.

Among the BNI pressure vessels within the scope of the ASN, the main primary and secondary systems of the 58 EDF PWRs are particularly important for safety. Since under normal conditions they operate at high temperature and pressure, their in-service behaviour is one of the keys to nuclear power plant safety.

ASN supervision of these systems is consequently very specific. It is based :

- for the design and construction stage, on the ministerial order of 26 February 1974, concerning the main primary system, and on Basic Safety Rule II.3.8 (1990), concerning the main secondary systems ;
- for the operating stage, on the ministerial order of 10 November 1999, covering requirements for both these systems.

Pressure vessel operation is covered by supervision particularly focused on non-destructive tests (NDT), maintenance operations, the handling of nonconformities affecting these systems and their periodic system requalification.

7.3.1.4.2 Current developments

Regulations applicable to pressure vessels are still being revised, notably within the framework of transposition of the European directive of 29 May 1997, concerning pressurised equipment.

The decree of 13 December 1999, which transposes this directive into French law, thus replaces the decree of 2 April 1926 for steam pressure vessels and the decree of 18 January 1943 for gas pressure vessels. It is more particularly intended for conventional equipments as opposed to the nuclear equipment.

Nuclear regulations is now being updated in order to take into account changes applicable to conventional equipment and integrate relevant operating feedback accordingly.

The first step consisted in the publication of the ministerial order of 10 November 1999, regulating in-service inspection of the main primary and secondary systems of EDF's PWRs. This text clarifies the responsibility of the operator and the conditions under which the ASN would act in this context and presents important new provisions, such as the qualification of NDT methods, the requalification of main secondary systems or the compilation of reference dossiers for each reactor concerning both design studies and in-service surveillance programmes or the necessity for a close watch on ageing phenomena. The ministerial order of 10 November 1999 partially revokes the ministerial order of 26 February 1974 and Basic Safety Rule II.3.8.

The second step, today in progress, consists in :

- regulating all the other BNI pressure vessels which are not covered by the European directive. That concerns pressure vessels which are “specially designed for nuclear uses, the failure of which could lead to radioactive emissions”. The year 2003 was devoted to defining graded requirements, in order to lead to a draft ministerial order, which has been the subject of consultation with interested utilities and organisations ;
- updating the regulatory provisions concerning the construction of PWR main primary and secondary systems. The technical rules approved by the Standing Nuclear Section of the Central Committee for Pressure Vessels in October 1999 were forwarded to the manufacturers concerned as the reference system both for any future construction work as well as for the replacement of large components. These requirements constitute the basis of the construction regulatory provisions. They are now incorporated into the draft order mentioned above, which will eventually fully revoke the order of 26 February 1974 and RFS II.3.8.

7.3.1.5 Environmental protection

The prevention and limitation of environmental hazards and detrimental effects due to BNI operation are ensured by application of the following legislation:

- the decree of 11 December 1963 concerning BNIs, further defined by its implementing order of 31 December 1999 which sets out general requirements concerning the prevention of environmental hazards and nuisances (notably accidental pollution), together with BNI waste management;
- the legislation concerning installations classified on environmental protection grounds and included within the perimeter of BNIs;
- the decree of 4 May 1995 concerning BNI liquid and gaseous effluents and water intake, further defined by its implementing order of 26 November 1999 and the circular of 20 January 2002.

Generally speaking, ASN policy regarding environmental protection tends towards that applied to conventional industrial activities. For example, the order of 26 November 1999, prescribing general technical provisions regarding the limits and conditions for BNI authorised releases and intake requires that BNI release limits be calculated on the basis of the best available technology at an economically acceptable cost, taking into account the specific characteristics of the site environment. This approach leads to specification and reinforcement of limits regarding release of chemical substances and to a reduction in authorised limits for the release of radioactive substances. The renewed release licences issued since that of the Saint-Laurent nuclear power plant (2 February 1999) reflect this policy.

It should be noted that the ASN is now responsible for monitoring BNI liquid and gaseous radioactive discharges, a duty hitherto carried out by the OPRI.

In line with this policy, the ASN has for several years been developing inspections focused on effluent and waste management and on the implementation of rules applicable to installations classified on environmental protection grounds. This action is intensifying, owing to the inspection procedures involving sampling which have been in force since 1 January 2000.

7.3.1.6 BNI working conditions

In BNIs, as in any industrial firm, compliance with regulations concerning health and safety in the workplace is the responsibility of labour inspectors. In the case of EDF nuclear power plants, these functions are entrusted to DRIRE personnel, under the supervisory authority of the DIDEME (Directorate for Energy Demand and Supply Contracts) at the Ministry for the Economy, Finance and Industry, acting on behalf of the Ministry for Labour. The DRIRE officers undertaking these tasks may also be BNI inspectors within DSNRs.

Nuclear safety supervision, radiation protection and labour inspection actions have common concerns, notably the organisation of work sites and the conditions governing use of subcontractors. For this

reason, the ASN, the DIDEME and the labour inspectors endeavour to co-ordinate their respective actions to the extent possible.

Finally, exchanges with the labour inspectors can also be a valuable source of information on the employment relations situation, in a nuclear safety and radiation protection context more attentive to the importance of individuals and organisations.

7.3.2 Supervision procedures

The ASN uses a vast array of supervision procedures. This supervision is mainly carried out by means of :

- plant inspections;
- work site inspections during power reactor maintenance outages;
- site technical meetings with BNI operators or plant equipment manufacturers;
- examination of supporting documents submitted by the operators.

7.3.2.1 Inspection

7.3.2.1.1 Principles and objectives

An ASN inspection consists in checking that the operator complies satisfactorily with safety and radiation protection provision requirements. It is neither systematic nor exhaustive and its purpose is to detect specific deviations or nonconformities together with any symptoms suggesting a gradual decline in plant safety.

These inspections give rise to factual records, made available to the operator, concerning :

- nonconformities with regard to plant safety or radiation protection, or safety-related points requiring additional justification in the opinion of the inspectors;
- discrepancies between the situation observed during the inspection and the regulatory texts or documents prepared by the operator in application of the regulations, whether in the safety or radiation protection fields or in related areas under ASN supervision (waste management, effluent release, installations classified on environmental protection grounds).

An annual inspection programme is determined by the ASN. It takes into account inspections already carried out, ASN information on various plants and progress made on technical subjects under discussion between the ASN and the operators. It is prepared after consultation between the DGSNR, the DSNR and the IRSN, using a methodical approach defining priority national topics and suitable coverage of the different sites. This programme is not communicated to BNI operators.

The inspections are either announced to the operator a few weeks beforehand or may be unannounced.

They mostly take place on nuclear sites, but may also be carried out in operator engineering offices, the workshops and design departments of a subcontractor or on the construction sites or at factories and workshops where various safety-related components are manufactured. Even when the inspection is not performed on the nuclear site, it is the BNI operator who is ultimately responsible for the quality of the work performed by its subcontractor and for the efficiency of its own surveillance at the subcontractor's or supplier's works.

Inspections are usually performed by two inspectors, one of whom directs the operations, with the assistance of an IRSN representative specialised in the plant to be inspected or the technical topic of the inspection.

The BNI inspectors are ASN engineers, selected from the inspectors of installations classified on environmental protection grounds and nominated by a ministerial order signed jointly by the Ministers for

the Environment and for Industry. Their supervisory functions are carried out under the authority of the Director General for Nuclear Safety and Radiation Protection. The inspectors take an oath and are bound to professional secrecy.

7.3.2.1.2 Inspection activities in 2003

The ASN uses six types of inspections :

- standard inspections;
- more stringent inspections on topics involving specific technical difficulties and normally conducted by senior inspectors;
- review inspections, scheduled over several days and requiring a team of inspectors. Their purpose is to enable examination of previously identified issues in greater detail;
- inspections comprising sampling and measuring operations, aimed at spot checking release levels independently of operator measurements;
- reactive inspections, carried out further to an incident or a particularly significant event;
- work site inspections, enabling adequate ASN representation on PWR work sites during outages.

In addition the ASN has set up a qualification system for inspectors taking into account their experience and their training; this system allows that more complex inspections are directed by senior inspectors

As at 31 December 2003, there were 143 BNI inspectors, including 76 at the DSNRs, 67 at the DGSNR, with 1 seconded to the United Kingdom safety authority.

The ASN conducts around 650 inspections annually; about half concerns power reactors and the other half the remaining installations. The number of unannounced inspections has increased in recent years to reach 25 %, as shown in the following table.

Number of inspections performed by the ASN

| Year | total | reactors | Other installations | Total unannounced |
|------|-------|----------|---------------------|-------------------|
| 1998 | 674 | 350 | 324 | 68 |
| 1999 | 667 | 326 | 341 | 87 |
| 2000 | 678 | 360 | 318 | 118 |
| 2001 | 653 | 383 | 270 | 129 |
| 2002 | 659 | 338 | 321 | 158 |
| 2003 | 670 | 343 | 327 | 176 |

Of the topics considered in 2003, the following should be mentioned. Some were priority issues for 2002 and will be the subject of a summary analysis:

- Radiation protection, interventions 9 inspections
- Instrumentation and control, process control relaying 13 inspections
- CEA Internal authorisation system 4 inspections
- Safety management 15 inspections
- Radiation protection management (ALARA) 16 inspections
- Maintenance in operation 17 inspections
- Application of main primary/secondary systems Order of 10 Nov. 1999 17 inspections
- Fire protection 46 inspections

7.3.2.2 PWR outage supervision

EDF takes advantage of refuelling outages to inspect all installations and check their condition by carrying out tests. These operations, which are particularly important as indicators of the current state of installations, are closely followed by the ASN, notably in the course of work site inspections, when the inspectors spot-check the conditions in which operations take place on various work sites, whether these concern plant renovation or modification, equipment in-service inspection or the periodic testing of components.

7.3.2.3 Pressure vessel supervision

Within the ASN, the fifth sub-directorate (BCCN) supervises application of the relevant regulations covering PWR main primary and secondary systems, together with all nuclear pressurised systems.

It directly supervises the construction (design and manufacture) of PWR main primary and secondary systems. In-service supervision of the main primary and secondary systems, as of all other pressure vessels, is the responsibility of the relevant DSNR.

7.3.2.4 Technical examination of operator files

The operator is required to provide the ASN with all data required to enable it to carry out its inspection functions. The extent and quality of such data should enable inspections to be focused on specific aspects and facilitate analysis of the technical demonstrations submitted by the operator. It should also enable outstanding events in the operation of a BNI to be identified and monitored.

7.3.2.4.1 Main areas concerned

SIGNIFICANT INCIDENTS

For all BNIs, the ASN has defined a category of unexpected events known as “significant incidents”, which have nuclear safety implications such as to justify that they be immediately reported. The ASN would subsequently receive a full report, indicating the conclusions reached by the operators after analysis of the incidents and the safety enhancement measures they had taken. Such incidents include excursions outside a plant’s normal operating range, impaired functioning of certain safety systems or unplanned radioactive release.

The immediate investigation of significant incidents at all Basic Nuclear Installations is entrusted to the DSNRs, which check that corrective provisions have been duly implemented and make the requisite preparations for informing the public in cases where this is necessary. The DGSNR ensures coordination of DSNR action in this field and provides suitable training courses each year for the engineers concerned.

Assessment of a significant incident by the DSNR consists in examining compliance with current rules regarding the detection and reporting of significant incidents, the immediate technical provisions made by the operator to maintain or place the installation in a safe configuration and, finally, the relevance of the incident analysis reports submitted by the operator.

Operating feedback on nonconformities and incidents is examined subsequently by the ASN and its technical support organisations, notably the Institute for Radiation Protection and Nuclear Safety (IRSN). The data supplied by the DSNRs and analysis of significant incident reports, together with periodic records sent in by the operators, form the basis of the ASN operating feedback structures. This operating feedback is notably put to practical use during the periodic safety reviews of plants and by means of requests for improvements in the condition of plants and in the organisational provisions made by the operator.

POWER REACTOR OUTAGES

Power reactors are periodically shut down for refuelling and servicing of their main components.

Considering the safety importance of work carried out on installations during these outages and the safety hazards incurred by certain shutdown situations, the ASN requires sound information from the operator in this respect, mainly concerning the work programmes involved and any nonconformities observed during the outage.

Approval of outage programmes has been a DSNR assignment since 1985. Reactor restart is subject to DGSNR approval, on a proposal from the relevant DSNR.

OTHER DATA SUBMITTED BY THE OPERATORS

The operator submits routine activity reports and summary reports on water intake, liquid and gaseous releases and the waste produced.

Similarly, there is a considerable volume of data on specific topics, such as, for example, the plant's seismic behaviour, fire protection, PWR fuel management strategies, relations with service companies, etc.

7.3.2.4.2 Evaluation of data submitted

The purpose of much of the data submitted by a BNI operator is to demonstrate that the objectives set by the general technical regulations or those set by the operator are respected. The ASN has to check both the thoroughness and the relevance of the demonstration.

Whenever it is deemed necessary, the ASN requests an opinion from its technical support organisations, the most important of which is the Institute for Radiation Protection and Nuclear Safety (IRSN). Safety assessment requires both the collaboration of many specialists and effective coordination structures to highlight the essential safety issues. The IRSN assessment relies on research and development programmes and studies focused on risk prevention and improving understanding of accidents. It is also based on in-depth technical exchanges with the operator teams responsible for designing and operating the plants.

ASN procedures for requesting the opinion of a technical support organisation and, where required, of an Advisory Committee, are described in Chapter 8. For major issues, the ASN requests the opinion of the competent Advisory Committee, to which the IRSN will present its analyses. For other matters, safety analyses give rise to IRSN opinions transmitted directly to the ASN.

7.3.3 ASN decisions and formal notices

7.3.3.1 General framework

Decisions which the ASN takes itself or proposes be taken by the ministers concerned result from a technical examination of available information and assessment data. It is not sufficient that these decisions be technically relevant, they must also be understood by those the ASN has to convince: elected officials, media, associations, safety authorities in other countries, etc.

Technical two-way discussion between the ASN and the operator is a vital element in the elaboration of ASN decisions. This does not mean that consensus has to be reached at any price, but that arguments have to be exhaustively developed. When all the arguments have been exchanged, the regulatory decisions are imposed.

Ensuing actions include the following:

- granting or refusal of the requested authorisation;
- requests for additional information or commitments on the part of the operator;

Part B - Article 7: Legislative and regulatory framework

- requests that certain work or tests be performed;
- partial or complete, temporary or final shutdown of the installation;
- submission of a report to the State Prosecutor.

It must be emphasised that the ASN has the power to interrupt plant operation on safety grounds. This is not a frequent occurrence but the capacity to shut down an installation is a vital element in the effectiveness of the ASN. Every year, several PWR maintenance and refuelling outages are in fact extended owing to additional checks or justifications required by the ASN.

Compliance with ASN decisions and requests gives rise to supervisory action, notably in the form of site inspections.

7.3.3.2 Formalisation of ASN decisions and formal notices

With a view to enhancing the transparency of its actions, the ASN set up a formalised system for decisions and formal notices. ASN decisions correspond to positions which it considers to be of particular importance and which are intended to be made public. In 2003 an example is the 7 January 2003 decision concerning the authorisation to resume normal power operation in the Phenix reactor in Marcoule.

The formal notices are injunctions addressed to operators, notably further to non-compliance with:

- a general regulatory text;
- a text specific to a given installation;
- a decision;
- a commitment made to the ASN.

Their purpose is to enjoin operators to comply with the requirements specified in the above documents within a realistic time set by the ASN. If the operators fail to comply, they become liable to sanctions, the nature of which is stipulated in the formal notice.

Both decisions and formal notices are made public, notably via the ASN web site (www.asn.gouv.fr). When a particular site is concerned, the Local Information Committee (CLI) is informed.

8. Article 8 : Regulatory body

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 7, and provided with adequate authority, competence and financial and human resources to fulfil its assigned responsibilities.

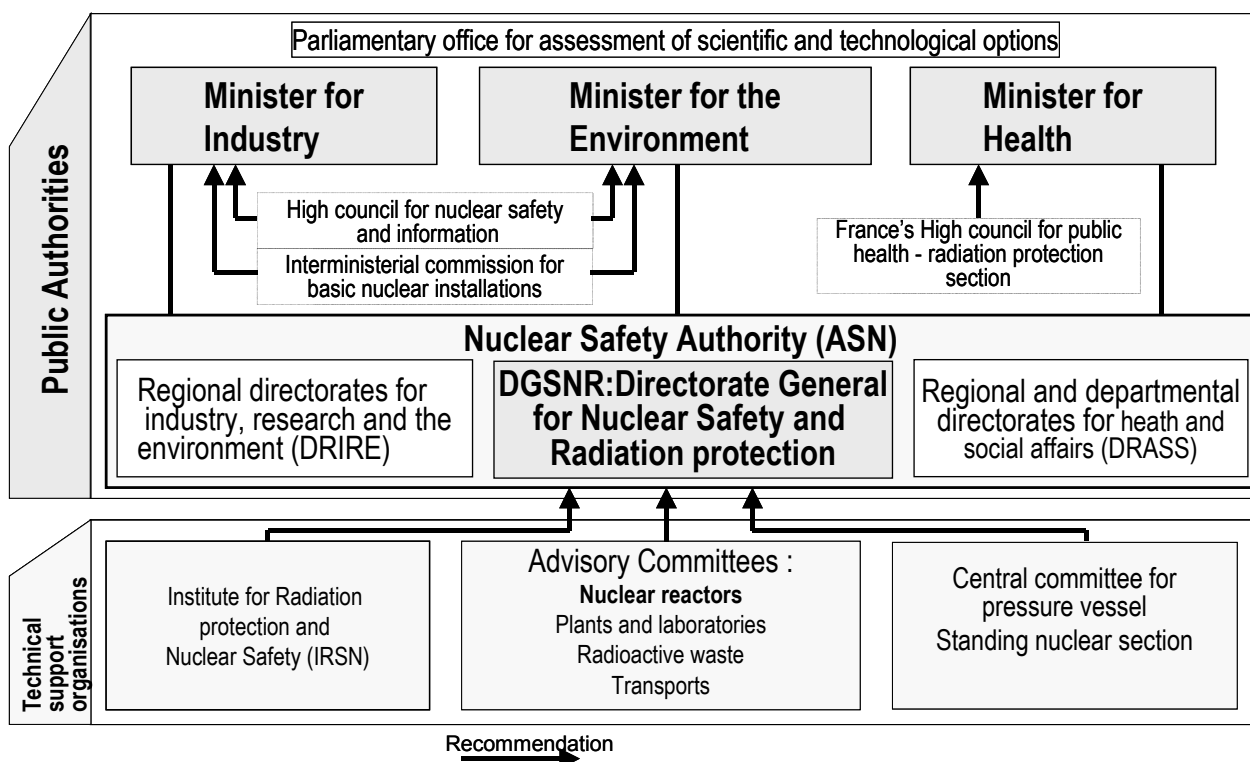
2. Each Contracting Party shall take the appropriate steps to ensure an effective separation between the functions of the regulatory body and those of any other body or organization concerned with the promotion or utilization of nuclear energy.

8.1 The Nuclear Safety Authority (ASN)

Within the Public Authorities, responsibility for supervision of the safety of basic nuclear installations (BNIs) and the safety of nuclear material transportation lies with the Ministers for the Environment and Industry and that for the supervision of the radiation protection with the Minister for Health.

Decree 2002-255 of 22 February 2002, modifying decree 93-1272 of 1 December 1993 and creating the Directorate General for Nuclear Safety and Radiation Protection (DGSNR), entrusts the latter, under the authority of the above-mentioned ministers, with responsibility for defining and implementing nuclear safety and radiation protection policy.

This double supervision guarantees the independence of the Nuclear Safety Authority from the Directorate General for Energy and Raw Materials, responsible for nuclear energy development and which reports exclusively to the Minister for Industry. The organisation of the Nuclear Safety Authority described in this chapter is illustrated by the following diagram.



The Nuclear Safety Authority (ASN) comprises a central administration, the Directorate General for Nuclear Safety and Radiation Protection (DGSNR) and regional departments of the State.

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.

8.1.1 The Directorate General for Nuclear Safety and Radiation Protection

Its main tasks are as follows:

- to draw up and supervise implementation of the general technical regulations for the safety of basic nuclear installations;
- to draw up and implement – in consultation 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 (authorisation for construction, commissioning, releases, etc.);
- to organise and coordinate surveillance of the installations by the BNI inspectors;
- to organise and coordinate 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 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 DGSNR also collects all information about research and development work conducted in the fields of nuclear safety and radiation protection.

8.1.2 The decentralized departments

Before the 2002 reform, the DSIN organised, steered, coordinated and monitored the activity of the Nuclear Installation Departments (DIN) of the Regional Directorates for Industry, Research and the Environment (DRIRE) concerning the supervision of basic nuclear installations (BNI) whereas the Directorate General for Health relied partly on the Regional and Departmental Health and Social Action Directorates (DRASS and DDASS) for supervision of radiation protection.

In 2003, the DGSNR continued to use these decentralised departments in the same conditions. At the same time, two prospecting exercises were initiated, the conclusions of which could be implemented in 2004 :

- a reconnaissance mission in the Rhône-Alpes and Basse-Normandie regions, which provided food for thought in the discussion about priorities, modalities and the tools for organising the supervision of radiation protection outside BNIs;
- a working group involving the DRASS, DDASS and DRIREs focusing on the distribution of duties and coordination of these various decentralised departments in the future.

8.1.2.1 The Nuclear Safety and Radiation Protection Departments of the Regional Directorates for Industry, Research and the Environment

The Nuclear Safety and Radiation Protection Departments (DSNR) which followed on from the DINs, operate under the authority of the DRIREs in a geographical area consisting of one or more administrative regions.

Part B - Article 8 : Regulatory body

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

- creation, modification or shutdown of BNIs;
- water intake and effluent release by BNIs;
- waivers to the general operating rules.

Oversight of examination of these requests remains the responsibility of the DGSNR and issue of the authorisations that of the Government or of the ministers.

The DSNRs also take part in supervising basic nuclear installations and shipments of radioactive materials through :

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

This supervision concerns not only regulations regarding nuclear safety specific to BNIs, but also the regulations relative to radiation protection, water intake and effluent releases, installations classified on environmental protection grounds and pressure-vessels.

In emergency situations, the DSNRs have a two-fold role to support the department Prefect, who is responsible for protection of the populations, and to monitor the site. To ensure preparedness for these situations, they take part in drawing up the emergency plans drafted by the prefects and in periodic accident simulation drills.

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 web site and its "Contrôle" publication, through their participation in the local information committees and their relations with local associations and media.

8.1.2.2 The Regional and Departmental Health and Social Action Directorates (DRASS, DDASS)

The DRASS and DDASS operate in a given geographical area, either a department or administrative region. The DRASS and DDASS take part in monitoring radiation protection both in the environment and in hospitals:

- radiological monitoring of drinking water;
- radon monitoring in institutions open to the public and in the home;
- monitoring of waste and effluent management in health care institutions.

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

- providing the Prefect with support in the event of an incident or accident;
- contributing to drafting the emergency plans drawn up by the prefects;
- stockpiling and distributing iodine tablets;
- taking part in periodic accident simulation drills.

From 2004, departing with the conclusions of the above-mentioned DDASS-DRASS-DRIRE working group, the activity of these departments will be maintained or even developed on topics related to health and the environment (drinking water, radon, health impact of installations, environmental monitoring, etc.), and scaled down concerning the supervision of radiation protection in medical installations.

8.1.3 Resources and management of human resources

8.1.3.1 Resources

Human resources

On 31 December 2003, the total workforce of the ASN stood at 312 persons, distributed between the DGSNR and the DSNRs in the DRIREs. It can be broken down as follows :

- 207 civil servants assigned to the ASN;
- 4 personnel on assignment from the Ministry for Infrastructures of the National Health-Paris Hospitals service;
- 11 contract employees;
- 90 personnel on assignment from the CEA and the IRSN under the terms of a convention signed with each of these two entities (see below "Financial resources").

About 80% of the ASN workforce are executives, primarily state officers (graduates from the Ecole des Mines and from the Ecole des Ponts et Chaussées, industrial and mining engineers, State public works engineers, public health medical inspectors, health engineering specialists) often with prior experience of inspection activities (in nuclear or other fields), personnel on assignment from the CEA or the IRSN and with experience of nuclear or radiological activities, and contracted specialist radiation protection engineers.

Within the framework of inspector exchange programmes with foreign nuclear safety authorities, an ASN engineer is on assignment abroad, with the Nuclear Installations Inspectorate (NII) of the Health and Safety Executive (HSE) in Great Britain since September 2002. A Spanish engineer from the Consejo de Seguridad Nuclear (CSN) and an NII engineer are on assignment with the ASN, since September 2002 and during the course of year 2003 respectively.

Financial resources

Since 2000, all the personnel and operating resources involved in the performance of the duties entrusted to the Nuclear Safety Authority are covered by the State's general budget.

The ASN's 2003 budget amounts to €30.8 million. It comprises civil servant wages (€12.5 million), and remuneration of the personnel on assignment with the ASN from the CEA, IRSN or AP-HP (€10.5 million), operating costs (€6.6 million) and safety work and analyses, studies and expert appraisals entrusted to outside experts (€1.2 million). To this should be added an extra amount of €54.1 million, corresponding to expertise work conducted by the IRSN on behalf of the ASN.

On behalf of the State, the ASN is also responsible for issuing the annual tax demands to the BNI operators. Governed by article 43 of the 2000 Budget Act, these taxes are paid into the State's general budget. For 2003, the revenue from these taxes amounts to 213.105 million euros. The breakdown of contributions is shown in the following table:

| OPERATOR | BNI TAX (euros) |
|--------------|--------------------|
| EDF | 174,191,000 |
| COGEMA | 18,586,000 |
| CEA | 8,666,000 |
| ANDRA | 6,403,000 |
| EURODIF | 1,830,000 |
| FBFC | 1,830,000 |
| OTHERS | 1,399,000 |
| TOTAL | 213,105,000 |

8.1.3.2 Human resources management

Staff training

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 course of technical training. This training curriculum comprises four technical training categories depending on the position occupied within the ASN:

- inspector training: this is a training course necessary to move up from trainee inspector to qualified inspector, with issue of the BNI inspector's card;
- 1st year basic training: this training is not required for moving from trainee inspector to qualified inspector but each part should be attended at the first opportunity;
- senior inspector training: training course for moving from qualified inspector to senior inspector; the qualification of senior inspector implies having attended the "inspector" and "1st year basic training" sessions;
- refresher courses: training not necessarily required for status of senior inspector. They may be attended on request of the staff or of his superiors, depending on the specific areas he is in charge of.

2061 days of training were given to the ASN's personnel in 2003. The overall cost of training sessions given by organisations other than the ASN or IRSN amounted to 500,000 euros.

Inspector qualification

The ASN 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 ASN Accreditation Committee. This is an advisory committee mainly comprising members from outside the ASN. 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 ASN 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. It proposes nominations for senior inspector to the Director General for nuclear safety and radiation protection, who decides accordingly.

On 31 December 2003, 35 senior inspectors were working within the ASN.

It should also be mentioned that ASN inspectors are usually assisted by technical experts from IRSN who have a long experience (10 to 30 years) of nuclear safety.

Finally it should be specified that in France there are no resident inspectors. All the inspectors are based in the ASN's premises (central or regional administration) and they travel for each inspection. They can therefore benefit at all times from exchanges with the other ASN inspectors or engineers.

Internal quality

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

- listening to the stakeholders' expectations (public, elected officers, association, media, trade unions, industry) within the framework of regulatory procedures (public enquiries) or a less formal context (qualitative opinion survey, hearings, etc.);

- action plans setting the ASN's objectives and its annual priorities, adjusted on a day to day basis by exchanges between entities (discussions, periodic meetings, memoranda, etc.);
- organisational notes and procedures, progressively structured and assembled to create an organisation handbook defining ASN internal rules for the proper execution of its missions;
- internal audits and inspections by the General Mining Council together with context, activity and performance indicators, enabling the quality and efficiency of ASN actions to be checked and improved.

Eight periodic annual meetings between those in charge of the various ASN entities lead to issue of conclusions, implementation of which is also checked.

Finally, the ASN's organisational memos are updated as and when necessary.

Also a part of internal quality monitoring are the periodic visits by DGSNR senior staff to the DSNRs and subdirectorates, as well as inspection of the DSNRs by the General Mining Council.

8.1.4 Technical support organisations

The Nuclear Safety Authority calls on the expertise of its technical support organisations. The Institute for Radiation Protection and Nuclear Safety (IRSN) is the main one, but in recent years, the ASN has been following a policy of service company diversification, both nationally and internationally.

8.1.4.1 The Institute for Radiation Protection and Nuclear Safety

As a public establishment of an industrial and commercial nature created by decree 2002-254 of 22 February 2002 the Institute for Radiation Protection and Nuclear Safety (IRSN), on behalf of the ASN, carries out studies and analyses in nuclear safety and radiation protection financed under an annual convention defining their nature and value.

In 2003, the work performed by the IRSN on behalf of ASN amounted to €54.1 million. It appears in the budget of the Ministry for ecology and sustainable development (Finance law, section IV, subsidies, chapter 44-40 article 20).

The major part of services provided by the IRSN to the ASN consists in safety analyses of nuclear installations. For the more important subjects (examination of safety analysis reports, major modifications to facilities), the ASN asks the relevant Advisory Committee to whom the IRSN presents its analyses. 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.

8.1.4.2 The other technical support organisations

In 2003, the ASN received the assistance of CETEN-APAVE in the fields of quality assurance, fire risk and obsolescence of nuclear facilities.

As part of its expert diversification policy, the Nuclear Safety Authority also called on the services of other organisations. Expert assessments were thus requested from the BURGEAP company, the Research Centre for protection assessment in the nuclear field (CEPN), ARMINES, the LIGERON SA company, the Mining and geological research Bureau (BRGM) and the national health monitoring Institute (INVS).

8.1.5 The expert groups

The Safety Authority relies on the opinions and recommendations of expert groups:

- the Advisory Committees;
- the Standing Nuclear Section of the Central Committee for Pressure Vessels.

The radiation protection section of the French Higher Public Health Council plays a similar role in the field of radiation protection.

8.1.5.1 The Advisory Committees

Four advisory committees available to the DGSNR, comprising experts and government representatives, were set up by ministerial decisions of 27 March 1973 and 1 December 1998. They examine the safety-related technical problems posed by the creation, commissioning, operation and shutdown of nuclear installations and their auxiliaries and the transportation of radioactive materials.

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

They therefore examine the preliminary, provisional and final 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 they feel would be useful. 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.

8.1.5.2 The Standing Nuclear Section of the Central Committee for Pressure Vessels

Created by article 26 of the decree of 13 December 1999 related to pressure vessels, the Central Committee for Pressure Vessels (CCAP) is a consultative body placed at the disposal of the Minister for Industry. In accordance with the order of 4 March 2003, it comprises members of the various government services concerned, persons designated for their competences and representatives of pressure vessel builders and users and interested technical and professional organisations. It can be consulted on all questions concerning enforcement of laws and regulations on pressure vessels. Pressure vessel accident reports are also forwarded to it.

In order to ensure closer monitoring of the more important pressure vessels in nuclear facilities, the CCAP set up a Standing Nuclear Section (SPN). The SPN's role is primarily to give its opinion concerning application of pressure vessel regulations to nuclear steam supply systems.

8.2 The other supervision players

8.2.1 The Parliamentary Office for Assessment of Scientific and Technical Options

Created by law 83-609 of 8 July 1983, the Parliamentary Office for Assessment of Scientific and Technological Options, a parliamentary delegation comprising eighteen deputies and eighteen senators, the composition of which was renewed on 10 July 2002, is responsible for informing Parliament of the consequences of scientific or technological options, in order primarily to assist it with its decisions.

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

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

From the outset, the Parliamentary Office carefully defined the scope of its rapporteurs, entrusted with investigating how safety and radiation protection were organised at both governmental and nuclear operator levels, comparing their findings with practice prevailing in other countries and checking that the

authorities were equipped to carry out the tasks allotted to them. This “supervision of the supervisors” thus concerns the efficacy of administrative structures as well as technical issues, such as the future of nuclear waste or the transportation of radioactive substances, or again, socio-political questions, like the circulation and perception of nuclear news items.

Hearings attended by the press have become a well-established tradition at the Parliamentary Office, since all parties concerned may express their opinions, defend their arguments and debate in public on a given topic, under the guidance of the rapporteur from the Office. A verbatim record of the hearings is appended to the reports. These hearings thus make a substantial contribution to both the information of the public and the transparency of decisions.

8.2.2 Consultative bodies

8.2.2.1 *The Interministerial Commission for Basic Nuclear Installations*

The Interministerial Commission for Basic Nuclear Installations (CIINB), set up by decree 63-1228 of 11 December 1963, as modified, concerning nuclear installations, must be consulted by the Ministers for the Environment and for Industry in the context of applications for BNI authorisation, modification or final shutdown decrees and of special requirements applicable to each of these installations. It is also required to give its opinion on the drafting and application of general BNI regulations. It comprises a standing section, competent to deal with routine issues.

The CIINB is an internal coordination body assisting the executive authority. It comprises representatives of ministers or State public institutions selected for their various degrees of competence or responsibilities in the nuclear safety field. Members of the Commission are designated by a Prime Ministerial order for a five-year term.

8.2.2.2 *The High Council for Nuclear Safety and Information*

The High Council for Nuclear Safety and Information (CSSIN), set up by decree 87-137 of 2 March 1987, provides the Ministers for the Environment and for Industry with a highly competent advisory structure for all questions related to nuclear safety and the information of the general public and the media in this context.

It brings together prominent personalities from widely different walks of life, comprising parliamentarians, personalities selected for their scientific, technical, economic or social competence, information or communication experts, members of representative trade unions and associations for the protection of natural environments, representatives of the operators and members of the governmental departments concerned (Prime Minister, ministries for Defence, the Environment, Industry, the Interior, Health, Labour).

The Council provides the Ministers for the Environment and Industry with recommendations deemed appropriate in the interests of the greater efficiency of the overall efforts pursued in the field of nuclear safety and information. The CSSIN may decide to entrust the investigation of specific topics to working parties, where necessary requesting the assistance of outside personalities. The DGSNR keeps the Council informed of the actions of the Safety Authority, in particular presents its annual report and deals with relevant secretarial requirements.

8.2.2.3 *The French High Public Health Council*

The French High Public Health Council (CSHPF) is a consultative body of a scientific and technical nature, reporting to the Minister for Health and competent in the field of public health.

It is responsible for issuing opinions and recommendations and for conducting assessments, in particular for anticipating, evaluating and managing health hazards.

Part B - Article 8 : Regulatory body

Without prejudice to the legislative and regulatory provisions making consultation of the CSHPF mandatory, the Minister for Health or any other minister may submit any draft legislation or regulations, draft administrative decisions and any question within its area of competence to the Council.

The CSHPF comprises four sections (water, communicable diseases, natural environments, radiation protection), each comprising 23 members appointed by order of the Minister for Health, with a 5-year mandate. The opinions of the sections are issued in the name of the CSHPF and published in the official bulletin of the Ministry for Health.

9. Article 9 : Responsibility of the licence holder

Each Contracting Party shall ensure that prime responsibility for the safety of a nuclear installation rests with the holder of the relevant licence and shall take the appropriate steps to ensure that each such licence holder meets its responsibility.

The fundamental principle on which the entire specific French 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 described in § 7.1 and summarised below.

Article 1 of law 61-842 of 2 August 1961, as amended, 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, implementing the afore mentioned law, 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 their function is defined, obtained and maintained for the various components of the facility and its operating conditions. The provisions implemented 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 life of the BNI.

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

- the ASN defines the general safety and radiation protection objectives;
- the operator proposes and explains technical measures for achieving them;
- the ASN then checks 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.

Within the Public Authorities, responsibility for supervision of nuclear plant and transport operation safety lies with the Ministers for the Environment and for Industry.

Responsibility for defining and implementing nuclear safety policy is entrusted to the ASN, under the joint authority of the above two ministers.

C. GENERAL SAFETY CONSIDERATION

10. Article 10 : Priority to safety

Each Contracting Party shall take the appropriate steps to ensure that all organizations engaged in activities directly related to nuclear installations shall establish policies that give due priority to nuclear safety.

10.1 Regulatory requests

Pursuant to its mission (see § 8.1), the ASN from the outset asked BNI operators to adopt an organisation guaranteeing that the top priority be given to safety.

The steps taken by the nuclear installation operators, as meant in this Convention, are presented below.

10.2 Measures taken for power reactors

Within the EDF Group, there are four main levels of nuclear operator responsibility: the president, the director of the Energies Branch, the director of the Nuclear Operations Department, responsible for the overall operation of all the nuclear power plants and the directors of the individual nuclear power plants (see EDF organisation in Appendix 3).

EDF attaches the utmost importance to safety, on the basis of:

- a company policy statement, the latest version of which was published in 2000 and which places safety and radiation protection at the heart of the Company's preoccupations and priorities;
- an operating safety management system, the general principles of which were established in 1997.

The guiding principles of the safety management system ensure that particular attention is paid to:

- strict compliance with safety requirements and the corresponding instructions;
- the existence of ambitions that are known and shared and which quite apart from the stipulated requirements reflect the Company's desire for progress and high performance in the field of nuclear safety;
- the responsibility of all the players, based on the awareness that man is a vital link in the safety chain and a fundamental vector for progress;
- clearly-defined safety responsibilities;
- the various inspection and verification procedures used to measure the effectiveness of the safety management system and rectify any deviations or drifts.

EDF is of the opinion that safety and competitiveness, both of which determine the legitimacy of the generation of electricity by nuclear means, can only be improved if all the players involved are made to feel responsible, hence the choice of a co-ordinated decentralisation policy. To this end:

- the management departments of the Nuclear Operations Department and the individual power plants draw up Guide Plans that determine the objectives and performance levels to be reached and the corresponding guidelines and avenues of progress. All the Guide Plans are consistent with each other.
- Guide Plans contain information on how the nuclear power plants can contribute to achieving overall performance levels, particularly in the three key areas of nuclear safety and radiation protection, competitiveness (availability and costs) and the management of individuals. It forms an important basis for the contractual relationships between the plants and Nuclear Operations Department management and for the associated inspection activities;

- there is a logic whereby players are encouraged to think about what they are doing and what it will involve and to share their findings, rather than simply act according to centralised decisions;
- the subsidiarity principle¹ guides decision-making at all levels in the hierarchy;
- a concise managerial structure and support functions are set in place;
- a Management Council is set up for each plant to debate the decisions to be taken and guarantee that they are taken correctly and implemented by the various players. The head of each plant has the final say in what he thinks is in the best interests of the plant;
- an inspection and verification system is created for each division of the Nuclear Operations Department.

Furthermore, if all the players are to be given a sense of responsibility, they must have the right to express themselves and criticise and there must be a system whereby their achievements are recognised; hence conditions have been created that encourage the players' right to inform² and duty to report³.

The relationship between the Nuclear Operations Department and the nuclear power plants is based on:

- a permanent reference system including requirements and guidelines relating to strategy, instructions and how the knowledge acquired in the plants as a whole should be put to use. It comprises four categories of products: management, doctrine, operation and procedure;
- the Guide Plan mentioned above, which is established every year under a Management Contract.

The management line of a division is responsible for monitoring the activities it carries out.

Management control allows division management to control and monitor the performance levels of the division.

Strategic control allows division management to ensure that the strategy guidelines in the policy reference system are appropriate and that sub-division projects are in line with the policy reference system.

In addition to the checks carried out by staff management, independent bodies also make checks. In the field of safety, these independent bodies are the Quality and Safety Advisory Units (MSQ) for the nuclear power plants, the Nuclear Inspectorate (IN) for the Nuclear Operations Department, the nuclear affairs delegation at the Energies Branch, the General Inspectorate for Nuclear Safety (IGSN), acting on behalf of the Plant Managers, the Director of the Nuclear Operations Department, the Director of the Energies Branch and the President of the EDF Group respectively. Safety analyses and comparisons are carried out regularly at the different levels under the supervision of the division managers: on-site Technical Safety Group, Committee for Nuclear Operating Safety within the Nuclear Operations Department, Committee for Nuclear Safety within the Energies Branch and the Nuclear Safety Council within the Group presidency.

With regard to the Nuclear Fuels Department and the Nuclear Engineering Department, bodies similar to the Nuclear Inspectorate of the Nuclear Operations Department make independent checks on activities important for nuclear safety or radiation protection.

¹ **Subsidiarity principle:** decisions should be taken as close to the field as possible, and should only be taken at a higher level of the hierarchy if there is a real advantage to be gained.

² **Right to inform:** all players should have a questioning attitude when carrying out their tasks and inform their hierarchy whenever an order or instruction is liable to reduce the quality of their work.

³ **Duty to report:** All events considered by players to be more important for safety than previously determined by their immediate hierarchy should be reported by the player to an EDF division responsible for safety (the head of the plant Safety and Quality Advisory Unit, the Director for Nuclear Safety at the Nuclear Operations Department, the Delegate for Nuclear Affairs at the Energies Branch, or the Inspector General for Nuclear Safety at EDF).

The following safety indicators and management tools are used:

- the annual safety reports published by each power plant and the associated report to the Director of the Nuclear Operations Department;
- the overall safety assessments made by the Nuclear Inspectorate and the corresponding comparisons;
- the environmental safety and radiation protection report drawn up by the Energies Branch;
- the annual report submitted to the President of EDF by the General Inspectorate for Nuclear Safety;
- a number of "quality tools" such as risk analysis, self-assessment and self-diagnosis;
- regular monitoring of indicators such as:
 - overall compliance with the general specifications for operation and maintenance;
 - piping alignment quality;
 - a reduction in the extent to which the reactor scram protection system is called on;
 - fire prevention.

10.3 Measures taken for research reactors

10.3.1 CEA research reactors

Measures taken by the CEA to guarantee safety take account of the wide variety of installations, related to the variety of research programs carried out by the CEA and their variation with time, and consequently the diversity of potential risks.

Nuclear safety has always been and is still the CEA's priority: operating shows that installations are operated in complete safety for the environment and for populations.

The appropriate safety level achieved by the CEA is based on the following three conditions being met:

- a clear organisation in which all players at every level are trained, made aware and responsible to perform the role that is clearly assigned to them (see the organisation presentation in Appendix 3);
- a taught, maintained and developed safety culture;
- skilled professional workers capable of working in teams.

Centrally, the general Administrator sets up measures designed to guarantee nuclear safety at the CEA. The general Administrator is assisted by the Directorate for nuclear safety and for quality, with respect to nuclear safety and quality, and by the central security Directorate with respect to radiation protection and transport. The two directorates form part of the "risk control" Division and define the CEA's safety policy, based on continual progress.

The Director for nuclear energy (DEN), assisted by the Directorate for security, quality and safety (DSQS), draws up the CEA's safety policy in all installations, and particularly on experimental reactors, and then monitors that it is applied.

Existing doctrine elements are included in the CEA nuclear safety handbook and comprise:

- circulars that are directives of general Management,
- recommendations designed to define the CEA doctrine.

Locally, centre managers, department leaders and facility leaders who form part of the line of action, check that the safety policy written in each installation for which they are responsible, is put into application.

The inspection function is performed by entities separate from the entities involved in the line of action. The inspection function consists of checking the effectiveness and appropriateness of actions carried out and their internal technical inspection.

The control function for which the General Administrator is responsible, is carried out by the general inspectorate of the "risk control" Division.

Each centre Manager at the Directorate for nuclear energy (DEN) is assisted by a safety Unit that carries out these inspections in the installations.

Moreover, the CEA continues to reinforce some areas of progress including:

- improvement to the organisation of radiation protection,
- reinforcement of the technical support organisation for installations in some fields of expertise such as earthquakes and human factors.

10.3.2 Case of the ILL's RHF high flux reactor

Nuclear safety has always been and still is the ILL's priority: operating experience over more than thirty years of operation demonstrates that the RHF is operated in complete safety, both for the surrounding population and for the environment. The good safety level achieved by the ILL is based on the following organisation:

- a radiation protection unit directly reporting to the Institute manager,
- a reactor Division: the ILL's Manager delegates the leader of the reactor Division to be responsible for the operation and safety of the reactor and its auxiliaries, and for quality assurance of this operation.

Among these activities, some of them (defined in a list) are called "monitored quality activities" (M.Q.A.) and a particular procedure is necessary for them. In principle, monitored quality activities are subjected to a double inspection in accordance with the quality order of 10 August 1984:

- first level inspection: this is an essentially technical inspection to guarantee that the intended result in the M.Q.A. is obtained. It is normally carried out within the functional Group responsible for carrying out the M.Q.A.
- second level inspection: additional inspections in the reactor Division, possibly made by spot checks, relate to both technical and management aspects of the M.Q.A. These external checks (or second level checks) are carried out by Quality Assurance staff set up in the reactor Division. This level consists of the C.Q.A.O. (Coordination and quality assurance office) supervised by the Q.A.M. (Quality assurance manager).

10.4 Analysis by the regulator

The regulator's assessment of the organisations adopted by the operators with regard to the priority to safety is presented in the subsequent chapters along the various articles of the Convention, but mainly in Chapters 12 and 13.

11. Article 11 : Financial and human resources

1. Each Contracting Party shall take the appropriate steps to ensure that adequate financial resources are available to support the safety of each nuclear installation throughout its life.

2. Each Contracting Party shall take the appropriate steps to ensure that sufficient numbers of qualified staff with appropriate education, training and retraining are available for all safety-related activities in or for each nuclear installation, throughout its life.

11.1 Regulatory request

French regulations set no official amount for the financial and human resources to be assigned by nuclear facility operators to safety aspects. Nonetheless, there is an indirect requirement, 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 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 Chapter 13) 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."

11.2 Resources allocated to safety in nuclear power plants

11.2.1 EDF financial resources

EDF was originally a single public company charged with generating, transmitting and distributing electricity in France. Over the years it has developed to become an international energy group.

This development, which was helped by the deregulation of European energy markets, is the result of a policy of rapid expansion outside France through external growth. The major financial results for the EDF Group for 2003 are as follows.

In 2003, EDF Group turnover was 44.9 G€, 30% up on the 2000 figures (34.4 G€). The Group's consolidated net result, after tax and before government interest, was 857 M€.

The turnover for non electricity-related activities in France was 16.5 G€. This total included a portion corresponding to "European" activities, which amounted to 12.7 G€.

In 2003, EDF sales in France rose; they amounted to 407.7 TWh for total generation of 490.9 TWh. Of that total, some 420.7 TWh were produced by nuclear means.

As the same time, sales on the European market amounted to 77.1 TWh. These results serve to confirm that EDF's output is perfectly able to meet energy demand in Europe.

Looking more specifically at the budgets dedicated to EDF's Nuclear generating fleet in 2003, the items in the table below should be noted:

| | M€ at current rate |
|---------------------------------------|--------------------|
| Operating budget | |
| Production | 574 |
| Training | 148 |
| Maintenance | 1,326 |
| <i>(including outage maintenance)</i> | <i>(436)</i> |
| Modifications and plant upkeep | 277 |
| Decommissioning | 52 |
| Investment budget | |
| | 478 |

EDF considers that the figures above clearly show that it has sufficient financial resources to meet the safety requirements of all its nuclear facilities throughout their lifetimes.

11.2.2 EDF's human resources

Around 20,000 people are employed in EDF's Nuclear Operations Department (20,615 in 2003, 20,753 in 2000), divided into three groups: operating staff (around 11%), supervisory staff (around 65%) and management (around 24%).

In addition to these 20,000 members of staff who are directly involved in the operation of EDF's 58 nuclear reactors, EDF also devotes human resources to developing, operating and decommissioning nuclear reactors:

- around 2,000 engineers and technicians at the Nuclear Engineering Department
- almost 200 engineers and technicians at the Nuclear Fuels Division;
- more than 600 engineers and technicians at the EDF Research and Development Division (EDF R&D).

Since these are human resources devoted to nuclear safety and radiation protection, EDF emphasises that it has taken steps to ensure that the large majority of personnel devote a considerable amount of time and energy to these two issues. Indeed, the Company policy aimed at decentralisation and making each player responsible for his actions (see § 10.2) and the development of a team safety culture (see Chapter 12) mean that nuclear safety and radiation protection are an integral part of all stages of an activity from planning to execution, to inspection and verification.

If allowance is made solely for those members of staff working exclusively in the field of radiation protection (safety engineers in nuclear power plants, safety specialists and experts in the headquarters departments, engineering divisions and inspection departments), the figure stands at around 300.

The order of magnitude is the same for staff carrying out industrial safety and radiation protection activities.

11.3 Resources allocated to safety in research reactors

11.3.1 CEA reactors

The first important point in terms of nuclear safety and radiation protection is to emphasise that personnel in installations are made aware of safety by special training and dedicate a significant proportion of their time and activities to this purpose.

11.3.1.1 Phenix reactor

The Phenix operator has a "Quality Safety Advisory Unit" to satisfy needs in the safety field, and five engineers working in this advisory unit are involved in safety and 3 engineers in quality.

The total number of persons working in the radiation protection department in the Phenix installation is 15, including 10 working full-time in shifts, to supervise the installation and for radiological monitoring of personnel.

Depending on needs, the design work is either:

- handled by specialised units in the CEA,
- or done by outside design offices, for example Framatome.

The Valrhô centre nuclear safety Unit, the security, quality and safety Directorate, and the nuclear protection and safety Directorate, contribute to monitoring, supervision and coordination of documentation.

During normal operation periods, about 10 M€ are set aside every year for reactor safety (personnel and subcontracted services: studies, work, etc.).

11.3.1.2 Other CEA reactors

A safety engineer's position has been created in each installation, and is occupied by an engineer familiar with the installation and with experience in the analysis and processing of safety files.

The nuclear safety Unit in each Centre, the security, quality and safety Directorate, and the nuclear protection and safety Directorate, contribute to monitoring, supervision and coordination of the files: between 10 and 20 engineers participate in this work on every site.

More than 25 M€ are thus dedicated to CEA reactor safety and research every year, including radiation protection.

11.3.2 RHF high flux reactor

The ILL has a safety engineer reporting directly to the Head of the reactor Division, to satisfy safety needs.

The workforce at the radiation protection Unit consists of 9 persons controlled by a radiation protection engineer, to monitor the installation and for radiological monitoring of personnel.

11.4 Analysis by the regulator

11.4.1 Safety and competitiveness for nuclear power reactors

The law of 10 February 2000 concerning the modernisation and development of the public electricity service considerably modifies the domestic electricity market in France. Whilst stipulating EDF's public service commitments, the law, which transposes a European directive on the internal market in electricity, places EDF, in particular, in a competitive situation for energy production and its supply to the larger customers.

A broader discussion has begun and is continuing on the potential safety impact of electricity market trends and the new methods implemented or foreseen by the operator and on the actions to be implemented by the ASN in this domain.

Cost control issues are nowadays given more emphasis by the operator in its discussions with the Nuclear Safety Authority. The technical discussions with EDF have clearly become tougher on these economic feasibility aspects, on the justification of some requests or some schedules and on the handling of very short term matters during outages.

Operator internationalisation has appeared at EDF with important organisational changes which were conducted in 2002. The implementation of this organisation was an opportunity, at the ASN's request, to redefine the nuclear operator's responsibilities between the EDF presidency, the Energies Branch, the corporate nuclear engineering Department and nuclear operation Department and the management of the nuclear power plants.

At the beginning of 2003, EDF announced its aim to develop cost-benefit approaches, enabling both technical and economical constraints as well as safety objectives to be taken into account in engineering decisions, and the relevance of the various options to be assessed. This approach would be applied to each dossier, to help choose a solution to a safety issue and to prioritise changes within a constant budget.

In view of the various challenges related to this approach, the ASN has identified the main areas of work requiring an investment in the coming years. The first area is the development of monitoring and follow-up tools for early detection of possible drifts: the review of the economical situation, of the expenditure trends, of the human resources management and of the organisational changes within the operator, will be given closer attention.

The second area is the implementation of a more open and responsible dialogue with the operator concerning its economic issues. The ASN is thus ready to examine a cost-benefit argument in which the operator would demonstrate that some improvements asked for by ASN do not represent an optimum allocation of available resources and would propose devoting its resources to actions having a more beneficial impact on safety.

The third area is the implementation of a clarified and strengthened legal framework. The draft law on transparency and security in the nuclear field aims to improve these aspects. Work has begun on general technical regulations with the implementation of the ASN decisions and formal notices together with the draft regulations for nuclear fuel and on general operating rules for nuclear power reactors.

The fourth area consists in developing international exchanges between nuclear safety authorities leading to harmonisation of requirements, in the light of the operators' internationalisation and the advent of an interconnected power market.

11.4.2 Safety and budget restriction for research reactors

Research installations are often operated by large public research organisations and the year 2003 showed the extent to which their resources are sensitive to national budgetary context. Several installations thus suffered from large-scale and unforeseen reductions in their investment and even operating resources, which led the ASN to urgently review applications for operating condition modifications. In one case the operator envisages a final shutdown of the installation. The ASN will make sure that budget restrictions will have no detrimental safety and radiation protection consequences on the operation of research facilities. This subject will be a particularly sensitive one in the coming years, given the changes in French public research policy.

12. Article 12 : Human factors

Each Contracting Party shall take the appropriate steps to ensure that the capabilities and limitations of human performance are taken into account throughout the life of a nuclear installation.

12.1 Regulatory requests

While a large majority of the actions carried out up to now in the field of nuclear safety has dealt with equipment and enhancing its reliability, organisational and human factors are considered as an essential source for further improving safety. This implies acting consistently on multiple levers: training and competence of staff working in the installations, individual and collective working methods, organisation and management, ergonomics of these installations and their operating documents.

The "Quality" order of 10 August 1984, requires the operator of a BNI to ensure that quality standards commensurate with the importance of their safety-related functions be defined, obtained and maintained for structures, components and equipment and for installation operating conditions. This order (Articles 7 to 9) stipulates in particular that the human and technical resources together with the organisational provisions implemented for the performance of a quality-related activity must be appropriate to this activity and enable compliance with the defined requirements. In particular, only adequately skilled staff may be assigned to quality-related tasks.

The circular associated with this order specifies that the personnel assigned to quality-related activities should be made aware of the degree to which their tasks are important for safety. As far as qualification or accreditation of personnel is concerned, the conditions of recognition of the qualification or issuance and renewal of the accreditation should be appropriate to the tasks the personnel are to perform. Accreditation of an individual for a given activity is granted by the operator for the activities performed by its staff or by the supplier if they are sub-contracted, and this accreditation attests to a person's qualification for the specified tasks and responsibilities. If an activity or set of activities simultaneously or successively involve several organisations or units of the operator or of one or more suppliers, specification of the responsibilities and duties of each person, of the limits of their actions and of the coordination between these organisations, is part of the requirements.

Changes in organisation must not be prejudicial to installation safety. Therefore, the operator must maintain teams that are large enough to ensure long-term performance of all functions such as operation, maintenance, engineering or internal assessment, including in the event of technical contingencies, incidents or accidents. Support and inspection functions and the circulation of information between departments must be specified, skills requirements must be assessed; the use of sub-contractors must entail the corresponding internal capability for follow-up and assessment of the services. In daily operation, operators must take steps to ensure staff professionalisation and management involvement, to improve organisation and working methods and modify individual and collective attitudes and habits.

The design of a new installation should enable the operator to gain a correct picture of the situation and guarantee that it has sufficient time to act: for example, urgent actions should be automated. When modifying existing installations, manufacturing documents should draw attention to the risks of error during installation and the personnel training required must be assessed in advance.

12.2 Steps taken concerning human factors in EDF nuclear power plants

Improved nuclear power plants performances, plus the need for an absolute guarantee of operating safety and quality, have led EDF in recent years to commit heavily to safety management and to incorporating human factors into the design and operation of its installations.

12.2.1 EDF's human factors policy

If sustainable progress is to be made in the field of human factors, a determining factor is to have a medium / long term view to ensure that measures are implemented consistently over a long period of time.

Consequently, in 1996 EDF established a policy that set out the main lines of the programme of actions to be taken in this field. For the period 2002-2005, three avenues of progress have been decided upon:

- improvement of operating means, by ensuring that socio-organisational and human effects are included in design dossiers and documentary and technical modification files as early as possible;
- skills management, within the context of renewal set to be adopted by EDF; the challenge is to use local skills development systems and full-scale training simulators, installed in all plants, to promote a professional approach and scenarios that most accurately reflect the requirements identified by the managers of each team;
- improvement of day-to-day practices with changes to the organisation, as well as to individual and collective working methods. The aim is to extract a commitment from all those concerned, employees, operators and managers, to improve the way these activities are carried out. This approach is based on the results of a shared diagnostic process, carried out within teams and project groups. The diagnostic aims to identify the difficulties encountered in working situations, and to help those concerned adopt practices that are universally considered to be efficient, and which contribute to high levels of professionalism and collective efficiency.

Both at individual unit and at the national level, support in the shape of human factors consultants is on hand to help managers implement these initiatives. In addition, a "safety and human factors management" advisory unit was set up in 2003. This unit, which forms part of the Nuclear Operations Department's senior hierarchy, aims to promote the overall safety management improvement policy that has been followed by EDF over the last few years.

12.2.2 Strengthening the safety culture at EDF

In 1997, the director of the Nuclear Operations Department sent a letter to the individual plant managers, entitled "managing nuclear operating safety". As a result of the process set in motion by this letter, each site has developed certain practices.

With effect from this date, six "tools" (referred to as "safety management levers") have been promoted and monitored closely, and have also received corporate support:

- the development of risk analysis skills,
- the safety and availability observatory,
- self-diagnosis,
- self-assessment,
- communication at operator level,
- handling of "sensitive" transients.

Six years after this approach was launched, work has just been carried out in an effort to capitalise on it. This process has enabled EDF to identify all the safety management practices implemented by the sites, and to consolidate them. The aim is to ensure that the practices are disseminated to other plants, so that all personnel are able to adopt those which they believe to be beneficial, depending on their diagnoses and ambitions. In addition to these six national levers, other local levers, defined at the initiative of a single site, have also been developed.

Moreover, this capitalisation work also provided the following lessons:

- the expected characteristics of the safety management system to be implemented on the sites,

- the requirement for managers to be present alongside teams,
- recommended use of the above mentioned management levers,
- the role of local and national support bodies to assist individual plants in this field.

All this work on safety management has been developed according to the consistent approach set down in the Nuclear Operations Department's management policy.

12.2.3 Management policy at the Nuclear Operations Department

One of the main objectives associated with the stakes for the company is to make quality the driving force behind success.

This objective is indicative of the conviction that the largest margins for progress are to be found within the work teams where motivating and stimulating safety-based actions should be taken to improve thoroughness and operating quality. The deployment of management through quality, which is directly related to the values specified in the Nuclear Operations Department's project, "A New Drive Toward Sustainable Development", meets this objective. These values have been converted into eight managerial principles based on the basic principles of the European Foundation for Quality Management.

The expected changes, expressed as such in the management through quality policy, will lead to:

- strengthened management,
- consolidated piloting,
- increased motivation in the coordination of activities,
- "win-win" relationships between partners.

12.3 Steps taken concerning human factors in research reactors

12.3.1 CEA reactors

An analysis of incidents identifies the main causes of failures and aims to determine corrective actions necessary to improve safety.

An observation of the number of human factor components in incidents justifies the specific approach of the CEA in processing these aspects, particularly by the creation of an expertise Centre consisting of experts and the promotion of human factor actions.

Actions have been carried out in various areas.

- Carrying out human factor studies in several installations after the emergence of identified problems.

The action of the human factor specialist is focused on 4 families of factors: organization of work, the team, the environment and technical devices. An analysis of these factors is based on observations of the activity, interviews and examination of technical documents. Working groups are set up to implement factor improvement actions, in particular placing emphasis on individual actions and the limitation of human failures.

- Human factors support on an increasing number of projects. Within this context, the input of the human factor specialist consists in giving priority to integration of human factors aspects throughout the project. This leads to performance of activity analyses in reference situations, simulation of the future activities using drawings, digital or full-scale mock-ups and proposals for improvements consistent with the project.
- Performance of human factors work specifically to satisfy requests by the safety Authority regarding periodic safety reassessments.

- A draft of the human factors reference system containing good practices to be applied and leading to customised recommendations.
- Setting up training courses, in particular leading to increased awareness by installation managers and safety engineers of human factors aspects.

These actions have improved the reliability and safety of the installations. The results are encouraging.

Human factors are also taken into account in subcontracting and in monitoring of service companies. In particular, a "service company safety quality" training course has been setup and is one of the quality assurance requirements imposed by Phenix on its suppliers when their activity relates to elements important for safety.

12.3.2 RHF high flux reactor

The steps taken by the RHF in the field of human factors are on the whole consistent with those of the CEA. The two institutions maintain regular contacts on this subject.

12.4 Analysis by the regulator

12.4.1 Human factors aspects in power reactor operation

Although a substantial proportion of nuclear safety actions concern the equipment and how to improve its reliability, the correct functioning of the installations depends, to a very large extent, on the quality of the work done by the personnel. It is therefore essential to look closely at the "human factor", given that this is a broad field encompassing individual and collective behaviour as well as organisation and management. Nuclear Safety Authority action is based on the following general principles:

- the responsibility of the operator: within the framework of general safety objectives, it is the role of the operator to define organisational provisions and to then adapt them whenever necessary and to ensure adequate training for their staff. The ASN analyses and where appropriate approves certain provisions but prescribes no standardised organisational arrangements for nuclear operators. Similarly, it falls to the utilities to train their staff and assess their ability to fulfil their tasks,
- surveillance: inspections carried out in nuclear operator departments often provide opportunities to take a closer look at the running of these organisations. Inspections on topics such as "safety management", "training", "human factors", "reactor control" or "service companies", for instance, enable assessment of the degree to which human and organisational issues are taken into account at nuclear installations,
- operating feedback: incident analysis should enable the operator to improve the efficiency of group work. Spontaneous forwarding of information should be aimed at improving safety rather than pointing the finger at culprits,
- defence in depth: to enable staff to play a significant safety role, organisational lines of defence must be set up. These would notably consist in definition of systematic technical supervision for sensitive operations, the provision of support for those directly concerned, the detection and treatment of deviations.

As underlined by the analysis of the causes of a number of events in recent years on reactors, human and organisational factors are considered to be a key area for future improvements concerning safety. The ASN therefore has undertaken a methodical review of consideration of these factors by the operators, in particular for power reactors.

It should also be noted that the ASN check on operator qualification comprises various aspects. The first consists in approving the safety analysis report, which should include a chapter on training referring to a qualification reference system under the responsibility of the operator. The second takes place during topical inspections through checking the qualification files of a sample of the staff and comparing them

with this qualification reference system. In addition analysis of the operating feedback analysis may lead the ASN to ask the operator to revise its training and qualification process. Finally for a number of years now, the Advisory Committee for nuclear reactors has been regularly consulted for examination of human factors related issues (modifications, final commissioning of N4 series, operating feedback, safety management, etc.).

12.4.2 Human factors aspects in research reactor operation

In 1998, the CEA decided to renovate, clarify and reinforce its nuclear safety and quality organisation. Two general instruction notes were released for this purpose. They notably set up safety commissions which assist the research centre managers in implementing an internal authorisation system; these commissions comprise CEA experts of national repute in their particular fields of competence.

In 1999, CEA organisational provisions with regard to nuclear safety and quality were subjected to thorough examination by the ASN and its technical support organisations, in particular the Advisory Committees for nuclear reactors and for laboratories and plants. Following this examination, the CEA had to specify the responsibilities, the respective functions and the allocation of resources and assessment tools for those responsible for action and for supervision in these fields.

In 2000, particularly through targeted inspections, the ASN began an assessment of the supervisory provisions concerning safety and radiation protection, in particular of the internal authorisation system set up by the CEA in 1998. This led in 2002 to the conclusion that the system was operational, even if extra human resources were still needed.

The ASN informed the CEA in 2003 that its new organisation contributed to a clearer view of the responsibilities and duties of the divisions, in particular concerning the continuity of the management line, the independence of the supervision function and the identification of a support function for the installations. In addition reorganisation of the corporate units enabled safety and radiation protection to be brought closer together.

However the ASN informed the CEA that it expected from it a self-assessment of the effectiveness of the steps taken regarding its organisation, particularly through performance indicators covering the safety and correct functioning of the organisation.

In this context, the ASN felt that the Centre managers, with the assistance of the Centre's safety unit and the safety commissions as applicable, should be allowed to authorise certain minor operations which did not compromise the installation safety demonstrations, without requiring formal authorisation from the ASN. In a letter dated 28 May 2002, the DGSNR therefore informed the CEA of the practical measures to be adopted for these internal authorisations, in particular with regard to the subjects to be examined by the operator and the procedures for prior notification of the ASN. About fifteen installations are concerned as of the end of 2003 and the system will be rapidly extended to the other installations.

The purpose of this approach is to improve the awareness of the operator as the ASN sometimes had to deal with a large number of minor questions which did not compromise the demonstrated safety or hazards of the installation, and which could have been dealt with by the operator. The risk in this state of affairs was of the operator losing all sense of responsibility, with over-reliance on the Public Authorities.

This approach will also enable the ASN to devote more resources to examining subjects entailing true safety issues, in particular the periodic safety reviews on the installations.

Finally, this approach demands that the CEA keep the safety reference systems of its installations up to date as these reference documents were frequently only updated belatedly, while the very nature of the CEA's installations means that they evolve rapidly. These updates should be an opportunity to think about defining broader operating domains than those currently described, in order to facilitate the necessary changes to these installations, which often imply no increase in the hazards involved.

While introducing this new system, a particularly close watch will be kept on the CEA, in particular through a series of inspections in 2003, which is to be continued in 2004, and by joint evaluation of certain files, chosen from among those which were internally approved by the CEA.

In tandem with the implementation of this system allowing the CEA to internally authorise certain modifications or operations, the ASN implements, for research reactors, a programme aimed at strengthening the safety requirements in two areas: the safety of experimental rigs placed within the reactors and the safety of reactor fuel management (fuel element loading and criticality procedures).

13. Article 13 : Quality assurance

Each Contracting Party shall take the appropriate steps to ensure that quality assurance programmes are established and implemented with a view to providing confidence that specified requirements for all activities important to nuclear safety are satisfied throughout the life of a nuclear installation.

13.1 Regulatory requests

As mentioned in Chapter 7 (§ 7.3.1.3), the 10 August 1984 quality order, concerning Basic Nuclear Installation design, construction and operation quality, provides a general framework for the provisions to be made by all BNI operators to devise, obtain and maintain plant and operating quality standards, that are necessary to ensure safety.

The order first of all concerns specification of the requisite quality level, by means of precise requirements, then obtaining it by appropriate skills and methods and finally guaranteeing it by supervision of compliance with these requirements.

The "quality" order also requires that:

- detected deviations and incidents be stringently dealt with and that preventive measures be taken (article 8),
- suitable documents testify to results obtained (article 10),
- the operator supervise its service companies and check compliance with the procedures adopted to guarantee quality (article 4).

13.2 EDF's quality assurance policy and programme

Given its industrial vocation and its public duty to produce electricity, EDF has to ensure that its plants are designed, built and operated in such a way that they are safe and efficient, both technically and economically. A quality policy helps meet this challenge and provide the proof needed to create a climate of confidence, the essential precondition to nuclear power being accepted by society.

Consequently, there are three objectives:

- to consolidate what has already been achieved and improve the results where required;
- to encourage the players to adhere to a quality system - without the players behind it, it cannot work;
- to have a quality system that meets French regulatory requirements and international recommendations on quality.

If power plants are to operate properly, they must be designed, built and operated properly. The quality policy concentrates on safety-related activities and is based on the following guiding principles.

13.2.1 Update the EDF quality system on the basis of knowledge already acquired

The need to guarantee safety has led EDF to create a quality system for its nuclear power plants based on:

- the skills of the personnel;
- the way in which work is organised;
- formalised methods.

The quality system is updated as follows according to the experience acquired:

- an overview of all activities;
- examination of the situation before any action is taken;

- the need to apply the requirements of the quality system to safety-related activities, availability, cost control and human resources management, in a modulated manner.

13.2.2 Using the EDF quality system as a tool working for professionals

Basic responsibility for the quality of any task lies with the person carrying it out. This is why skill, experience and culture are of paramount importance when it comes to achieving the required level of quality.

The quality system is the unifying force behind individual actions. It produces overall quality and the corresponding quality assurance. It is built around the players and provides them with methods, an organisational structure and tools, which they can use to take full advantage of their know-how.

The hierarchy has a key role to play in the quality system; it has to become involved by clearly stating what is at stake, allocating resources, determining objectives and priorities and setting an example.

13.2.3 Modifying EDF quality assurance requirements in line with the importance of its activities

The activities that are of importance to the plants are identified. Each potential activity is carefully examined. The difficulties associated with the activity and the consequences (particularly on safety) of any possible failures at the various stages are examined.

This brings to light the quality characteristics that are essential to the activity, particularly the level of quality required. This results in suitable quality assurance measures, particularly pre-established methods and procedures that have to be complied with. These pre-established measures are tools to be used by the players. Through a questioning attitude and by suggesting improvements, responsible players can help to make them more powerful.

13.2.4 Giving EDF the most suitable organisational structure and resources

Quality objectives can only be reached if tasks are allocated unambiguously and the duties, responsibilities and interactions between players clearly identified at all levels within the company.

Human and technical resources are adapted to the level of quality required, as are methods and procedures.

EDF constantly monitors the activities it sub-contracts to ensure that the services provided are of a high standard. This monitoring in no way relieves the service company of its contractual responsibilities, particularly those relating to application of the quality assurance rules. The contracts binding the service company to the service buyer clearly state the responsibilities of each and the applicable requirements.

13.2.5 Guaranteeing quality at EDF by means of appropriate checks

The quality of an activity depends first and foremost on the person carrying it out. Checking processes are one way of ensuring that quality is achieved. They focus on compliance with the requirements identified during the preliminary analysis and on the way in which the activity as a whole, plus its interfaces, is controlled.

These processes are adapted to the degree of importance of the activities and apply at all levels, from individual player to entire system. They include the following, whenever required:

- self-checking;
- checking by another qualified person capable of giving a critical opinion;
- verification actions designed to ensure that the quality system was correctly implemented. These are taken independently once the activity has been carried out.

All of the above contribute to the defence-in-depth-system.

13.2.6 Attesting to quality at EDF through traceability

Documents prepared at all stages of the activities, from preliminary analyses to final reports, attest to the fact that quality has been obtained. These documents are preserved, thereby ensuring the traceability of operations, particularly in the field of nuclear safety.

13.2.7 Anticipation, prevention and progress at EDF

To prevent faults from occurring and to improve results, an operating feedback system is implemented. This approach involves collecting details of faults, analysing them and attempting to determine their root causes, as well as validating good practice and ensuring that it becomes widespread. The experience gained with nuclear power plants in France is supplemented by the experience of other nuclear operators.

This approach involves indicators that reveal trends and make it possible to take preventive measures. Only a few indicators should be set in place. They are determined as a function of the targeted objective and established in collaboration with the players involved.

Periodic reviews offer the opportunity to determine what has been achieved and identify areas in which improvements can still be made.

In 2001, EDF initiated a proactive approach to obtain ISO 9001 and 14001 certification. At the time of writing, all the engineering units of the Energies Branch now have ISO 9001 certification. The EDF Group obtained ISO 14001 certification in April 2002. At the end of 2003, almost all units of the Nuclear Operations, Nuclear Engineering and Nuclear Fuels Departments also obtained this certification. A follow-up audit has already been carried out on several of them, and drew no comments likely to raise doubts over the certification.

13.3 Quality assurance policy and programme in research reactors

13.3.1 CEA quality assurance policy and program

Quality is intimately related to safety of installations, since it provides a means of increasing the reliability and the safety level achieved. Therefore it is not surprising that CEA attaches paramount importance to it.

The CEA quality handbook produced by the Directorate for protection and nuclear safety, states quality policy and defines the guidelines that all CEA divisions and units use to organise their own quality system consistently with each other.

The CEA quality policy has been discussed and approved by various authorities and is based on:

- responsibility of management that fixes its objectives, manages it through its decisions and gets involved in its implementation,
- participation of everyone through efforts to increase skills, strict control, transparency and a desire to transmit know-how and experience in the general interest,
- contribution to the control of safety and security.

The nuclear security, quality and safety Directorate (DSQS) suggests to the nuclear energy Directorate (DEN) how to apply the CEA quality policy to all installations belonging to the nuclear energy Directorate.

This breakdown is translated by the DSQS in the "safety and environment quality manual" that defines the main processes used by the nuclear energy Directorate, including the "maintaining nuclear installations in operational and safe conditions" process.

The DEN uses these processes to manage and rationalise control of all its activities to enable overall continuous improvement in order to improve "customer" satisfaction, while simultaneously improving internal operation.

Beyond quality, the policy adopted at the DEN leads to the development of a company culture based on security, safety, and the environment.

At each hierarchical level, "quality" managers handle CEA quality policy and are responsible for discussion, coordination and control of its implementation in the unit. Discussions organised between quality managers enable the experience acquired to be shared and built on.

Audits of units or their service companies are carried out regularly by internal or external auditors qualified in the units, in order to:

- measure progress made and define new lines of progress;
- evaluate the capability of suppliers and service companies to satisfy the CEA in terms of quality.

Thus, about thirty audits are carried out every year in research reactors, including ten or so in the Phenix installation. The main topics discussed during audits are:

- installation control,
- maintenance,
- the test process: control of inspection, measurement and test equipment;
- zoning and the process of sorting, packaging and transporting waste,
- control of risks related to the work.

The main objectives defined by the Director for nuclear energy for 2005 are:

- ISO 9001 V2000 certification for the entire DEN for mid-2005;
- ISO 14000 certification for the Cadarache, Saclay and Valrho centres for the end of 2005.

13.3.2 Quality assurance policy and program for the ILL's RHF high flux reactor

The reactor Division is responsible for operating the reactor and its auxiliaries (heat sink, detritiation, particular physics equipment). Considering the particular importance of these operating activities for safety, and in accordance with the provisions of the 10 August 1984 "quality" order, a quality assurance organization has been set up to guarantee that the required quality level (defined during the design or subsequent analyses) is obtained and maintained, and to provide as means of demonstrating that it is obtained and maintained.

Six guiding principles were used to produce this organisation:

- I: The operator defines the quality organisation application field, identifying activities and equipment affecting safety, and defining the necessary requirements for each of them. These activities (and equipment) are said to be "monitored quality activities".
- II: Staff qualified to perform a "monitored quality" activity (production of documents, technical or management checks, etc.) are appointed by the operations Manager. These staff are said to be "authorized".
- III: Any "monitored quality activity" is performed in accordance with written documents produced in advance, and execution of this activity is followed by written reports. These documents are called "monitored quality documents". In this respect, they undergo a technical (or internal) inspection, and a management (or external) inspection.
- IV: Monitored quality documents are kept up to date and are archived for a guaranteed duration that depends on the importance of the document.

- V: The results of an activity with monitored quality are checked from the technical (quality control) and management (quality monitoring) viewpoints. A report is produced for this check.
- VI: "Execution" and "Verification" functions are separate and carried out by different staff. The quality monitoring function is independent of operations functions.

13.4 Analysis by the regulator

Nuclear installation incident and accident feedback, together with inspection findings, enables the Safety Authority to assess compliance with requirements of the quality order of August 1984 by analysing malfunctions.

13.4.1 Quality assurance aspect of power reactor operation

13.4.1.1 General surveillance of operation quality

During its inspections and regardless of the field (operation, maintenance, radiation protection) the ASN strives to check that quality assurance principles are complied with. The adequacy between duties and resources, staff training, working methods, the documentation associated with the operations and internal surveillance methods, can thus be checked.

13.4.1.2 Quality aspect related to the use of service companies

Most nuclear reactor maintenance work is subcontracted by EDF to outside companies. This work is mainly seasonal, as it is highly dependent on the schedule of plant outages and concerns some 20,000 people every year. The quality of operation is therefore particularly dependent on the quality of these service companies.

Although creating an industrial policy of this nature is a strategic choice that lies with the operator, the Safety Authority, in application of the ministerial order of 10 August 1984, is responsible for checking that EDF still assumes its responsibility for the safety of its installations through quality monitoring of its external service companies.

Within this framework, the main areas for Nuclear Safety Authority supervision are the following.

13.4.1.2.1 Choice and supervision of service companies

In order to meet the requirements of the ministerial order of 10 August 1984, EDF has a service company selection process based on an assessment of their technical know-how and their quality organisation. In addition to this prequalification approach EDF, being responsible for its installations, also has to supervise or delegate supervision of its service companies and to use operating feedback in order to validate their qualification continuously.

Supervision of this service company qualification system is checked by the ASN in the power plants but also in the EDF head office departments responsible for this process.

In particular, adjusting the existing system to EDF's recent policy of using "integrated services" (contract placed with a service company in which a single order covers a maintenance activity involving various trades and including an overall coordination function and work sites delegated to the prime contractor) was dealt with in terms of control of the second level subcontracting that this implies.

Finally, as regards field supervision of the service companies, the Nuclear Safety Authority through its work sites inspections feels that EDF must still make significant progress on this aspect of subcontractor management.

13.4.1.2.2 The conditions for intervention preparation

An important factor in determining the quality of work is the care with which it is prepared together with the time allocated to the service company to do it. With regard to preparation of work, the Nuclear Safety Authority has observed a significant improvement in early placing of orders giving the service companies a much clearer picture of their upcoming workload: in 2002 half of the plants undergoing outages had placed at least 40% of their orders more than four months before the beginning of their outage (as compared to less than 20% of orders in 2001).

13.4.1.2.3 Radiation protection and working conditions

With regard to worker radiation protection, the Nuclear Safety Authority aims to check that EDF gives equal treatment to all nuclear workers, regardless they are service company employees or operator employees.

If working condition supervision, designed to protect individuals, is the responsibility of the Labour Inspectorate, the Nuclear Safety Authority for its part considers that degraded working conditions are also prejudicial to the quality of the work and therefore to safety. Labour inspectors and BNI inspectors thus exchange their views on this topic of common interest (assessment of labour accidents, compliance with legal working hours, etc.). It is interesting to mention that in many cases, with regard to EDF installations, the duties of BNI inspector and of labour inspector are given to the same person.

13.4.1.2.4 Service company market

The choice by the operator to outsource part of the maintenance of its reactors must not lead to a situation of dependency in which it loses control of the scheduling or the quality of the work done (defaulting by a company enjoying a monopoly for a given activity, lack of resources within a service company to deal with a volume of work, and so on).

Even if EDF has set up a structure for monitoring its service company market and following-up the available resources, the Nuclear Safety Authority wishes to obtain its own view of this subject, independently of the operator. In 2003, it therefore initiated a specific audit in 2003, the results of which are expected in 2004.

13.4.2 Quality assurance aspect of research reactor operation

Unlike power reactors, research reactor maintenance makes far less use of outside service companies, with the exception of exceptional maintenance operations.

In this context, the ASN checks, notably through inspections, the application of quality assurance principles by the operator during reactor operation and maintenance. The ASN pays particular attention to reactor operator supervision of activities carried out by the common technical services within a CEA Centre, which in the past tended to be less rigorous than the supervision of external service companies, owing to the fact that the workers were part of the CEA.

Exceptional maintenance activities are the subject of a specific surveillance programmes by the ASN decided on a case by case basis. Consideration is currently being given to general formalisation of the ASN's requirements for quality assurance documentation updating following exceptional maintenance and before restart.

14. Article 14 : Assessment and verification of safety

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

- i) comprehensive and systematic safety assessments are carried out before the construction and commissioning of a nuclear installation and throughout its life. Such assessments shall be well documented, subsequently updated in the light of operating experience and significant new safety information, and reviewed under the authority of the regulatory body,*
- ii) verification by analysis, surveillance, testing and inspection is carried out to ensure that the physical state and the operation of a nuclear installation continue to be in accordance with its design, applicable national safety requirements, and operational limits and conditions.*

As indicated in the text of the present Article, "comprehensive and systematic safety assessments are carried out before the construction and commissioning of a nuclear installation and throughout its life". These assessments are to be seen as an integral part of the licensing and supervision process, which regulates all stages of the life of an installation, from the design and siting stages up to the dismantling phase. As a consequence, the present chapter should be read in conjunction with Chapter 7 for the description of the regulatory framework, and Chapters 17 to 19 for the description of the licensing process.

14.1 Regulatory requests

14.1.1 Initial requests concerning nuclear reactors

When a site is envisaged by an operator for the construction of a nuclear reactor, the ASN assesses the site characteristics from the viewpoint of safety. When an operator intends to build a new type of reactor, the ASN asks the Advisory Committee for nuclear reactors to examine the proposals submitted, and then informs the operator of the issues to be included in its authorisation decree application.

Granting of the authorisation decree relies on the review by the Advisory Committee for nuclear reactors of a preliminary safety analysis report submitted by the operator to support its application. The operating licence is subject to review by the Advisory Committee for nuclear reactors of a provisional safety analysis report, together with provisional general operating rules and on-site emergency plan provided by the operator. Final commissioning is granted after review by the Advisory Committee for nuclear reactors of a final safety analysis report, together with general operating rules and on-site emergency plan taking account of lessons learned from operation since first start-up.

The content of the various reports is specified in the 27 March 1973, instruction implementing decree 73-278 of 13 March 1973. The guidelines for the content of safety analysis reports for nuclear reactors are given in Appendix 2.

The successive reviews by the Advisory Committee for nuclear reactors of the documents supplied by the operator are based on analysis reports established by the IRSN.

14.1.2 Continuous reactor surveillance

The continuous surveillance of the safety of nuclear installations is based on general operating rules and supervision of maintenance (described in Chapter 19). It is the objective of the major part of the ASN inspection's programme, the practical details of which are presented in Chapter 7.

In practice, each nuclear power plant is the subject of an average of about twenty inspections a year, not including technical meetings between the operators and the ASN. In addition frequent contact, at least by telephone, is maintained between the operator and the ASN regional division. Research reactors are the subject of the same kind of supervision but less frequently.

14.1.3 Periodic safety reviews and 10-yearly outages

14.1.3.1 General principles

The safety of a nuclear facility depends on a safety analysis performed at the outset, which demonstrates that the facility meets the safety requirements fixed for it. This initial safety analysis does however need to be periodically reviewed, for two main reasons. The first is that the facility evolves: it can be modified, deviations can occur at construction, and the effects of ageing can lead to deterioration. The second is that the safety requirements themselves change, as the ASN considers that safety requirements must keep pace with technical change and accumulated experience, and that what may have been felt to be acceptable at a given time may no longer be acceptable later on.

This is provided for in the article 5 of decree 63-1223 of 11 December 1963, as amended, which notably stipulates that the Ministers for the Environment and for Industry "can jointly request that the operator, at any time, conduct an installation safety review".

The purpose of the periodic safety reviews is therefore to reconsider the original safety demonstration and on the one hand to check that the installations are still in conformity with the initial requirements fixed for them and on the other to raise and improve their level of safety. The periodic safety reviews are thus of prime importance, both to detect any conformity deviations and ensure that ageing phenomena are controlled, and to improve the safety of the installations, through a realistic risk reduction approach. The periodic safety review takes place over several years and demands considerable resources on the part of the operator, but also on the part of the ASN and its technical support organisation, the IRSN.

14.1.3.2 Specificity of power reactor periodic safety review

The general process for the periodic safety reviews involves a two-fold comparison.

- Comparison of the condition of the installations with their design reference, taking account of any changes made since they were built: this is the conformity check.

The conformity check, as carried out in France on the power reactors, is of a scale unique in the world. The conformity check performed on the 900 MWe and 1300 MWe reactors included a check on the conformity of the measures to protect against external hazards, including extreme weather conditions and seismic activity, and against internal hazards such as high energy pipe breaks, or a check on the ability of the equipment to function in degraded conditions (known as qualification for accident conditions). A "program of additional investigations" was also defined, to check those parts of the installation which are not covered by maintenance programs, such as certain portions of piping or tanks which are inaccessible during normal operation.

Each reactor is thus subject to in-depth review and any anomalies are recorded, with the aim of ensuring that the reactors are in conformity with their design assumptions, no later than during the ten-yearly outage. For anomalies in which the safety stakes are high, the ASN can nonetheless set shorter times to restore conformity.

- Comparison of the level of installation safety with that required for the most recent reactors, examination of the consequences of retroactive application of the most recent safety rules, comparison with best international practices and taking account of the lessons learned from reactor operation: this is the safety reassessment.

The ASN asks the operator to examine the consequences of implementing stricter safety requirements and, whenever feasible, to propose modifying the plants. These modifications are generally made during the reactor ten-yearly outages which, for a given plant series, can extend over about ten years.

In practice, given the standard design of the reactor series, this review is conducted jointly on all the reactors in the same plant series, which enables a large percentage of the studies to be shared and the review to be underpinned by extended operating feedback.

To this must be added measures which strictly speaking in France are not within the remit of the periodic safety review, but which are guided by the same determination to verify conformity and bolster requirements: this in particular concerns the current revision to the plant effluent release licences and application of the ministerial order of 31 December 1999 concerning protection of the environment.

After the periodic safety review, the ASN decides on whether or not reactor operations can continue until the next ten-yearly outage.

14.1.3.3 The 10-yearly outages of nuclear power plants

The 10 November 1999 order requires that, after an operating period of ten years, each main primary and secondary system of a pressurised water reactor undergo a full inspection and requalification comprising renewal of the hydrotest. The full inspection enables verification of plant condition, in addition to the periodic examinations carried out during refuelling outages, extending the checks to areas which are not regularly inspected. This outage is also an opportunity for inspection of the reactor vessel, particularly the most irradiated area in the immediate vicinity of the reactor core, and its welds.

The main primary system hydrotest, which consists in subjecting this system to a hydraulic pressure equal to 1.2 times the design pressure, constitutes an overall pressure resistance test. This test does not take into account all the types of operating loads involved, but it enables identification of serious defects in unsuspected areas. This was, in fact, the case in 1991 with detection of the vessel closure head adapter cracking phenomenon and in 1989 with the cracks in the 1300 MWe reactor pressuriser nozzles.

14.1.3.4 Research reactors periodic safety reviews

Many current CEA installations began operating at the beginning of the 1960s. These installations, designed to meet former requirements, contain timeworn equipment. They have also undergone modifications on various occasions, sometimes without an overall safety review. Remedial work is now needed to make these installations compliant in safety terms, both for the medium and indeed the long-term.

The ASN informed the operators that it feels a safety review of old installations to be necessary about every ten years. At the CEA, safety reviews are in progress on the Cabri and Masurca reactors on the Cadarache site.

The CEA intends to start the safety review of its other installations within the next six years following a schedule approved by the ASN in 2002. In 2004, the ASN intends to specify what it expects from the safety reviews of the CEA installations in terms of responsibilities, content and scheduling.

14.2 Safety reviews and verifications carried out at nuclear power plants

14.2.1 Initial review by EDF

The safety analysis report informs the Safety Authority of the steps taken at each stage in the lifetime of the installation (design, construction, commissioning, operation and decommissioning) to comply with the regulations and guarantee safety, and justifies them. It includes all the information required to verify that due allowance has been made for all risks (nuclear and otherwise) and all potential hazards (of internal or external origin) and that in the event of an accident, the personnel, the public and the environment would be properly protected by the systems set in place. The report makes allowance for

the specific characteristics of the site and its environment (meteorology, geology, hydrology, industrial environment, etc.).

The construction licence application that EDF submits to the Public Authorities is accompanied by a file containing a study of the impact on the environment and the associated danger. The preliminary safety analysis report describes the design and construction steps taken to guarantee safety. Six months before the start-up tests take place, EDF issues the provisional safety analysis report along with an application for authorisation to load fuel and operate at reduced power. This report contains all the necessary details on the actual construction of the facility and the conditions in which it is to be started up, as well as provisional versions of the general operating rules and of the on-site emergency plan. After a period of time set by the construction licence decree (usually ten years), EDF issues the final safety analysis report and the general operating rules, together with a licence application for commissioning.

In compliance with regulatory requirements, EDF carries out a thorough inspection of its facilities every ten years, the key areas being the reactor vessel, complete re-qualification of the reactor coolant system and a containment pressure test.

14.2.2 EDF safety review

To take account of the effect of time on the facilities and changing safety standards, and to make allowance for new knowledge, EDF, as well as analysing operating feedback, also carries out regular safety reviews of each technical reactor series.

The first safety review began in 1988 for the oldest reactors in the fleet, i.e. Fessenheim and Bugey (which are part of the CP0 reactor series). In this instance, the main aim was to compare these units to the CP1-CP2 reactor series to obtain an overall level of safety for all the 900 MWe reactors series. The safety review was then extended to the CP1-CP2 reactor series. This "VD2" review process (i.e. for the second ten-yearly outage) was concluded after the first-of-series reactor was restarted, with the updated safety analysis report being approved. The modifications are implemented when each of the reactors are shut down for their ten-yearly outages. The safety reassessment process for the third ten-yearly outages began as soon as the VD2 reviews were completed. The Advisory Committee for nuclear reactors gave its opinion on the contents of the review in 2003. For the 1300 MWe series, the reassessment of the second ten-yearly outages began and was discussed at several sessions of the Advisory Committee for nuclear reactor, even before the modifications resulting from the second ten-yearly outages had been defined. The results of the reassessment are incorporated into an updated version of the safety analysis report, which will be sent to the ASN before the next ten-yearly outage of the first-of-series reactor.

The reassessment approach approved by the ASN is in three stages:

- the safety requirements reference system, comprising a set of rules, criteria and specifications applicable to a given technical series, is described;
- it is demonstrated that the reactors comply with the safety requirements reference system. There are two aspects to this demonstration:
 - i. the design must be shown to comply with safety requirements. This part consists of a number of studies that are generally the same for all plants of the series,
 - ii. the reactors must be shown to comply with their respective designs. This part is carried out by the operator at each site,
- the extent to which the safety requirement reference system is up-to-date and complete is assessed by examining all the lessons important for safety and reference systems applied to more recent reactors. The process then involves identifying any modifications that might have to be made to the standard state of construction of the reactor series during the ten-yearly outage.

This approach ensures that the safety requirements applicable to a given technical series are clearly identified and guarantees that the units comply with the reference system. It also highlights any aspects of safety that have to be analysed in more detail, particularly in the light of new knowledge and operating feedback from facilities in France or abroad. This analysis can lead to a change in the reference system, which becomes a new reference state. The "10-yearly outage edition" of the safety analysis report is updated and the corresponding modifications incorporated.

Description of safety reference system

For example, for the 1300 MWe reactor series, the safety requirements reference system prior to the second ten-yearly outage is the 1998 edition of the final safety analysis report. Similarly, for the 900 MWe reactor series, the safety requirement reference system prior to the third ten-yearly outage is the "second ten-yearly outage" edition of the final safety analysis report.

Review of compliance by EDF

The compliance of installations with safety requirements is a major issue for nuclear operators at various levels.

Firstly, at the design stage, the designer designs a reference installation (technical series) that meets these requirements and has it built according to pre-determined rules that make it possible to check compliance right up to industrial commissioning.

Then, during the operation stage, the nuclear operator (the Nuclear Operations Department) ensures that the facilities continue to comply with the safety requirements applicable to them by making use of the organisational systems described in the Quality Manual, according to the terms and conditions applicable for permanent monitoring (application of Technical Operating Specifications) or periodic monitoring (surveillance tests, basic preventive maintenance programmes, etc.).

During the safety review, EDF identifies those points that have to be:

- analysed further in relation to the safety case of the reference facility;
- the subject of specific checks to be applied to the actual units in addition to pre-existing monitoring systems. In the case of the second ten-yearly outages, these checks consist of a "compliance review" programme and a "programme for additional investigation".

The compliance review programme comprises a set of special checks or targeted actions on issues relating to safety requirements (classification of safety-related equipment, qualification for use in accident conditions, extreme cold, resistance to earthquakes, flooding risk, risk of high-energy pipe break, etc.) and, in certain areas, can be used to establish a "baseline" for the state of the installations, for example masonry structures. When the programme is implemented, deviations can be identified whose processing is commensurate with the importance of the deviation from a safety point of view, the compliance of the units can be determined and, even more importantly, useful lessons can be learned as to how to gain better control of the compliance of the installations with a view to ensuring their durability. Project management is entrusted to each nuclear power plant, with strategy being controlled by plant management and a project team headed by a staff manager.

For the second ten-yearly outage reviews, the corresponding checks were carried out between 1997 and 2000 for the 900 MWe reactor series on the basis of preliminary operating feedback from the first-of-series plants (Tricastin and Fessenheim). Between 1999 and 2003, checks were carried out on the 1300 MWe reactor series (the first-of-series plants at Paluel and Cattenom).

The programme for additional investigation comprises non-destructive checks that are spread over several units and carried out on the occasion of the ten-yearly outages. The aim is to confirm the validity of the scenarios (degradation modes) on which the basic preventive maintenance programmes are based. The programme is implemented at the start of the ten-yearly outage period.

Assessment of the reference system by EDF

All new facts, whether they result from operating feedback in France or abroad or from special studies or changes made to later series, are examined and the most sensitive issues are assessed with regard to their impact on the level of safety of the reactor series. When it is apparent that they are sufficiently important and that this importance far outweighs any other disadvantages there may be, the safety requirement reference system is modified. If necessary, verification studies are carried out again. Probabilistic safety assessments may be used, particularly to determine and analyse accident precursors or priorities in the main components of the risk and assess the level of safety.

For example, assessment of the safety reference system after the second ten-yearly outage of the 900 MWe reactor series (CP0, CP1-CP2) began in 2001 with a view to planning the third ten-yearly outages.

14.3 Safety reviews and verifications carried out on research reactors

As mentioned in chapter 6, after more than 20 years of operation, the ASN in 1995 wanted the safety status of the Phenix reactor to be reviewed. The Phenix reactor safety review was followed by very extensive work that is described in chapter 6. The positive conclusions of the Advisory Committee for nuclear reactors session in October 2002, enabled the Nuclear Safety Authority to authorise resumption of Phenix reactor normal power operation in January 2003. The plant's 51st operating cycle began in June 2003.

Over the last three years, Advisory Committees have met for a number of sessions to deal with the following CEA reactors:

- the Jules Horowitz reactor, which is now being designed and which will be built over the coming decade on the Cadarache site (see chapters 17 and 18),
- the CABRI reactor on the Cadarache site, which is now being completely renovated.

Moreover, following ASN requests, the CEA has carried out detailed studies on different topics on all installations, and particularly:

- earthquake resistance,
- fire protection,
- protection against internal and external hazards.

Finally, the ASN initiated the RHF safety review in 1995. The main purpose of ASN requests and the operator's commitments during the safety reassessment was to achieve the following objectives:

- bring the RHF up to current seismic standards, by strengthening all buildings whenever necessary, creating EIS-Ss (Equipment important for safety in case of earthquakes) that remain operational after the reference earthquake selected for the design,
- complete the demonstration that the flooding risk has been taken into account,
- update all the following subjects: calculation of the radiological consequences of design basis accident situations, protection against the risk of fire and explosion, containment of the installation, electrical power supply and instrumentation and control, protection against radiation.

Difficulties encountered during this review mainly concern the consequences of an earthquake close to the installation. After the session of the Advisory Committee for nuclear reactors that was held on 2 May 2002, the ASN requested that seismic strengthening work on the installation as already proposed should be carried out quickly and that new studies should be sent to it in order to complete this periodic safety reassessment.

A specific project organization, the Refit Management Committee, was set up with significant resources, of the order of € 20 million over 4 years (2003-2006), to perform all design and work corresponding to these commitments.

14.4 Analysis by the regulator

14.4.1 Nuclear power plant periodic safety reviews

For power reactors, for which most of the periodic review is performed at the same time on all the reactors of the same series, several important steps were reached in 2002 : the conclusion of the 900 megawatt reactors safety review after their 20 years of operation, the review by the ASN of the studies performed by EDF for the corresponding review of the 1300 megawatt reactors and the start of the review of the 900 megawatt reactors in view of their third 10-yearly outage.

14.4.1.1 Conclusion of the 20-year safety review on the 900 MW reactors

This review was begun in 1987 for the Fessenheim and Le Bugey reactors and in 1990 for the other 900 MWe reactors. Initially, until 1995, the aim was to ensure a uniform level of safety for all the 900 MWe reactors: a number of design changes were thus defined for the older plants, those of Fessenheim and Le Bugey, so that they can now be considered as having the same level of safety as the other 900 MWe reactors.

A wide-ranging conformity check led to the detection and correction of non-conformities, in particular concerning the seismic resistance of components and their qualification for accident conditions.

The safety review approach was based on a comparison between the 900 MWe reactors and the 1300 MWe reactors and the more recent N4 plant series. Probabilistic safety assessments were used to highlight failure scenarios the importance of which had hitherto been underestimated. Several modifications designed to improve safety were felt to be necessary by the ASN: for example, the addition of heating to guarantee equipment operation in particularly cold weather, or improved reliability of certain safety-related systems, such as the steam generator auxiliary feedwater system, the ventilation systems or the back-up turbine generator.

This review led to a significant improvement in the level of safety of the reactors concerned. After the exercise was completed, the ASN approved a new standard safety analysis report for these reactors and gave a green light for continued operation until the third ten-yearly outage.

The ten-yearly outages, during which the above-mentioned modifications were made, began in 1999 and will be completed in 2010.

14.4.1.2 The 20-year safety review for the 1300 MW reactors

This safety review after 20 years of operation began in 1997. The safety review is conducted with reference to current requirements for the N4 plant series reactors. In 2002, the ASN consulted its Advisory Committee for nuclear reactors concerning the validity of the engineering studies conducted by EDF, and considered that some proposals could not be accepted as they stood. A new dossier including results of the studies and lessons learned, in particular with regard to installation modifications or changes in operation or maintenance, will be submitted for assessment to the Advisory Committee for nuclear reactors in 2005.

The conformity check, the program of which comprises all the checks performed on the 900 MWe reactors and includes issues such as protection against hazards originating from the reactor's industrial environment, protection against internal missiles and the operability of equipment needed in incident or accident conditions, is currently being completed on all 1300 MWe reactors. In 2003 Paluel, Saint-

Alban, Flamanville and Cattenom NPP presented the result of their conformity checks to the DGSNR and IRSN.

Most of the modifications resulting from the safety review have already been defined. They will be implemented on the 1300 MWe reactors, during the second ten-yearly outages, as of 2005.

14.4.1.3 Initiation of the 30-year safety review for the 900 MW reactors

In 2003, after the initial technical discussions and a consultation of the Advisory Committee for nuclear reactors, the ASN has defined the orientations for the periodic safety review of the 34 900 MWe reactors in association with their third ten-yearly outage.

The ASN relied on national and international operating feedback and on a comparison with more recent reactor types, including the EPR reactor project for the definition of the scope of the review.

These orientations are specified in a letter of 9 October 2003 instigating this safety review, determining the scope and the limits of the studies to be made by EDF, together with the deadlines to be met to enable the resulting modifications to be integrated on the 900 MWe reactors during their third ten-yearly outages scheduled as of 2008.

The ASN also asked that top priority be given to studies concerning the risk of containment building sump filter clogging in accidental conditions and that they be examined in priority and extended to all types of pressurised water reactors.

14.4.2 Analysis of steps taken for research reactors

After important refurbishing works on the Phenix reactor and after a final examination by the Advisory Committee for nuclear reactors of the files related to overhaul of the reactor steam generators at the end of year 2002, the ASN informed the CEA that it considered that satisfactory answers had been given to the issues related to the safety review of the installation and on which power build-up was conditional. The ASN thus informed the CEA in January 2003 that it had no objection to resumption of the operation of the reactor, at the partial power of 350 MWth, for the six remaining irradiation cycles to be performed up to 2008.

The first cycle was authorised in June 2003, enabling the CEA to resume the power operation of the Phenix reactor in July 2003. Certain difficulties within the non-nuclear part of the installation, due to the lengthy shutdown of the reactor, delayed the power build-up. Finally the discovery of a leakage on the resuperheater of steam generator n° 1 led the CEA to shut the reactor down in September 2003. An application for reactor restart was submitted to the ASN, which issued its approval in November 2003, after analysis of the CEA's assessments for identifying the origin of the leakage.

The ASN duly noted the CEA's undertaking to conduct the periodic safety review of old installations about every ten years. The CEA aims to have them under way within the next six years, according to a schedule which was approved by the ASN in 2002. In 2004, the ASN intends to clarify what it expects from the safety review of CEA installations in terms of responsibility, content and scheduling.

As regards the ILL, files should be submitted in 2004 to allow completion of the safety review of the installation which began several years ago.

15. Article 15 : Radiation protection

Each Contracting Party shall take the appropriate steps to ensure that in all operational states the radiation exposure to the workers and the public caused by a nuclear installation shall be kept as low as reasonably achievable and that no individual shall be exposed to radiation doses which exceed prescribed national dose limits.

15.1 Radiation protection regulation

Since the publication of Directives 96/29/Euratom and 97/43/Euratom, the legislative and regulatory provisions on radiation protection contained in the Public Health Code and the Labour Code, have been completely overhauled. The legislative part was updated in 2001 and the implementation decrees were published in 2002 and 2003.

The new legislative part of the Public Health Code (Chapter V.I "Ionising radiations") is practically be completed. The new provisions currently under preparation, concerning the creation of a radiation protection inspectorate are yet to be published. These provisions are included in the draft law related to transparency and safety in the nuclear field.

In terms of regulations, decree 2002-460 of 4 April 2002 concerning the protection of individuals against the dangers of ionising radiation, the decree 2003-270 of 24 March 2003 concerning protection during exposure for medical and medico-legal purposes, decree 2003-295 of 31 March 2003 related to intervention in radiological emergency situations or long lasting exposure and decree 2003-296 of 31 March 2003 related to the protection of workers against the hazards of ionising radiation, were successively published.

Decrees 2002-460, 2003-270 and 2003-295 are now codified in the chapter III "Ionising radiations" of the regulatory part (Articles R.1333-1 to R.1333-92) of the Public Health Code. Decree 2003-296 is codified in section VIII "Prevention of the risk of exposure to ionising radiation" of the Labour Code.

The effective implementation of part of these new regulatory provisions remains dependent on the publication of orders; several (9) were published in 2003, others will be published in 2004.

15.1.1 The legislative and regulatory framework for radiation protection

15.1.1.1 The Public Health Code

The new chapter V.I of the L section of the Public Health Code, entitled "Ionising radiation" covers all "nuclear activities", in other words, all activities involving a risk of human exposure to ionising radiation, coming from either an artificial source, whether a substance or a device, or from a natural source, when the natural radionuclides are or have been processed owing to their fissile or fertile radioactive properties. It also includes "interventions" aimed at preventing or mitigating a radiological hazard following an accident, due to environmental contamination.

The general principles of radiation protection (justification, optimisation, limitation), defined internationally (ICRP) and adopted in the directive 96/29/Euratom, are incorporated into the Public Health Code (art. L.1333-1). They guide regulatory activities which are the responsibility of the ASN.

1) The principle of justification – "A nuclear activity or an intervention can only be undertaken or carried out if its health, social, economic or scientific benefits so justify, given the risks inherent in human exposure to ionising radiation which it is likely to entail".

Depending on the type of activity, the responsibility for decisions concerning justification lies with different authorities: with the Government for issues of general interest such as the use of nuclear energy; with the DGSNR by delegation of the Minister in charge of Health in the case of sources used

for medical, industrial or research purposes; with the AFSSAPS (health products Agency) for authorisation to market a new irradiating device and with the doctors when prescribing or performing an action with a diagnostics or a therapeutic purpose.

The assessment of the expected benefit of a nuclear activity together with the associated detrimental health effect may lead to a ban on an activity for which the benefits would not seem to outweigh the risks. Either the ban is generic (for example: ban on intentional addition of radioactive substances in consumers goods), or the required radiation protection licence will be refused or will not be renewed. For existing activities, a reassessment of the justification may be initiated if current knowledge or technology so warrants.

2) The principle of optimisation – “Human exposure to ionising radiation as a result of nuclear activities must be kept as low as reasonably achievable, given current technology, economic and social factors and, as applicable, the medical purpose involved”.

This principle, known as the ALARA principle, leads for example to a reduction, in the release licences, of the amount of radionuclides present in the radioactive effluents released by nuclear installations, to stipulation of monitoring of the exposure at work so as to reduce to that strictly necessary, and to ensuring that medical exposure resulting from diagnostics acts remains close to previously accepted reference levels.

3) The principle of limitation – “The exposure of an individual to ionising radiation resulting from a nuclear activity cannot raise the total doses received above the limits set by the regulations, except when this person is exposed for medical or biomedical research purposes”.

The exposure induced by nuclear activities on the general population or workers is subject to strict limits. These include important safety margins in order to prevent any occurrence of deterministic effects; they are also much lower than the exposure for which probabilistic effects (cancer) have begun to be observed (100 to 200 mSv). Exceeding these limits is unacceptable and - in France - it may lead to administrative or criminal penalties.

In the case of medical exposure no strict exposure limit is set since this exposure has a voluntary aspect and is justified by the expected health benefits to the exposed person.

This new legislative basis incorporated into the Public Health Code enables the Council of State to issue decrees to lay down general rules concerning the conditions for prohibition, authorisation and declaration of use of ionising radiation (art. L.1333-2 and 4), as well as rules for the management of artificial or natural radionuclides (art. L.1333-6 to L.1333-9). These authorisations and declarations concern all applications of ionising radiation generated by radionuclides or by electrical X-ray generators, whether for medical, industrial or research purposes. Some may however benefit from exemptions.

Transposition of Directive 96/29/Euratom also requires new provisions for evaluating and reducing exposure to natural radiation, in particular radon, when human activities contribute to enhancing the level of this radiation (art. L.1333-10).

A general obligation to train the medical professions in patient radiation protection is introduced, under application of Directive 97/43/Euratom (art. L.1333-11).

Finally, these measures are accompanied by a new system of legal sanctions (art. L.1336-5 to L.1336-9).

15.1.1.2 The Labour Code

The new provisions of the Labour Code (art. L.230-7-1 and 2) introduce a legislative basis specific to the radiation protection of workers, whether or not salaried, for the transposition of Directives

90/641/Euratom and 96/29/Euratom. They bring French legislation into line with Directive 90/641/Euratom concerning non-salaried workers exposed to ionising radiation.

A link with the three radiation protection principles in the Public Health Code is established in the Labour Code, and the rules concerning worker protection were the subject of a specific decree (decree 2003-296).

15.1.2 Protection of the population against ionising radiation from nuclear activities

15.1.2.1 General protection of workers

The new articles R.231-71 to R.231-116 of the Labour Code, introduced by decree 2003-296 set a single radiation protection regime for all workers (whether or not salaried) likely to be exposed to ionising radiation in the course of their professional activity. Amongst these provisions, it should be mentioned:

- the application of the optimisation principle to the equipment, processes and work organisation, (art. R.231-75) which will lead to clarification of where responsibilities lie and how information is circulated between the head of the establishment, the employer, in particular when he or she is not the head of the establishment, and the person with competence for radiation protection;
- the effective dose limits (art. R.231-76), which, after a 2 years period (i.e. in April 2005), will be reduced to a maximum of 20 mSv for 12 consecutive months, barring waivers resulting from exceptional exposure levels justified in advance, or emergency occupational exposure levels;
- the effective dose limit for pregnant women (art. R.231-77) or more precisely for the child to be born (1 mSv for the period between declaration of pregnancy to birth);
- the limits of the various regulated areas (art. R.231-81), which will be reviewed in the light of the new dose limits (effective and equivalent). Thus, for the effective dose, the supervised area will cover potential worker exposure of more than 1 mSv per year, and the controlled area covering exposure likely to exceed 6 mSv per year;
- the duties of the person with competence for radiation protection, extended to the demarcation of areas working with radiation, to the assessment of exposed workplaces and to the steps aimed at reducing exposure (optimisation); to perform these duties this person will have access to data from passive and operational dosimetry (art. R-231-106);
- the provisions for the medical surveillance of exposed workers and the role of the company medical officer (art. R.231-98 to R.231-102).

15.1.2.2 Protection of the general population

Apart from the special radiation protection measures included in nuclear activity authorisations, and drafted for the benefit of the population as a whole and the workers, a number of general measures enshrined in the Public Health Code are more directly aimed at protecting the public against the hazards of ionising radiation:

- The intentional addition of natural or artificial radionuclides in all consumer goods and construction materials is prohibited (art. R.1333-2 of the Public Health Code). Waivers may however be granted by the Minister for Health after consulting the French High Public Health Council, except with respect to foodstuffs and materials placed in contact with them, cosmetic products, toys and personal ornaments. 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 effective annual dose limit (art. R.1333-8) received by a member of the public as a result of nuclear activities is set at 1 mSv; the equivalent dose limits for the lens of the eye and for the skin are respectively set at 15 mSv/year and 50 mSv/year (average value for any 1 cm² 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 the ministerial order of 1st September 2003.
- A national network for collection of environmental radioactivity measurements is set up (art. R.1333-11); the data collected shall contribute to estimating the doses received by the population. This network collates the results of the various environmental impact assessments required by the regulations, and those of analyses performed by the various government departments and public institutions, by local authorities and by associations who so request. These results will be made available to the public. Management of this monitoring network is entrusted to the IRSN, with its guidelines defined by the ASN (Order of 17 October 2003).

To obtain validated and comparable measurement results, the laboratories working in this network must meet the accreditation criteria defined by this ministerial order.

- The management of waste and effluents produced by basic nuclear installations (BNIs) and installations classified on environmental protection grounds (ICPEs) is subjected to the particular regulatory frameworks concerning these installations. For the management of waste and effluents produced by other nuclear activities, including those performed in hospitals (art. R.1333-12), general rules will be stipulated by interministerial order (not yet published). These waste and effluents must be disposed of in duly authorised facilities, unless there are special provisions for on-site organisation and monitoring of their radioactive decay (this concerns radionuclides with a half-life of less than 100 days).
- Although Directive 96/29/Euratom so allows, French regulations have not adopted the notion of clearance threshold, in other words the generic level of radioactivity below which the effluents and waste from a nuclear activity can be disposed of without supervision. In practice, waste and effluent disposal is monitored on a case by case basis when the activities which generate them are subject to licensing (as is the case of BNIs and ICPEs). Otherwise, these releases are the subject of technical specifications.

The regulations also do not include the notion of “trivial dose”, in other words the dose below which no radiation protection action is felt to be necessary. This notion appears in Directive 96/29/Euratom (10 microsieverts/year).

15.1.3 The case of Basic nuclear installations

BNIs are included in the « nuclear practices », as defined in the Public Health Code, but they are specifically regulated and supervised owing to the risk of severe exposure to ionising radiation.

A BNI operator has to implement all the necessary provisions to ensure the protection of workers against the hazards of ionising radiation, and in particular to comply with the same general rules applicable to all the workers exposed to ionising radiation (annual dose limits, worker exposure categories, definition of supervised and controlled areas, etc.), as well as technical or administrative provisions specific to BNIs (work organisation, accident prevention, keeping registers, service company workers, etc.). It has also to implement the necessary provisions to maintain an optimum protection level for the population and in particular to check the effectiveness of the technical devices intended.

15.1.4 Release licences

The normal operation of basic nuclear installations produces liquid and gaseous effluents, both radioactive and non-radioactive. The impact of these releases on the environment and on the health has to be strictly limited.

The installations must therefore be designed, operated and maintained in such a way that the corresponding releases are kept as low as reasonably achievable. These releases cannot exceed the limits set on a case by case basis by the Public Authorities according to the best available technology at an economically acceptable cost and to the particular characteristics of the site. Finally these releases shall be permanently measured and their real impact be regularly assessed, in particular for radioactive releases which make nuclear installations different.

As mentioned in § 7.2.2.1, effluent release and water intake authorisation orders are being renewed in application of decree 95-540 of 4 May 1995. For this purpose, the ASN has initiated a systematic approach involving all nuclear operators to revise licences relating to all water intake and effluent releases, including the release of conventional chemical substances. In accordance with this approach, the effluent release and water intake licences for Saint-Laurent-des-Eaux, Flamanville, Paluel, Belleville, Saint-Alban, Chinon, Blayais, Cruas, Gravelines and Cattenom nuclear power plants were renewed. The ASN's aim is to achieve a reduction in most of the existing release limits in the coming years.

These renewals enable the ASN to group into a single document all the requirements previously specified by various different ministerial or prefectural orders, depending on the type of release concerned. These requirements in particular specify the amount, concentration and provisions for monitoring of the pollutants likely to be present in the releases and in the environment. In this context, the ASN has decided to modify the specified requirements regulating release according to the following principles:

- the new requirements of the order of 26 November 1999, notably as regards establishing radioactive release limits in terms of emission rate (expressed in becquerels per second), at each release point, are included in the release licences;
- with regard to radioactive releases, the actual releases from nuclear power plants have been constantly falling and are far below the initial limits, so the ASN intends to reduce these limits so as to take advantage of technical progress. It has stipulated new limit values, for each 900 MWe and 1300 MWe plant series, based on operating feedback concerning actual releases, whilst taking account of reactor operating contingencies. The release limits have thus been divided by a factor ranging from 2 to nearly 40, depending upon the parameter considered. Moreover, individual limits are now set for the iodine isotopes and for carbon 14;
- with regard to chemical substances, the ASN has decided to improve regulation of their release, with a view to correcting the shortcomings in the original requirements.

In particular, release licences set authorised limits, release conditions and practical details of the environment surveillance programme. With regard to public health, the decisive limit is the maximum activity concentration added to the environment due to a power plant whatever its power or the number of reactors. This limit, in terms of calculated added activity, was conventionally regulated in the release licences. The new licences make it possible to introduce a limit for the total activity concentration measured in the receiving environment, which is easier to monitor. Assuming this concentration to be maintained at the limit throughout the year, the added activity in the environment will lead to a total dose far below the acceptable dose limits.

Every month, the operator provides the ASN with its results concerning releases. These data are regularly reviewed and compared with reactor operations during the corresponding period. Any anomaly detected lead to the operator being asked for additional information.

15.2 Measures taken by EDF in the field of radiation protection

15.2.1 Radiation protection of workers

Any action taken to reduce the doses received by personnel has to begin with thorough knowledge of collective and individual doses. The doses received by workers can result from internal contamination or external exposure to radiation. EDF's "clean plants" policy and the systematic use of respiratory protective measures in the event of a suspected risk of internal contamination, mean that cases are rare and not serious. Since most of the doses received can be attributed to external irradiation, this is what EDF is endeavouring to reduce.

To better optimise and reduce the doses of exposed individuals, EDF launched an ALARA 1 policy in 1992. This led to considerable reductions, since the collective dose fell from 2.4 man.Sv/year per unit in 1992 to 1.08 in 2000, and just 0.89 in 2003. Special measures have also been taken to limit the highest individual doses. The aim is to reach a situation whereby no worker is exposed to a dose greater than 20 mSv per year from 2000 onwards, barring exceptional circumstances.

To reach the objective of 0.80 man.Sv/year in 2005, EDF has launched a new ALARA approach implementing the optimisation principle as a whole. This approach forms part of a wider initiative to develop radiation protection management, which places great importance on clear requirements, rigorous application and reinforced internal checks.

The approach is based on three avenues of progress.

- Reducing contamination in systems

Contamination in systems is one part of exposure which, when controlled, should help to bring down dose levels during operation and above all during outages. To this end, various actions are being studied or have already been undertaken. These are aimed at optimising operating factors and shutdown procedures for refuelling, notably by modifying chemical conditions or optimising primary water purification (treatment by filters and resins).

- Planning work by optimising doses

The process is as follows:

- an estimate is made of the forecast dose for operations in controlled areas, both collective and individual;
- the operations are classified according to the dose risk (very low, low, considerable or high);
- an optimisation analysis is made of these operations - the degree of detail varies according to the dose risk;
- collective and individual dose objectives are set for each operation once the optimisation analysis has been completed;
- collective and individual exposure during these operations is monitored in real time and any discrepancies are analysed and dealt with;
- operating feedback is amassed and the deviations and best practices are analysed so that they can be applied to future operations.

Activity planning must include assessment of individual and collective doses, since the depth of analysis depends on the associated dose risk. The optimisation stage involves reducing doses that were assessed previously.

When operations have a considerable or high dose risk, activity planning should include an analysis of the work by a two-man team comprising a radiation protection specialist and someone responsible for design. For the highest dose risks, the operation is studied stage-by-stage and job-

by-job to determine which protection devices, tools and working methods are the most suitable. Individual and collective dose objectives are set after optimisation.

The individual and collective dose targets are indicators that enable workers to detect any discrepancies in exposure levels.

Optimisation is a process of constant improvement, since analysis after the work has been completed should make it possible to optimise future operations even further.

The operational dosimetry set in place by EDF in the early eighties, digitised in the 90s and written into law for all work in controlled areas by the decree of 24 December 1998, which amended decree 75-306 of 28 April 1975, and integrated in article R.231-94 of the Labour Code by the decree 2003-296 of 31 March 2003, makes it possible to monitor worker dosimetry in real time during an activity in a controlled area, and to display any discrepancies in relation to the objectives set.

- **Using and circulating operating feedback**

The second ten-yearly outages of the 900 MWe plants offer an opportunity to make a substantial number of modifications to reactors in terms of safety, availability and so forth. Operations with a high exposure risk are put under the microscope to see what can be learned from them, and to ensure that any lessons learned from previous modifications to reactors are passed on to the entire series. Optimisation is an iterative process and analysis of the operations after they have been completed should make it possible to optimise future operations even further. Where options are taken up for the purpose of lowering doses, due allowance is made for the economic and social aspects which are also defined as part of the optimisation process.

To reduce the doses received by workers, EDF was ahead of its time in lowering the annual limit to 20 mSv as far back as 2000. Furthermore, alarm thresholds have been implemented when managing operating doses common to all EDF nuclear sites. The thresholds have been fixed at 16 and 18 mSv. If these values are reached, special consultation procedures are introduced, bringing together workers, medical experts and radiation protection specialists. These procedures lead to an assessment and fine optimisation of subsequent doses. Monitoring is also intensified to ensure that regulatory limits are not exceeded.

15.2.2 Radiation protection of the public

EDF has committed itself to an environmental management approach that meets the international ISO 14001 standard. It is a proactive approach with objectives aimed at continuous improvement, preventing pollution and controlling its effects and comprising a commitment to complying with the regulations. The new environmental regulations for Basic nuclear installations, which will become applicable in a very short time, will involve a lengthy and complex implementation period. These two approaches, one regulatory and the other proactive, complement each other and are, in many respects, very similar.

The aim is to obtain certification of the nineteen nuclear power plants in operation by the end of 2004. The approach has been decentralised: each plant runs its own certification project, with corporate departments providing support services in the form of resources that can be shared. They also take charge of monitoring and reporting.

15.2.2.1 Releases of effluents

The regulations on the release of radioactive effluents comprise:

- general laws (decree of 4 May 1995 relating to the BNI liquid and gaseous effluent release and water intakes, the order of 26 November 1999 describing the general technical requirements for BNI

releases and water intakes, the order of 31 December 1999 laying down the general technical rules for preventing and reducing the nuisances and external risks resulting from operation of BNIs, etc.);

- orders that are specific to each sites.

The general regulations lay down:

- the procedures for obtaining release licences;
- the conditions for release and associated standards;
- the role and responsibilities of the plant managers.

The orders specific to each plant lay down:

- the limits that should not be exceeded (annual authorised limits, maximum added concentrations in receiving environment);
- the release conditions;
- the terms and conditions of the environmental monitoring programme.

These concentration limits are associated with annual total activity limits that are set not for public health reasons but to improve management. For a given type of reactor, the limits depend on the installed power. It goes without saying that they comply with the health criteria, with an acceptable margin, even in the case of large plants.

This regulatory framework also means that an optimisation principle has to be implemented, aimed at reducing the effect of radioactive releases to a level that is "as low as reasonably achievable in the light of economic and social aspects". This approach is adopted at the design stage (with the installation of effluent treatment systems, etc.) and in practical terms, leads to a stringent effluent management system.

These measures have made it possible to reduce dramatically the amount of liquid effluents (with the exception of tritium). In the past, these effluents had the most serious impact on the environment and health (dose).

The considerable reduction in the amount of liquid releases, with the exception of tritium, observed over the last few years means that nowadays, tritium and carbon 14 are the two main contributors when it comes to dose-related impact.

Nonetheless, the dose-related impact of radioactive releases remains extremely low at less than around 1 $\mu\text{Sv}/\text{year}$, according to the EDF assessment. This is well below the natural exposure level in France (2,400 $\mu\text{Sv}/\text{year}$) and the limit set for the public (1,000 $\mu\text{Sv}/\text{year}$). It is also less than the "negligible" level set at 10 to 30 $\mu\text{Sv}/\text{year}$ by international bodies such as the International Commission on Radiological Protection (ICRP) and the International Atomic Energy Agency (IAEA). This level is defined as being a level below which the risk, if indeed there is one, can be considered as negligible.

15.2.2.2 Monitoring the environment

The environment is monitored in two ways, continuously and by measuring the radioactive and non-radioactive releases made into it. The environment begins at the boundary of the controlled area. This issue therefore covers monitoring of the site road systems and monitoring of the radioactivity outside the site boundary.

Environmental monitoring is a regulated activity whose quality is monitored.

Environmental monitoring by the nuclear operator has three technical functions:

- an alert function;
- a checking function;

- a tracking and study function.

The alert function makes it possible to report any environmental problems in a short space of time. It is associated with variations in measurements, which may be directly related to power plant operation.

For EDF, the alert function is associated with monitoring at the emission point and continuous recording of the ambient gamma radiation around the plant, automatic chemical monitoring of the receiving environment for riverside plants and radioactivity monitoring portals at the site entrance and exit.

The checking function ensures that the regulations are complied with. Parameters are compared with criteria. The checking function corresponds to checks laid down in the release licences and to checks for radioactivity on roadways.

The scientific tracking and study function means observing and predicting changes. It tracks a parameter that changes very gradually and which is usually associated with an integrating phenomenon. The tracking function includes radio-ecological studies (ten-yearly and yearly reviews, special studies, helicopter monitoring, etc.) and hydro-ecological campaigns.

These functions are also associated with a communication function, aimed at both the authorities and the public.

The responsibility for keeping regulatory registers (effluents and the environment) is entrusted to a single department that is directly answerable to the plant manager and acts independently of the departments charged with requesting and carrying out releases.

A special effort has been made at EDF to standardise radioactivity measurements in the environment and to compare the results of the plant laboratories under the aegis of the Henri Becquerel National Laboratory, which is the French standards laboratory. This initiative should be pursued at an international level.

Every year, radioecological monitoring is carried out at all nuclear power plants in operation. This is part of a monitoring programme devised under an agreement with the Institute for Radiation Protection and Nuclear Safety (IRSN). Monitoring has been carried out in all the plants since 1992 and gives an overall view, in time and space, of the impact of the facilities.

Furthermore, a ten-yearly review is made, comparable to the baseline established when the first unit of a plant is commissioned. All the sites have now completed their first ten-yearly reviews and seven of the nineteen plants have completed their second reviews (Fessenheim in 1998, Bugey in 1999, Golfech in 2000, Tricastin and Dampierre in 2001, Blayais and Gravelines in 2002). It must finally be mentioned that two sites initiated their second reviews in 2003 (Chinon and Saint-Laurent), and two others are scheduled for 2004 (Cruas and Saint-Alban).

The analyses of the results of radiological monitoring confirm that the releases into the atmosphere do not have an impact on the terrestrial environment.

In the aquatic environment, radioelements from nuclear power plants liquid releases are detected as traces in sediments and aquatic plants just downstream of the release point.

15.3 Measure taken in the field of radiation protection for research reactors

15.3.1 Radiological monitoring at the CEA

Radiological monitoring of personnel is done on each site by specialised teams responsible for assigning and checking the dosimetric film of each CEA employee. All recorded values are sent to the IRSN. Each employee who works in the controlled area is also provided with an individual DOSICARD type dosimeter used for continuous monitoring of doses received.

Subcontractors are monitored by approved organisations including the IRSN, that issues dosimetric films to them and make measurements on the films. Monitoring is complemented by individual DOSICARD type dosimeters, submitted and analysed by competent CEA teams on the site.

Liquid and gas radioactive effluent releases are covered by:

- national regulations applicable to nuclear installations that define general requirements about effluents, methods for authorisation or declaration procedures, the responsibilities of the various authorities and general rules for studying and monitoring of the impact of these releases on the environment,
- a specific regulation for each site, fixing annual allowable limits for releases and methods of monitoring the environment.

The environment monitoring program is produced and performed on each site by radiation protection units and followed by the ASN.

Releases have been well below allowable values in recent years, and are no more than a few percent of these values.

15.3.1.1 Case of the Phenix reactor

For all installations in the power station, gas releases (essentially rare gases) do not exceed one percent of allowable releases during normal operation. The dosimetric impact is consequently very low and is far below 0.1 microSv/year.

A fast neutron reactor does not produce any liquid effluents during normal operation; it only produces liquid effluents during washing of irradiated assemblies or exceptional operations for decontamination of components in the primary system.

The radiation protection Department working in the Phenix installation to monitor the installation and personnel includes 15 persons, 10 of whom work in shifts to guarantee a continuous service.

Radiation protection management includes the following, respecting applicable rules:

- a clear zoning known to everyone,
- continuous management of radioactive materials, including nuclear materials,
- precise and clear writing of procedures in force,
- application of the ALARA principle, particularly during modification work.

The efficiency of the existing system and the continuous efforts to reduce doses have been justified by the history of doses received by Phenix personnel and by personnel working for outside companies during the last 20 years: no-one has been exposed to an annual dose of more than 20 mSv and the total dosimetry (personnel + service companies) during this period is 1.6 man.Sv, which is an annual total average dose of less than 0.080 man.Sv/year. The total annual dosimetry (personnel + service companies) in 1999 and 2000, during which a significant amount of work was carried out, remained less than 0.120 man.Sv/year.

The total dose can vary from one year to another depending on the operations carried out. The total dosimetry outside important work periods is much lower (for example about 0.030 man.Sv/year in 2002 and 2003). The very low collective doses received during reactor structure inspection operations also demonstrates the good practices implemented in the power plant.

15.3.1.2 Other CEA reactors

Gas releases and liquid releases remain very low at all CEA research reactors, and are only a few percent of allowable releases.

In order to monitor the installation and personnel, the radiation protection Department has a team in each installation comprising an adequate number of persons, and providing on-duty staff at all times outside normal working hours.

As with the Phenix power reactor, management of radiation protection includes:

- a clear zoning known to everyone,
- continuous management of radioactive materials, including nuclear materials,
- precise and clear writing of procedures in force,
- application of the ALARA principle, particularly during modification work.

The efficiency of the existing system is clearly demonstrated by the history of doses received by installation personnel and by personnel working for outside companies during recent years: no-one has received an annual dose of more than 5 mSv, with the average effective individual dose not exceeding 1.3 mSv, and the total annual dosimetry (personnel + service companies) remained less than 0.060 man.Sv/year for the 500 persons wearing a dosimeter.

15.3.2 Radiological monitoring at the RHF

The Radiation Protection unit that monitors the ILL and its personnel is composed of 9 persons. On-duty staff are present on the ILL site at all times outside working hours.

Management of radiation protection includes:

- clear and exhaustive zoning of all BNI buildings,
- continuous management of radioactive materials, including nuclear materials,
- precise and clear writing of procedures in force,
- application of the ALARA principle, particularly during modification work. In particular, the operational dosimetry is provided by DMC 2000S units, for which real time reading by terminals judiciously placed throughout the installation guarantees good monitoring of all exposed workers.

The effectiveness of the complete radiation protection system in place is demonstrated by the history of doses received by BNI personnel, guest research workers and personnel working for outside contractors in recent years: in 2002, no-one received an annual dose of more than 5 mSv, with the average effective individual dose not exceeding 0.26 mSv for category A personnel, and the total annual dosimetry (personnel + research workers + service companies) remained less than 0.12 man.Sv/year for the 300 persons wearing a dosimeter all along the year.

Gas releases are of the order of 10 to 50% of the allowed values of tritium, and not more than a few % for other radioelement categories.

Liquid releases are of the order of 10% of allowed values, both for tritium and for other radioelement categories.

15.4 Regulatory surveillance in the radiation protection field

Monitoring activities can be schematically broken down into monitoring the general environment and monitoring the environment in the vicinity of industrial nuclear sites, including nuclear power plants. Details in the environment monitoring and effluent releases are provided in appendix 4.

15.4.1 Monitoring the general environment

Monitoring the general environment is carried out by provisions implemented by the Public Authorities, and comprises the following equipment:

- seven stations, known as reference stations, located in the countryside far from any nuclear activity, produce systematic samples that are analysed in the laboratory: aerosols, rainwater, ambient gamma radiation, soil, plants, cow's milk, bones (rabbits),
- sixty nine stations spread around the country mainly monitor the atmosphere of city centres: aerosols, rainwater, ambient gamma radiation,
- a monitoring network for continental water (river, groundwater and sea) measures its radioactivity. In addition the Hydroteleray network continuously monitors the five rivers on which nuclear power plants are located. This network is being supplemented by a simplified set of Telehydro stations,
- the food chain is monitored every month in school canteens and one staff canteen together with various products such as honey, fish, rabbit, bovine thyroid, cereals, milk from cows raised on farms or co-operatives,
- the radioactivity of land and aquatic flora and marine sediments is monitored regularly,
- 156 Teleray stations continuously measure the ambient gamma dose rate over the country. Likewise, general national monitoring is carried out by means of some 2,300 integrating dosimeters measuring the local terrestrial and cosmic doses every six months.

15.4.2 Monitoring the environment of nuclear reactors

As a counterpoint to the self-monitoring carried out by the operators, the ASN checks that release conditions are properly complied with by EDF and the CEA, that the corresponding radioactivity measurement installations are operating, that analyses are actually performed and finally that authorisation orders are complied with.

Every month, the ASN checks the registers submitted by the plant managers and analyses their consistency.

It performs technical checks or inspections to verify the conditions in which measurement and monitoring installations are used, their good condition, their operating conditions and the local radiation protection organisation.

Independently of the operators, the IRSN performs its own environmental monitoring in and around power plants by measuring the ambient gamma dose rate, analysing air at ground level, rain water, plants, soil, farm production, milk, environments receiving liquid releases and groundwater.

With regard to releases, the IRSN performs weekly analysis of the aerosol and halogen (iodine) filters for gaseous releases and, for liquid releases monthly analysis of samples: total alpha, total beta, carbon 14, tritium, gamma spectrometry, etc.

The ASN compares the measurements made by the operators with those of the IRSN.

15.5 Summary of regulatory monitoring and checks

15.5.1 Exposed workers

EDF and the CEA are allowed to carry out regulatory dosimetric monitoring of their own staff. As regards contractor staff, monitoring is carried out by the IRSN and the Central office for electrical industries (LCIE). The results of EDF's dosimetry films and those of the laboratories in charge of contractor monitoring are sent to the IRSN every month for recording.

The monitoring system for the exposure of people working in installations in which ionising radiation is used has been in place for several decades. Based on the mandatory wearing of dosimetric film for workers likely to be exposed, it is used to check compliance with the regulatory limits applicable to workers. The recorded data indicate the cumulative exposure over a given period (monthly or quarterly) and are compiled in the SISERI system managed by the IRSN and are the subject of an annual

publication. The SISERI system will eventually also allow collection of "operational dosimetry", that is real time measurement of exposure doses.

The dosimetric follow-up review for the year 2002, for the personnel working in BNIs associated to reactors, is presented in the following table:

| Company | Number of persons monitored | Total doses (Man.Sievert) | Doses > 20 mSv |
|-------------------|-----------------------------|---------------------------|----------------|
| EDF | 20 071 | 11.25 | - |
| CEA | 7 399 | 1.64 | - |
| Other contractors | 38 348 | 23.10 | 5 |

15.5.2 Monitoring population and environment exposure

The automatic monitoring networks managed nationwide by the IRSN (Teleray, Hydroteleray and Telehydro) offer real-time monitoring of environmental radioactivity and can highlight any abnormal variation. In the case of an accident or incident leading to the release of radioactive substances, these measurement networks would play an essential role by providing data to back the decisions to be made by the authorities and by notifying the population. In a normal situation, they take part in evaluating the impact of basic nuclear installations.

On the other hand, for methodological reasons, there is no overall monitoring system able to provide an exhaustive picture of the exposure to which the population is subjected as a result of nuclear activities. Consequently, it is impossible directly to check compliance with the exposure limit for the population. However, for basic nuclear installations, radioactive effluent releases are precisely accounted for and radiological monitoring of the environment surrounding the installations is in place. On the basis of the data collected, the dosimetric impact of these releases on the populations living in the immediate vicinity of the installations is then calculated, using models for simulating transfers to the environment. The impacts vary, according to the type of installation and the living habits of the reference groups chosen, from a few microsieverts to several tens of microsieverts per year. These estimates are unknown for nuclear activities other than basic nuclear installations.

15.5.3 Monitoring releases

The result of environment monitoring around BNIs are given for each plant in Appendix 4. It should be noted that, except for tritium, releases represent only a few percent of the authorisation limit, although tritium release are still below the authorisation limits. When they are renewed, the current authorisation levels are being reduced accordingly and to encourage the operators to make use of the best available techniques to reduce releases.

In addition, as mentioned in chapter 7, compliance with release licences is subject to inspection, which may include taking of samples.

16. Article 16 : Emergency preparedness

1. Each Contracting Party shall take the appropriate steps to ensure that there are on-site and off-site emergency plans that are routinely tested for nuclear installations and cover the activities to be carried out in the event of an emergency.

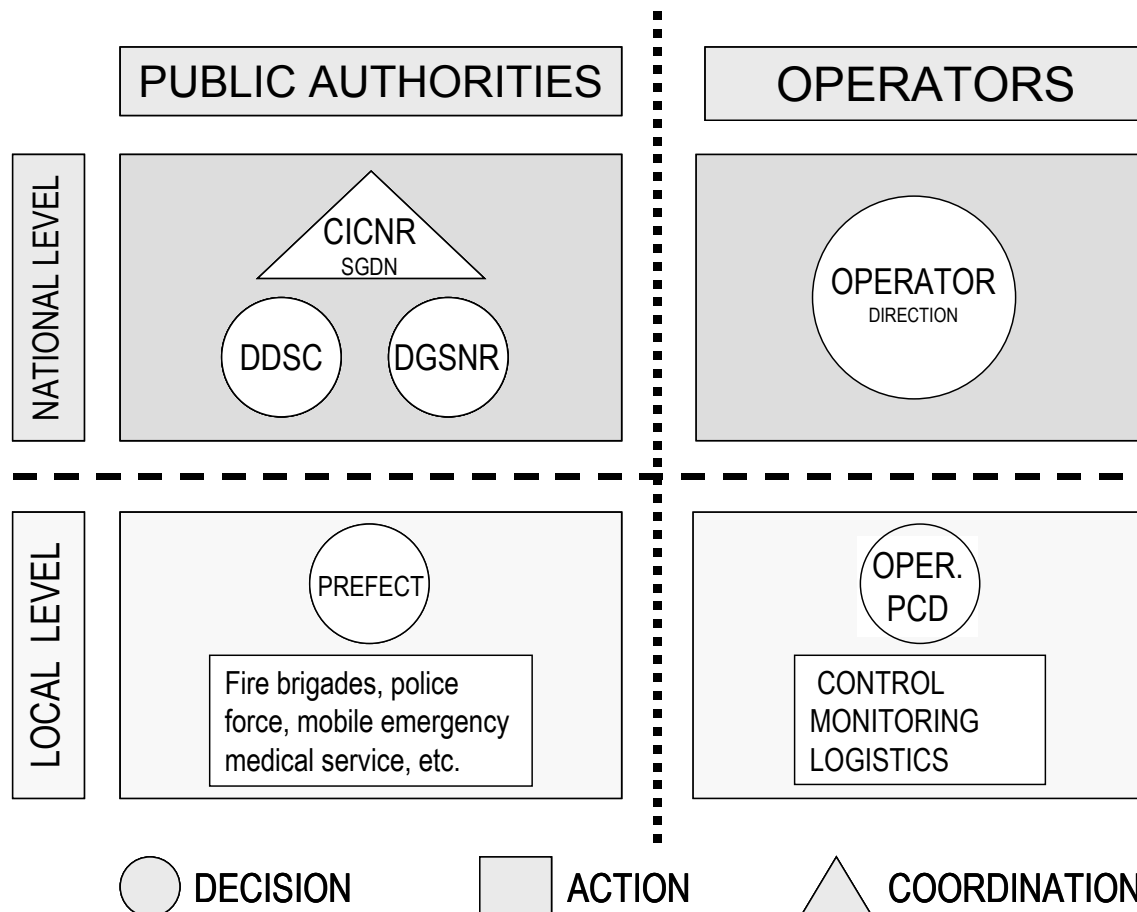
For any new nuclear installation, such plans shall be prepared and tested before it commences operation above a low power level agreed by the regulatory body.

2. Each Contracting Party shall take the appropriate steps to ensure that, insofar as they are likely to be affected by a radiological emergency, its own population and the competent authorities of the States in the vicinity of the nuclear installation are provided with appropriate information for emergency planning and response.

3. Contracting Parties which do not have a nuclear installation on their territory, insofar as they are likely to be affected in the event of a radiological emergency at a nuclear installation in the vicinity, shall take the appropriate steps for the preparation and testing of emergency plans for their territory that cover the activities to be carried out in the event of such an emergency.

16.1 General emergency response provisions

The organisational provisions of the Public Authorities in the event of a nuclear incident or accident are set out in directives from the Prime Minister concerning nuclear safety, radiation protection, public order and civil defence, and also in the emergency plans provided for in decree 88-622 of 6 May 1988. The organisational provisions of both the Public Authorities and the operators are summarised in the diagram below for the case of an accident in an EDF reactor. Similar provisions are made in the case of other nuclear operators.



It should be mentioned that decree 2003-865 of 8 September 2003, instituting the Interministerial Committee for nuclear or radiological emergencies (CICNR) reorganised the interministerial coordination for accidental situations. This decree cancels the former interministerial Committee for Nuclear Security (CISN) and entrusts the General Secretary for National Defence (SGDN) with the secretariat of the CICNR.

As regards informing neighbouring countries in the event of a radiological emergency, this is the subject of the Convention on Early Notification of a Nuclear Accident adopted on 26 September 1986 ratified by France in 1989. In addition, bilateral Conventions have been signed with the Authorities of border countries.

Exercises are periodically organised as training for emergency teams and to test resources and organisational structures with a view to identifying possible weak points.

16.1.1 Local provisions

In an emergency situation, only two officials are responsible for taking the operational decisions:

- the operator of the affected nuclear installation, who must implement the organisational provisions and the means provided to bring the accident under control, to assess and mitigate its consequences, to protect site staff and alert and regularly inform the Public Authorities. These measures are described fully in the on-site emergency plan (PUI), which the operator has the duty to prepare,
- the Prefect of the department where the installation is located, who is responsible for decisions as to the measures required to ensure the protection of both population and property at risk owing to the accident. He acts within the framework of an off-site emergency plan (PPI), which he has specially prepared for the vicinity of the installation considered. He is thus responsible for coordination of the PPI resources, both public and private, equipment and manpower. He keeps the population and the local representatives informed of events.

16.1.2 National provisions

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 severity of the incident or accident, and possible developments.

The main bodies concerned are as follows:

- Ministry for the Interior: the Directorate for Civil Security and Defence (DDSC) which has the support of the Interministerial emergency management operational centre (COGIC) and the Nuclear Risk Management Support Team (MARN), to provide the Prefect with the human and material reinforcements needed to protect persons and property;
- Ministry for Health: the DGSNR which has the role of health protection of persons against the effects of ionising radiation,
- Ministry for Industry and Ministry for the Environment: the DGSNR for the supervision of the safety of nuclear facilities, with the technical support of the IRSN. The Minister for Industry also co-ordinates communication at a national level in the event of an incident or accident affecting a nuclear facility under his supervision, or occurring during transport of nuclear materials; the DGSNR, as the competent authority, ensures the collection and the synthesis of information with a view to ensuring the notifications and information required by the international conventions dealing with third country information in the event of a radiological emergency situation,

- The General Secretary for National Defence (SGDN), ensuring the secretariat of the CICNR is in charge of ensuring the consistency between ministries of the measures planned in the event of an accident and to look after the scheduling of exercises and of their assessment.

16.1.3 The emergency response plans

16.1.3.1 The general principle

Application of the defence-in-depth principle implies including the occurrence of very low probability severe accidents in the basic data used to define the emergency plans, in order to determine the countermeasures to be implemented to protect plant staff and populations and bring the affected plant to a safe configuration.

The On-site Emergency Plan (PUI), drawn up by the operator, is aimed at restoring the plant to a safe condition and mitigating accident consequences. It defines the organisational provisions and the resources to be implemented on the site. It also comprises provisions whereby the authorities can be rapidly informed. PUI activation is decided by the operator based upon predetermined criteria, related to the status of the installation or its environment, or at its own initiative when it feels the situation so warrants.

The Off-site Emergency Plan (PPI), drawn up by the Prefect, is aimed at providing populations with short-term protection against any threat and providing the operator with outside assistance. It defines the tasks assigned to the various services concerned, warning system utilisation instructions and material and human resources. The PPI is activated if measures to protect the population appear necessary (sheltering, administration of stable iodine tablets, evacuation, etc.).

16.1.3.2 Technical basis and countermeasures of emergency plans

The emergency plans must be able to respond effectively to accidents liable to occur at BNIs. This implies the definition of a technical basis, i.e. the adoption of one or more accident scenarios bounding the possible consequences, with a view to determining the nature and extent of the remedial means which would have to be provided. The task is difficult, since the cases of real significant accidents are extremely rare, with the result being that a conservative theoretical approach is usually adopted to estimate the source-terms (i.e. the quantities of radioactive materials released) and calculate dispersion in the environment with a view to assessing the radiological impact.

It is then possible to define PPI countermeasures, based on action criteria defined by the Ministry for Health, i.e. population protection measures which appear justified to limit direct impact of the estimated release. Such measures could include:

- sheltering aimed at protecting inhabitants from direct exposure to the radioactive plume and diminishing the inhalation of radioactive substances,
- absorption of stable iodine in addition to sheltering in cases where the release comprises radioactive iodine (notably I-131),
- evacuation in situations where the above measures would be insufficient owing to the extent of the release.

To give an example, the maximum credible PWR accident could result in a decision, to be taken within 12 to 24 hours, to shelter populations and organise absorption of stable iodine in a radius of 10 kilometres and evacuate populations in a maximum radius of 5 kilometres.

Attention is also drawn to the fact that the Off-site Emergency Plans are only concerned with emergency measures and not intended to foresee longer-term measures with wider scopes, such as restrictions on the consumption of certain foodstuffs or the reclaiming of contaminated zones.

16.2 The role and organisation of the ASN

16.2.1 ASN assignments in an emergency context

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 circulation of information,
- 4) to be the competent authority within the framework of international conventions.

16.2.1.1 Monitoring of the actions taken by the operator

As in a normal situation, it is up to the ASN to supervise the operator of a facility where an accident has occurred. 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.

16.2.1.2 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 DGSNR to inform the Prefect of its view 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 releases). This advice deals also with measures to be implemented for the health protection of the public.

16.2.1.3 Circulation of information

The DGSNR intervenes in information circulation in several ways:

- information of the media and the public: the DGSNR helps to inform the media and the public in a variety of ways (press releases, website, press conference); it is important for this to be done in close coordination with the other communicating entities (Prefect, local and national operator),
- information of the authorities: the DGSNR informs its supervisory Ministers and the SGDN, responsible for informing the President of the Republic and the Prime Minister. The DGSNR also informs the Directorate General for Energy and Raw Materials (DGEMP) at the Ministry for industry,
- information of foreign safety authorities: without prejudice to application of international conventions signed by France for the exchange of information in the event of an incident or accident likely to have radiological consequences, the DGSNR informs foreign safety organisations, in particular those with which mutual safety information agreements exist.

16.2.1.4 The function of competent authority under the international conventions

Since the publication of decree 2003-865 of 8 September 2003, the DGSNR is entrusted with the mission of being the competent authority under the international conventions (Convention on the early notification of a nuclear accident, to which France subscribed on 26 September 1986, and decision of the Council of European Communities of 14 December 1987, concerning the community provisions for

rapid exchange of information in the event of a radiological emergency). In that capacity it collects and synthesises the information with a view to ensuring the notifications and information provided for by the international conventions dealing with third-party country information in the event of a radiological emergency situation. This information is forwarded to international organisations (IAEA and European Union).

16.2.2 Provisions ensuring nuclear safety

16.2.2.1 Main components

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 (DSNRs) of the DRIREs, activates the following organisation:

At the national level :

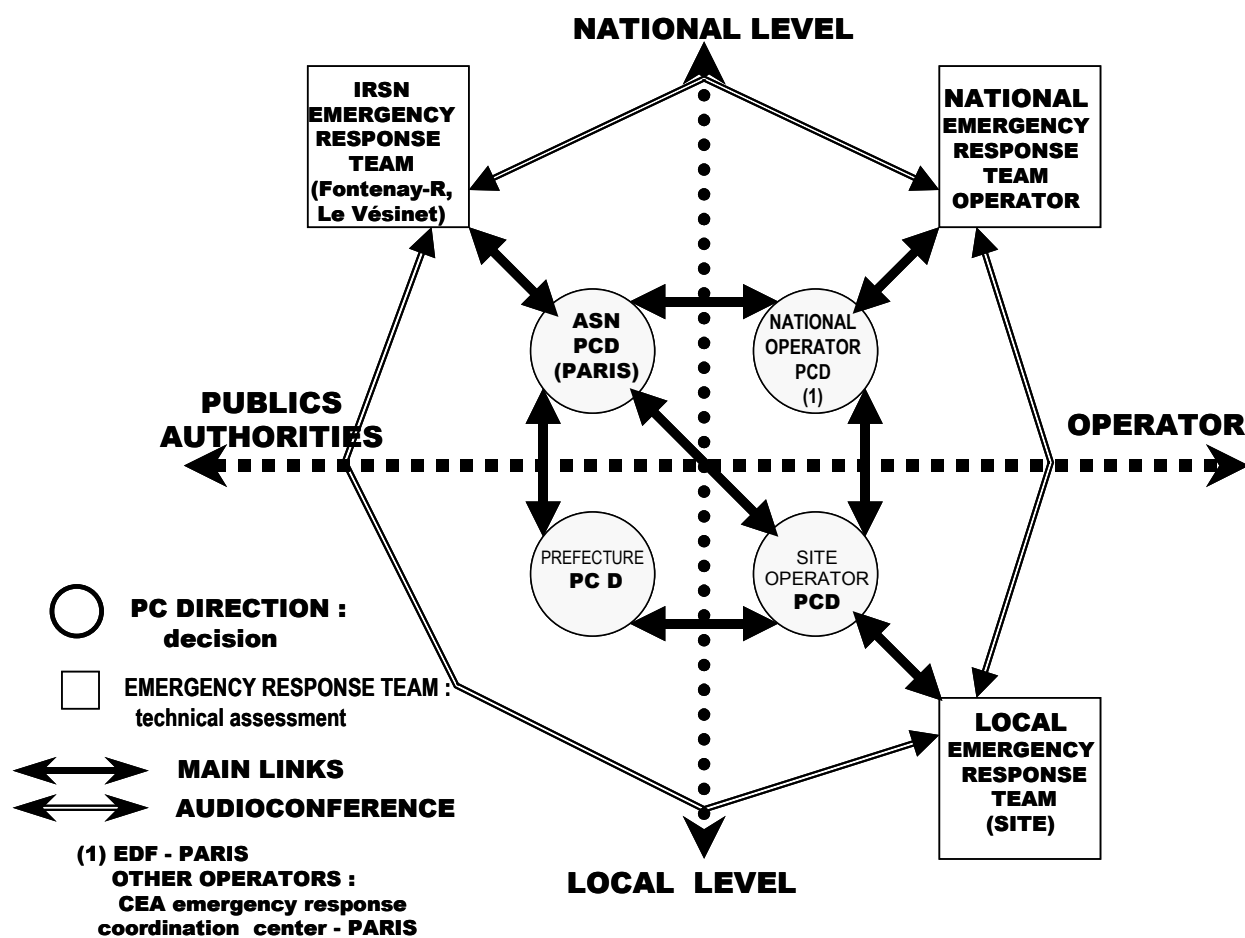
- a decision-making or management command post (called PCD DGSNR), located in the DGSNR's nuclear emergency response centre in Paris. This post is managed by the director general of the DGSNR or his representative. Its purpose is to adopt positions and take decisions, but to refrain from a technical analysis of the accident in progress. A spokesperson from the DGSNR, who is not the PCD manager, will be appointed to represent the DGSNR with the media;
- an information unit located close to the PCD of the DGSNR, chaired by a representative from the DGSNR assisted by staff from the directorate for communication (DIRCOM) from the ministry for finances, economy and industry,
- an analysis team headed 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 research centre. One or more engineers can be delegated to it by the DGSNR. This team must work in close collaboration with the operator's technical teams, in order to reach common views on an analysis of the accident situation and anticipate how it will develop and what its consequences are likely to be.

At the local level :

- a local team at the prefecture, primarily comprising representatives from the decentralised divisions of the DGSNR, 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 team at the affected plant site, also consisting of DSNR representatives along with those of the DGSNR and IRSN if necessary, assisting the site PCD head. The role of this team 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.

The DGSNR and its technical support organisation the IRSN have signed protocols with the main nuclear operators concerning the setting up of the emergency response organisation. These protocols 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 post (PC) on the site, and a national management command post 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 PCD spokespersons to ensure that the information sent out to the public and the media is consistent.

16.2.2.2 The DGSNR emergency response centre

To ensure the success of its actions, the DGSNR has its own emergency response centre, the two main functions of which are:

- to alert ASN staff rapidly;
- to exchange information in reliable conditions with its numerous partners concerned.

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 violent storm of 27 December 1999. It was again activated on 2 and 3 December 2003 during the extreme bad weather in the Rhone valley, which led the Cruas NPP to trigger its on-site emergency plan and to alert the ASN. During the course of these two days, the Tricastin NPP and the Tricastin operational hot unit (BCOT) also triggered their on-site emergency plan.

Alert system

The ASN emergency response centre is equipped with an alert system ensuring swift mobilisation of the DGSNR and DRIRE/DSNR teams concerned and the IRSN on-call engineer. This automatic radio or telephone messaging system sends an alert signal to all personnel equipped with dedicated pagers or mobile phones, as soon as it is remotely triggered by the operator of the affected nuclear plant. This alert system also contacts staff at the Directorate for Civil Security and Defence (DDSC), the General Secretariat for National Defence (SGDN) and Meteo-France (French weather service).

Telecommunication networks

The emergency response centre is equipped, in addition to the public telephone network, with several separate telecommunication networks with limited access systems and is provided with a direct line with the main nuclear sites. The DGSNR PCD has also a video-conference system primarily linked with the IRSN response centre. The DGSNR PCD also uses dedicated computer equipment appropriate to its duties.

16.2.3 Role of the ASN in the preparation of emergency plans

16.2.3.1 On-site plan approval and supervision of application

Since January 1991, 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 DGSNR 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 relevant Advisory Committee for its opinion.

The review of the updated PUI, which is the task of the nuclear safety and radiation protection departments (DSNRs) of the DRIREs, takes place as follows:

- if a BNI authorisation decree specifies PUI approval, an updated on-site emergency plan requires ministerial approval before it can be applied by the operator. The DGSNR has defined a procedure whereby this approval can be obtained within a period of about 3 months, after prior analysis of main aspects by the IRSN,
- in all other cases, an updated PUI is immediately applicable, but must be submitted to the DGSNR for possible observations if considered necessary.

Finally, correct implementation of the on-site emergency plans is checked by the ASN during inspections.

16.2.3.2 Participation in off-site emergency plan preparation

In application of the 6 June 1988 decree on emergency plans, the Prefect is responsible for the drafting and approval of off-site emergency plans (PPI). He is assisted by the DGSNR and the DRIRE concerned, which supply the basic technical elements, as derived from the IRSN assessment, taking account of the most recent available data on severe accidents and radioactive material dispersion phenomena and ensuring consistency in this respect between the PPI and the PUI.

This gave rise to sustained activity in recent years due to the decision to incorporate a reflex action stage in the PPI. Within this framework, the ASN approved the fast developing accident scenarios defined by the operators, liable to result in environmental release over a period of less than 6 hours, necessitating population protection measures, based on the intervention levels defined by the ministry for Health.

16.3 The role and organisation of the operators

16.3.1 The role and organisational structure of EDF

The emergency response structure set up by EDF comprises a local level and a national level. The organisation is built around teams (or Emergency Response Centres) which cover the four major issues (expert appraisal, decision-making, communication and action).

The organisation can be mobilised at any time, following a call from the plant to the national emergency response manager (Director of the Nuclear Operations Department or one of his deputies). The national emergency response organisation is mobilised where a power plant initiates an on-site emergency plan

(PUI), or in certain other situations ("non-PUI" and "infra-PUI" situations) which are not serious enough to warrant an on-site emergency plan.

The safety and radiological situations covered by the on-site emergency plan are situations where the safety of the installation is seriously affected and/or situations in which there is a risk that radioactivity might be released into the environment leading to the exposure of persons working outside the controlled area or of people living in the vicinity.

The criteria for putting a safety and radiological on-site emergency plan into operation can be found in the operating procedures, the plant protection procedures and the alarm sheets. The organisational structure set up when the safety and radiological on-site emergency plan is put into operation is upper bound, in other words it means that the consequences associated with both conventional risks (such as fire, personal accident etc.) and radiological risks, whether actual or potential, can be dealt with.

Responsibility for initiating the on-site emergency plan lies with the plant manager or his representative, namely the duty manager of the local management emergency response centre.

The emergency response system and the roles of the various teams are as follows.

At the national level, the national management emergency response centre (PCD-N) has the following tasks:

- to coordinate the actions taken by the different bodies making up EDF's emergency response structure,
- to define a strategy for dealing with the technical, organisational and media-related aspects of the incident,
- to advise the plant concerned,
- to keep the EDF Group presidency, the government and other plants informed.

The national management emergency response centre maintains contact with the EDF Group presidency, which can also mobilise its Group Emergency Response Unit. It is also in contact with experts from the national emergency response technical team (ETC-N).

This team has two main duties:

- it provides technical support to the national management emergency response centre. This involves a continuous analysis of the situation, the state of the reactor affected and releases (situation diagnosis) and short to medium term forecasts (prognosis);
- it provides technical assistance on-site, in conjunction with the local emergency response team (ELC) for managing the affected installation, and with the assessment emergency response centre (PCC) for handling environmental conditions.

At the local level, the plant manager or his representative is responsible for managing the emergency response procedure. He directs the local management emergency response centre, which helps him to assess situations, define strategies, inform the national management emergency response centre and the local government authorities, and keep the media informed.

The site's emergency response manager is responsible for the safety of installations and the protection of equipment and personnel. In this capacity, he is responsible for all decisions as to how the installation should be operated in situations not covered by the incident and accident procedures and for site personnel protection. If so specified in the off-site emergency plan, he may be delegated by the Prefect to alert the public if the criteria for putting the off-site emergency plan into operation automatically have been met.

The operating team of the affected unit is primarily responsible for bringing the situation back to normal. This team is known as the local emergency response centre (PCL) and works under the responsibility of

the operations shift manager, taking operating action in line with the procedures in force. In addition to permanent operation and monitoring of the installation, there is another special duty in incident situations, namely the transmission of technical data on the state of the installation using, among others, pre-formatted data sheets.

The local management emergency response centre (PCD) relies, at the local level, on two expert appraisal teams:

- the local emergency response team (ELC), which is charged more specifically with analysing the state of the installation and forecasting developments,
- the assessment emergency response centre (PCC), which is responsible for assessing the consequences of the accident on the public and the environment.

The activities of these two teams are closely intertwined since the local assessment emergency response centre bases its forecasts of releases and the associated consequences on the installation prognosis made by the local emergency response team.

All the technical information on the installations is sent to the local emergency response team and all the technical information on environmental monitoring is available at the local assessment emergency response centre.

In incident and accident situations, environmental monitoring is based largely on the monitoring resources used during normal operation. The radioactivity in the environment is monitored continuously by means of a network of radiation monitors located around the plant. Furthermore, additional radiation monitors are also installed round the perimeter fence and in the vicinity of the plant within a radius of 10 km. Each plant also has two laboratory vehicles provided with measuring equipment (external exposure, contamination, gamma spectrometry) and sampling apparatus.

Meteorological data is provided by the meteorological station on or close to the site. Wind characteristics (speed and direction) and atmospheric diffusion conditions (stability) are recorded continuously in the control room and emergency response centres. These characteristics and the intensity of any precipitation are also available in the emergency response centres. Furthermore, with a view to forecasting the consequences in accident situations, a national convention provides for the supply of data collected by the French weather service at local and national level.

Both teams (ELC & PCC) have another role, specified in the special protocol signed by EDF, the DGSNR and the IRSN. It is to keep the national technical teams informed so that they can carry out their own duties (which include providing support and expert analysis to these same units).

These units keep the local management emergency response centre regularly informed of any events likely to alter the emergency response strategy (for example loss or recovery of an engineered safety system, detection of release of activity into the environment).

The local management emergency response centre is also supported by a logistics emergency response centre (PCM), which is charged with ensuring that all steps associated with logistics are taken so that the emergency can be properly managed. The logistics centre keeps the local management emergency response centre informed of the actions it is taking, the additional resources available and the working or living conditions of the personnel. The logistics emergency response centre is also mobilised at the request of the local management emergency response centre which may ask it to repair equipment that is unavailable or help to set in place mobile resources or "exceptional alignments". It also takes action in the following areas:

- protection of personnel;
- management of telecommunications systems for all the emergency response centres;

- organisation of work and special tasks on equipment at the request of the local management emergency response technical centre;
- logistics back-up for external emergency services and emergency response teams.

Exchanges of information with off-site external organisations (EDF, government authorities and others) take place over a network on the basis of the various levels of responsibility described above (expert appraisal, decision-making, communication).

The parameters required to cover all the accident situations envisaged, i.e. the physical parameters and the activity measurements used to monitor the barriers and containment of the premises, are available in the national technical emergency response centres.

Not only do the technical emergency response teams assess the situation, they also predict how it will develop. These forecasts have to enable the decision-makers (the Prefect and the emergency response manager in the plant) to take whatever preventive measures are required to protect the public and the personnel.

16.3.2 Role and organisation of the CEA

The CEA's emergency response organization is included in the general organization described in § 16.1.

If an emergency occurs on an installation operated by the CEA, an emergency response organization is set up to complement the mechanisms of the Public Authorities.

In accordance with the diagram in § 16.2, the CEA performs a local role (the affected site) and a national role (the CEA general management).

The affected site (local level):

- manages the work inside the plant,
- controls communication from the plant to the local media in the case of an emergency, in liaison with the prefecture,
- is responsible for relations with the prefecture and with the IRSN's technical emergency centre.

The CEA general Directorate (central level):

- issues guidelines for work done by the CEA nationally,
- is responsible for communication with the national media,
- is responsible for relations with national Public Authorities.

To perform their role, the local level and the central level are assisted by a local or central management command Centre, called the PCD-L and CCC (emergency coordination centre) respectively.

- The centre Director or his representative is responsible for the PCD-L. It includes a decision team, a local technical emergency response team (ETC-L), a control team, an operational team, a communication team and a press team,
- The general Administrator or his representative is responsible for the CCC. It includes a decision unit, a central technical emergency response Team (ETC-C), a communication team and a press team.

The communication and press teams work with the PCD-L or the CCC to produce press releases, reply to external calls and manage interviews.

The site is responsible for triggering the on-site emergency response plan (PUI).

The plant Manager or his representative (on-duty management staff in non-working hours) is responsible for evaluating the severity of the event as a function of predefined criteria for triggering the PUI and choosing its level.

If the PUI is triggered, the director or his representative is responsible for:

- directing and coordinating the initial safety actions,
- very quickly informing local authorities, safety authorities and the CEA general Directorate,
- calling in any personnel necessary to reinforce teams, particularly outside working hours.

If there is a severe event, the initial information is sent to the CEA permanent alert structure.

The general Administrator or his representative may decide to activate the CCC, depending on the severity of the event.

16.3.2.1 Application to the Phenix reactor

At the moment, the PUI of the Marcoule CEA Centre applies to the Phenix power station. This PUI was brought into force at the beginning of 2004 after a simulation exercise.

Two exercises are planned for 2004, the first at CEA level and the second with the Public Authorities.

During the 2001 - 2003 period, the power plant carried out 10 exercises with support from command centres outside the working hours, and about twelve tests in which on-call persons were called, and a few exercises on assembly at evacuation muster points.

16.3.2.2 Application to other CEA centres

An emergency exercise took place in Saclay in May 2000, simulating a hypothetical release of rare gases from the OSIRIS reactor into the stack. The potential consequences went beyond the perimeter of the Saclay site and an external assistance action was simulated.

A national emergency exercise took place at the end of 2002 based on the simulation of an abnormal radiological situation on MASURCA at Cadarache.

This exercise tested:

- the organisation of the CEA and Public Authorities,
- traffic interruption and diversion,
- sheltering of populations,
- information agreements with local radio stations.

The existing organisation was tested and improved as a result of these exercises.

16.3.3 Role and organisation of ILL

The ILL emergency organisation forms part of the general organisation described in § 16.1.

As shown in the diagram in § 16.2, the ILL performs a local role (the affected site) and a national role (through the CEA General Directorate).

In the case of an incident or an accident, the ILL immediately informs the CEA-Grenoble centre and, depending on the case, implements the provisions planned in its PUI.

This organization is based on:

- a management command Centre (PCD), called the action PCD in the PUI,
- a reactor technical command centre
- an organisation set up by the CEA Grenoble.

16.3.3.1 The ILL PCD

The ILL PCD is managed by the Manager responsible for general safety of the ILL and particularly, in the case of an accident, rescue of persons and protection of property - or this manager's representative.

The manager of this PCD is responsible for general coordination of the work on his plant and official contacts between the ILL, CEA-Grenoble and the Public Authorities both locally (Prefect concerned) and centrally (DGSNR).

In particular, he informs these authorities about:

- the circumstances of the accident and any bodily injury and equipment damage,
- planned provisions to limit the consequences,
- the state of the installation concerned and foreseeable prospects for development,
- radioactive releases taking place at the time, or in the future, and possible developments in the short and medium term,
- radioactivity transport into the environment, evaluated from measured or estimated releases, measurements in the field and local meteorological data,
- forecasts for foreseeable changes to this transport, particularly taking account of local meteorological forecasts.

Existing specialised teams or teams specially created as a function of the needs and circumstances of the accident assist the ILL PCD, and are managed by managers appointed by the ILL Manager.

These teams are:

- The ILL control Team (EC) responsible for centralisation and interpretation of radiological measurements and evaluation of the radiological consequences of the incident or the accident. This team is managed by the ILL radiation protection manager or his representative.
- The movement Team (EM) responsible for controlling personnel movements, coordinating the use of vehicles, and in general providing the internal logistic service. For an incident limited to the ILL site, this team is managed by the ILL safety group leader or his representative.
- The ILL Technical emergency response Team (ETC) consisting of specialists and experts with good knowledge of the installation, the technical problems involved and safety and radiation protection questions.

16.3.3.2 The Reactor Technical PC

The installation leader or his representative is responsible for the reactor technical command centre, and this reactor technical command centre is responsible for performing control and safeguard functions. This technical PC reports to the ILL PCD and sends useful information to the ILL ETC.

The reactor technical PC is located in a service room (reactor control room or PCS/LMA), where information from the reactor or its auxiliaries is sent, and in which all telecommunication means necessary for liaison with the ILL PCD and ETC are located.

16.3.3.3 Organization set up by the CEA-Grenoble

In the event of an incident or accident occurring at the ILL, and at the request of the ILL manager (or his substitute), the Grenoble CEA Manager (or his substitute) can provide the ILL with technical and human means adapted to the situation for the following topics:

- Fallback rooms for emergency management,
- experts specialised in environmental monitoring,
- work personnel (security, radiation protection, technical support).

16.4 Accident simulation drills

It is important not to wait for a significant accident to actually occur in France before testing the emergency response provisions described, under real conditions. Exercises are periodically organised as training for emergency teams and to test resources and organisational structures with a view to identifying weak points. They are also an opportunity for circulating information about nuclear activities and control of hazards.

National emergency response drills are organised at the rate of 8 to 10 per year by the ASN, and involve the Public Authorities, the operators and the technical support entities. Each drill is analysed with the various participants, leading to enhancement of operating feedback.

In addition to national drills, EDF carries out local drills on sites : thus, owing to the size of the fleet, EDF carries out drills, large or small, about every two days.

An annual assessment of the emergency drills enables the lessons from the previous year to be learned and improvements proposed (to drills, organisation, interfaces, etc.) both internally and externally.

16.4.1 National emergency response drills

Each year the ASN prepares a national nuclear emergency drills programme, which is forwarded to the Prefect with a circular jointly signed by the DGSNR, the DDSC and the SGDN. Owing to the large number of players likely to be involved in drills (local representatives, and the population around the sites) and in order to avoid prejudicing the quality of drill by setting too many objectives, two types of exercises have been carried out since 1997:

- exercises targeting "nuclear safety", involving no actual population actions and mainly aimed at testing the decision process on the basis of a freely-established technical scenario,
- exercises targeting "civil defence", involving actual application, on a significant scale, of off-site emergency plan countermeasures for population protection (alert, sheltering, evacuation) on the basis of a technical scenario based on the population participation conditions adopted.

For most of these exercises, simulated media pressure is used to test the communication capacity of the main players concerned.

The table below lists the main characteristics of the national drills carried out in 2003. Of the seven drills involving nuclear reactors, five mainly targeted "nuclear safety" and one, carried out over a 2-day period, comprised one day mainly focused on nuclear safety and one on local civil defence.

National nuclear Emergency response drills involving reactors in 2003

| Nuclear site | Date | Prime Target | Characteristics |
|-----------------|-----------------|---------------------------------|--|
| Tricastin (EDF) | 21 January | Civil Defence | Test of the new PPI and alert system |
| Saclay (CEA) | 25 March | Nuclear safety | Test of evacuation of 8 contaminated injured people to the Percy hospital |
| Chooz (EDF) | 12 June | Nuclear safety | Activation of the Belgian emergency response organisation |
| Paluel (EDF) | 16 September | Nuclear safety | |
| Chinon (EDF) | 9 October | Nuclear safety | Coupled with a health drill with 6 contaminated injured people evacuated |
| Bugey (EDF) | 23 October | Nuclear safety | Test of an automatic telephone calling system to supplement the siren alert system |
| Civaux (EDF) | 5 & 11 December | Civil Defence Nuclear safety | On 12/05 : local civil defence drill |

In addition to the national exercises carried out on an average every three years on each nuclear site, the prefects are asked to conduct local exercises in collaboration with the sites in their vicinity, with a view to better preparing for emergency situations.

16.4.2 International drill sessions and co-operation

The year 2003 also witnessed the continuation and expansion of international co-operation in emergency response and the related drill sessions. In particular, the French-Belgian coordination was tested on the occasion of the Chooz drill and Swiss observers attended the Le Bugey drill.

Generally speaking, the ASN is of the opinion that emergency situation co-operation should be reinforced with States with which France share a common border. Discussions were therefore held to define relations between France and Switzerland in the event of an accident at a nuclear installation in one or other of these countries. Information and co-operation procedures in a similar situation are also under discussion with Germany and Luxembourg. A protocol with Belgium, tested on the occasion of the 12 June 2003 drill, is currently being finalised.

The year 2003 also witnessed the continuation and expansion of international co-operation of EDF in emergency response and the related drill sessions: in particular, the signature of an agreement with Minatom (Russian federation) and continuation of cooperation agreements with RosEnergatom (Russian federation) and Energoatom (Ukraine). Russian (RosEnergatom) and Ukrainian (Energoatom) delegations attended the Gravelines emergency drill scheduled for May 2004, as observers. Finally, observers attended the emergency drill held in Daya Bay. In the first half of 2003, the EDF national emergency organisation was reviewed by foreign experts within the framework of the OSART at Nogent and Civaux NPPs.

16.4.3 Lessons learned from the drills

Many lessons can be learned from these exercises, some of which are recurrent from one exercise to another. To this end, each exercise is the subject of careful assessment, concluded by a general national assessment meeting held one or two months after its completion. In addition, various observers (civil servants, persons from neighbouring countries, qualified personalities) often see things in a new light, from an original angle.

With a view to summarising the lessons learned and deriving new lines of action to be adopted, the DGSNR leads a national working group on feedback from these exercises, associating the main national public organisations (IRSN, CICNR, DDSC, Météo-France) and the operators. This group met twice in 2003.

Among those lessons learned from the drills of the previous year, it is worth noting the need to vary the drill scenarios to avoid routine, particularly for those at the national level who take part in several drill sessions every year.

The following paragraph describes the main developments envisaged for the future, based on the lessons learned from drills conducted in recent years.

16.5 Lessons learned : development in nuclear emergency provisions

As in any other nuclear safety field, emergency response structures have to develop on the basis of experience. The main sources of experience in France are: drills and exchanges with foreign countries, together with certain exceptional events in France (Civaux-1 incident on 12 May 1998, violent storm on 27 December 1999, heavy rains on 2 and 3 December, 2003 in the lower Rhone valley) or abroad (Tokai-Mura accident on 30 September 1999).

16.5.1 Revision of the off-site plans

Since 1997, the ASN has been leading a discussion group involving the DDSC, the DGS, the IPSN, the OPRI, the SGCISN and the BNI operators, with the aim of updating the off-site emergency plans for nuclear sites, taking into account feedback from the nuclear accident drill sessions. This led to signature of the interministerial circular of 10 March 2000.

The main innovations presented in this circular are as follows:

- the creation of a reflex stage, which corresponds to a decision by the Prefect to trigger an immediate previously defined action, in the case of accidents liable to cause radioactive release resulting in the off-site action level being overstepped within a period of less than 6 hours. The operator relies on objective criteria approved by the ASN comprising parameters identified beforehand and easily accessible to the operating staff,
- limitation of off-site emergency plan initiations in reflex or concerted mode to cases where population protection measures are required. In all other cases, the Prefect sets up a "watch committee",
- definition of new intervention levels, based on the most recent international recommendations.

The prefects had a period of 2 years, starting from receipt of the circular, in which to revise their PPIs. Owing to the extent of the revision, most of the Prefectures could not meet that deadline. However most Prefectures have now completed the revision of their PPIs. They thus have at their disposal truly operational plans tailored to the potential hazards involved in the nuclear installations

Application of these measures to the context of each PPI will provide a further opportunity for informing the general public and the local councillors, notably through the Local Information Committees (CLI).

16.5.2 Preventive distribution of stable iodine

In the event of substantial accidental release 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 a distribution of tablets, in the event of an accident, using stockpiles, generally on or near the nuclear sites. The first accident drills (1995 and 1996) soon showed the difficulties involved. Thus, after 1997, the decision was taken to opt for preventive distribution of stable iodine tablets to populations living in the vicinity of nuclear power plants. After completion of the preventive distribution of tablets, the drill sessions revealed the necessity for further improvements in this respect.

In addition, the shelf-life of the tablets was extended from 3 to 5 years before the second distribution campaign. 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 hardly applicable without a supplementary distribution.

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, and to plan the stockpiling in each department with a view to improving provisions for the protection of children, adolescents and young adults against radioactive iodine beyond the PPI zone. To create these stocks, the Ministry for Health ordered 60 million tablets from armed forces central pharmaceutical supplies. Delivery of the tablets began in 2002 and should be completed in 2004 (at the end of November 2003, 27 millions tablets had been produced and distributed throughout the regions). 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 drafted by Prefectures. In addition, the DGSNR has initiated an enquiry with the DDASSs in order to more precisely assess the effectiveness of the new distribution campaign within the perimeters of the PPIs.

16.5.3 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 other varied post-accident consequences (economic, health-related, social), which have to be dealt with in the medium or even long term, with a view to reverting to a situation deemed normal.

Further to the "Becquerel" drill carried out in October 1996 around the Saclay site, several interministerial working parties were set up for the purpose of defining the way in which the various post-accident problems should be dealt with. The DGSNR was represented on three of the working parties, dealing respectively with environmental clean-up, radioactive contamination measurements and population management and follow-up. One of the first lessons learned from this exercise led to the setting up of a group responsible for carrying out environmental radioactivity measurements. This group is now systematically activated during drills. The measurements which are conducted on the occasion of each drill now have to be transposed into the regulations.

Further to the terrorist attacks on 11 September 2001 in the United States of America, the French Government requested that work on post-accident questions should proceed with a view to rapidly reaching operational conclusions. Within this context, an experimental "post-accident" delegation was set up by the Aube prefecture. Four working groups run by key players in the department were created and given the task of examining the following subjects respectively: questions of administrative and economic organisation; environmental measurements and monitoring of public health; questions of decontamination, clean-up and contamination of the food chain; questions of movements around the zone. The concrete proposals for action presented by the groups are being analysed by the ASN with a view to including them in a national post-accident doctrine.

On the basis of discussion conducted by ASN with the support of the IRSN, the SGDN will in 2004 initiate an action plan to achieve progress on post-accident issues.

16.5.4 Updating of regulatory texts governing nuclear installation accident provisions

The emergency response provisions of the authorities in the event of an accident are currently defined by interministerial directives mainly dating back to the late eighties, and which are now partially obsolete.

The ASN has consequently suggested that these existing interministerial directives be revised on the basis of the following principles:

- the current system which is tested for each exercise must be kept in the next regulations,
- continuity in emergency management is essential: organisational provisions set up for the immediate emergency response stage must provide the basic fabric of the system devised to manage the follow-up sequences and transition to the post-accident stage,
- there must be no single information emitter or centraliser; each entity concerned must communicate within its sphere of competence; there must be dialogue between spokespersons, who must be apart from the decision-makers in order to perform their duties satisfactorily,
- the new regulations will apply to clearly defined areas (BNIs, classified BNIs, Ministry of Defence nuclear installations).

These proposals imply substantial interministerial discussions which have just been initiated under the responsibility of SGDN and should be completed in 2004.

16.5.5 Outlook

Publication of the decree 2003-865 of 8 September 2003 instituting the CICNR, introduces an important change in the provisions of the Public Authorities in the event of a nuclear accident, entrusting the

Part C - Article 16 : Emergency preparedness

SGDN with extensive coordinating powers. This should result in 2004 in the redrafting of interministerial texts regulating emergency provisions, on the basis of experience feedback from numerous national and international emergency drills performed with the active participation of the ASN.

When dealing with radiological emergencies outside nuclear installations, the ASN is working on setting up appropriate emergency provisions for managing events of widely differing types and scales. The ASN will aim to ensure that these provisions are then tested during drills.

D. SAFETY OF INSTALLATIONS

17. Article 17 : Siting

Each Contracting Party shall take the appropriate steps to ensure that appropriate procedures are established and implemented:

- i) for evaluating all relevant site-related factors likely to affect the safety of a nuclear installation for its projected lifetime,*
- ii) for evaluating the likely safety impact of a proposed nuclear installation on individuals, society and the environment,*
- iii) for re-evaluating as necessary all relevant factors referred to in sub-paragraphs (i) and (ii) so as to ensure the continued safety acceptability of the nuclear installation,*
- iv) for consulting Contracting Parties in the vicinity of a proposed nuclear installation, insofar as they are likely to be affected by that installation and, upon request providing the necessary information to such Contracting Parties, in order to enable them to evaluate and make their own assessment of the likely safety impact on their own territory of the nuclear installation.*

17.1 Regulatory request

Well before applying for an authorisation decree, the operator provides information to the authorities concerned on the site or sites selected for construction of a BNI, which means that main site characteristics can be analysed at a very early stage.

This analysis is mainly concerned with socio-economic aspects and safety. If the planned BNI is intended for power generation, the Directorate General for Energy and Raw Materials at the Ministry for Industry will be directly involved. The DGSNR will meanwhile review the safety-related characteristics of the site: seismicity, hydrogeology, industrial environment, heat sinks, etc.

Furthermore, for implementation of section IV of law 2002-276 of 27 February 2002 related to local democracy (articles L.121-1 to L.121-15 of the Environment Code), a decree of 22 October 2002 related to the organisation of a public debate and to the National Commission for public debate, stipulates that the authorisation of a BNI is subject to a public debate procedure:

- necessarily for any new nuclear power plant site or any new nuclear site apart from nuclear power plant sites, corresponding to a capital outlay in excess of 300 million Euros,
- possibly for any new nuclear power plant site corresponding to a capital outlay in excess of 150 million Euros.

In addition, the French Government, in compliance with the treaties in force, notifies neighbouring countries.

If new data concerning nuclear sites (earthquake, flooding, etc.) are identified and are likely to compromise nuclear safety, a safety reassessment is conducted as discussed in Chapter 14.

17.2 The situation during the period in question

The CEA had chosen the most appropriate site during the previous period within the context of detailed design work for construction of the Jules Horowitz research reactor on the Cadarache site. This site selection procedure took place:

- by applying Fundamental Safety rules to geological and geotechnical studies (RFS I.3.c), to the determination of seismic movements to be considered (RFS 2001-01) and to the inclusion of the risk of flooding from external causes (RFS I.2.e).
Basic Safety Rules were applied making it necessary to take account of soil characteristics

(geology, hydrogeology and geotechnical) and the behaviour of the land (settlement and swelling, liquefaction and slope stability),

- by applying the normal approach of the French nuclear industry which also respects the spirit of the approach recommended by the IAEA for site classification.

The main techniques involved are all derived from earth sciences and are complemented by boreholes and survey pits in order to obtain information about land not outcropping on the surface.

Of the constraints to be met by the site, which are classified into four categories ranging from compulsory to flexible, the following for example are compulsory:

- location outside the floodable area,
- site with sufficient load bearing capacity,
- site composed of either a limestone or marl-limestone, or alluvial formations, at the bottom of the excavation,
- site without any active faults on the surface,
- land free of karstic pockets, potentially liquefiable levels or important faults, down to a depth equal to at least twice the buried part,
- consideration of the environment.

One "limestone" site was selected in "reactor's valley" in the Cadarache centre, from among the three sites initially selected as being possible.

The ASN approved the choice of the site.

A model of the aquifer in the chosen zone will be useful for sizing drainage, if necessary.

When the civil engineering work is sufficiently advanced, specific geotechnical tests will be carried out at the location of the heavy and sensitive buildings.

18. Article 18 : Design and construction

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

- i) the design and construction of a nuclear installation provides for several reliable levels and methods of protection (defence in depth) against the release of radioactive materials, with a view to preventing the occurrence of accidents and to mitigating their radiological consequences should they occur,*
- ii) the technologies incorporated in the design and construction of a nuclear installation are proven by experience or qualified by testing or analysis,*
- iii) the design of a nuclear installation allows for reliable, stable and easily manageable operation, with specific consideration of human factors and the man-machine interface.*

18.1 Licensing process

The nuclear installation authorisation process as described hereafter results in a "plant authorisation decree" which specifies the principles to be complied with both at the design and construction stages (quality of methods, component qualification) and in operation (defence in depth, prevention of accidents and limitation of their consequences, consideration of the risk of human errors).

18.1.1 Safety options

When an operator intends to build a new type of BNI, it is expected to present the relevant safety objectives and the main characteristics as early as possible, well before submitting its licence application.

The DGSNR generally asks the competent Advisory Committee to examine the proposals submitted, on the basis of an analysis performed by the IRSN, and then informs the operator of the issues which must be included in its authorisation decree application.

This preparatory procedure in no way exempts the applicant from the subsequent regulatory examinations but is designed simply to facilitate them.

18.1.2 Plant authorisation decrees

18.1.2.1 Submission of the plant authorisation application

Applications for BNI authorisation decrees are sent to the Minister for the Environment and the Minister for Industry, who forward them to the other Ministers concerned (Interior, Health, Agriculture, Town Planning, Transport, Labour, etc.). Each application file comprises a preliminary safety analysis report containing the description of the installation and of the activities which will be carried out, the inventory of any hazards it presents, the analysis of the provisions taken to reduce the probability and the consequences of accidents. The application also comprises a document specifying the provisions designed to facilitate the subsequent dismantling of the installation.

Processing of the application includes a public inquiry and a technical assessment.

18.1.2.2 Consultation of the public and the local authorities

The public inquiry is opened by the Prefect of the department in which the installation is to be built. The documents submitted to the inquiry must notably specify the identity of the applicant, the purpose of the inquiry and the nature and basic characteristics of the installation. They must include a plan of the new plant, a map of the region, a hazard analysis and an environmental impact assessment.

In addition to the prefecture concerned, a descriptive file and an inquiry register are made available in all towns and villages which are even partly within a 5 km radius around the planned installation. If two or more departments are concerned, a joint order of the concerned Prefects organises the public inquiry in each of them, the Prefect of the main location being the coordinator of the process.

In accordance with the general provisions in this respect, the public inquiry shall proceed for a minimum period of one month and a maximum period of two months, with the possibility of a two-week extension in the event of a well-founded decision in this matter on the part of the Inquiry Commissioner. Moreover, in the case of BNIs, by virtue of a specific provision, introduced by a decree of 12 May 1993, the Government may extend the duration of the inquiry by a maximum period of one month.

The purpose of the inquiry is to inform the public and collect opinions, suggestions and counter-proposals, in such a way as to provide the competent authority with all the necessary information. Any interested person therefore, whatever his nationality or place of residence, is invited to express his opinion.

An Inquiry Commissioner (or an Inquiry Committee, depending on the nature or extent of the operations) is appointed by the President of the competent Administrative Court. He may receive any documents, visit the site, arrange to meet all people wishing to make statements, organise public meetings and request extension of the inquiry period.

When the inquiry is over, he examines the public's comments entered in the inquiry register or sent to him directly. Within one month of the end of the inquiry, he sends a report and his recommendations to the Prefect.

The departmental or regional offices of the ministries concerned by the project are also consulted by the Prefect.

Finally, the latter sends the report and conclusions of the Inquiry Commissioner, together with his recommendations and the results of the competent authority consultations, to the Ministers in charge of nuclear safety (Environment and Industry).

The public inquiry organised in the context of a declaration of public interest procedure may in some cases replace the public inquiry required for an authorisation decree application.

18.1.2.3 Consultation of technical organisations and of ministries

The preliminary safety analysis report appended to the authorisation decree application is submitted for review by one of the DGSNR Advisory Committees.

In view of the recommendations of the Advisory Committee, the results of the public inquiry and possibly the remarks of other ministers, and if there are no objections, the DGSNR prepares a draft authorisation decree.

This draft decree is then communicated to the Interministerial Commission for Basic Nuclear Installations (CIINB) by the Ministers in charge of nuclear safety. The Commission shall give its opinion within two months.

The draft decree, amended if necessary, is then submitted to the assent of the Minister for Health who must state his position within three months.

18.1.2.4 Authorisation decree

The authorisation decree, based on the proposals of the Ministers for the Environment and for Industry, defines the perimeter and characteristics of the installation and the specific requirements which must be met by the operator. It also states the justifications which the operator has to submit both for start-up and normal operation of the installation and subsequently for its decommissioning.

The specific requirements imposed for the installation shall under no circumstances be detrimental to compliance with the general technical regulations, regulations concerning release of effluents or any other texts applicable with regard to environmental protection or worker health and safety issues.

18.2 Presentation of current projects

18.2.1 Nuclear power reactors

In 2000, the Advisory Committee for nuclear reactors and group of German experts completed their investigation into the main safety options for the planned Franco-German pressurised water reactor, the EPR (European Pressurised water Reactor).

The EPR is an evolutionary pressurised water reactor developed jointly by French and German industrialists and electricity utilities (Framatome, Siemens, EDF and a group of German utilities). As far as safety is concerned, this project aims to improve considerably on the defence-in-depth system in place in present-day reactors.

The review of the project's safety options began in 1993 in the form of a Franco-German technical cooperation agreement. Successive recommendations, issued by the groups of French and German experts, were approved jointly by the safety authorities of the two countries, then, from the end of 1998, by the ASN.

This resulted in a preliminary Basic Design Report being submitted to the French and German safety authorities in October 1997. It covered the EPR nuclear island and took into account recommendations that had already been issued. After a project optimisation stage piloted by the designers in 1998, an updated version of the Basic Design Report was issued in February 1999.

Between January and April 2000, the Advisory Committee for nuclear reactors and the German experts met regularly to complete the Technical Guidelines, a set of recommendations concerning the safety options of the EPR project. The final version of the Technical Guidelines was validated in October 2000 by the Advisory Committee for nuclear reactors, with the participation of German experts.

A working programme agreed between EDF and the ASN set out the parameters for the exchanges that took place between 2001 and 2003, in preparation for the drafting of the first preliminary safety report. The exchanges mainly concerned:

- containment of peripheral buildings;
- improvements to the design of the spent fuel cooling system to eliminate the risk of total coolant loss;
- the complements to Probabilistic Safety Assessments (complements to the PSA level 1 Basic Design Assessments, methodology of PSA level 2 Assessments);
- the list of events in the complementary field;
- the working programme concerning actions to take account of human factors;
- the dossiers on important design decisions for major components of the primary and secondary cooling systems.

A number of complementary safety dossiers were sent out in 2003 and are currently being examined. They concern, among other things, changes to the design of the containment building combined with the introduction of a metal liner on the internal building, the approach to take account of preventive maintenance and R&D changes concerning the design of measures relating to severe accidents.

At the end of 2003, the EPR was chosen for the fifth French reactor. Following a debate of the orientation of French energy policy, Parliament in June 2004 declared itself in favour of construction of an EPR reactor.

18.2.2 Research reactors

The CEA considers it necessary to build a new reactor, called the Jules Horowitz reactor (RJH), due to aging of European irradiation reactors currently in service and their shutdown in the short or medium term. This new pool type irradiation reactor will enable the CEA to meet its research and development needs until about 2050. Reactor startup is currently scheduled for 2013.

The prime objective of the reactor is irradiation of materials and fuels to support the French nuclear power program. Additional functions are planned such as the production of neutron beams; reservations are included in the design for industrial neutronography or for installation of a new medical technique on the site, developed for the treatment of cancerous tumours.

The design of the RJH is based on the concept of defence in-depth, meaning that special attention is paid to containment by defining barriers between radioactive products and the environment outside the installation.

In particular, the RJH safety approach takes account of:

- reactor aspects:
 - incident and accident situations in an approach comparable to that requested by the IAEA on power generating reactors of the future,
 - definition of safeguard and ultimate protection systems,
 - component flexibility in order to facilitate their replacement,
 - in-service maintenance and inspection conditions to make them as easy as possible,
 - taking account of internal and external hazards: earthquakes, explosions, fires, extreme weather conditions, etc.
- experiment aspects:
 - physical separation between reactor operating systems and operating systems for experimental devices;
 - possibility of exceeding nominal power reactor conditions in order to enable safety experiments to be carried out in which samples could be severely degraded (representativeness of accident sequences),
 - criteria in terms of the reactor itself, concerning added radioactivity and release of radioactive products caused by the failure of experimental devices,
 - finally, associated experimental means (hot cells and support laboratories) concomitant with the reactor and for which the same safety approach is applied.

Operating Experience accumulated in operating research reactors at the CEA and elsewhere, is an integral part of the studies, as is the inclusion of human factors.

Finally, the design of the RJH is based on low enrichment fuel use.

The safety options file of the future reactor was sent to the ASN in January 2002. The Advisory Committee for nuclear reactors reviewed this file in the first half of 2003. The ASN informed the CEA in August 2003 that it did not have any objection to the CEA continuing the RJH project, based on safety options presented to the ASN and provided that complementary requests were taken into account.

19. Article 19 : Operation

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

- i) the initial authorization to operate a nuclear installation is based upon an appropriate safety analysis and a commissioning programme demonstrating that the installation, as constructed, is consistent with design and safety requirements,*
- ii) operational limits and conditions derived from the safety analysis, tests and operational experience are defined and revised as necessary for identifying safe boundaries for operation,*
- iii) operation, maintenance, inspection and testing of a nuclear installation are conducted in accordance with approved procedures,*
- iv) procedures are established for responding to anticipated operational occurrences and to accidents,*
- v) necessary engineering and technical support in all safety-related fields is available throughout the lifetime of a nuclear installation,*
- vi) incidents significant to safety are reported in a timely manner by the holder of the relevant licence to the regulatory body,*
- vii) programmes to collect and analyse operating experience are established, the results obtained and the conclusions drawn are acted upon and that existing mechanisms are used to share important experience with international bodies and with other operating organizations and regulatory bodies,*
- viii) the generation of radioactive waste resulting from the operation of a nuclear installation is kept to the minimum practicable for the process concerned, both in activity and in volume, and any necessary treatment and storage of spent fuel and waste directly related to the operation and on the same site as that of the nuclear installation take into consideration conditioning and disposal.*

19.1 Licensing process and regulations

19.1.1 Power reactor operating licences

The first load of fresh fuel elements can only be delivered to the fuel storage building after authorisation by the Ministers for the Environment and for Industry, granted after examination by the DGSNR :

- of the storage provisions made by the operator, as presented at least three months beforehand,
- of the conclusions of an inspection carried out just before the date fixed for delivery of the fuel elements.

Moreover, six months before fuel loading, the operator must send the Ministers for the Environment and for Industry a provisional safety analysis report together with provisional general operating rules and an on-site emergency plan specifying the organisational provisions and measures to be implemented on the site in the event of an accident. The DGSNR consults the Advisory Committee for nuclear reactors on these documents before drafting its own recommendations. Upon receipt of the latter, the Ministers can authorise fuel loading and pre-commissioning tests.

For PWRs, at least four successive licences are required at the start-up stage:

- a fuel loading licence , authorising fissile fuel elements to be installed in the reactor vessel, enabling fuelled testing to start (pre-critical cold tests),
- a licence for pre-critical hot testing, prior to first criticality. These tests are subject to satisfactory performance of the pre-critical cold tests. Operating the reactor coolant pumps then enables rated pressure and temperature levels to be reached in the primary system. These tests are only

authorised after issue of the primary system hydrotest, in application of the ministerial order of 26 February 1974 (see § 7.2.2.1),

- a licence for first criticality and power build-up to 90% of nominal,
- a licence for power build-up to 100% of nominal.

After initial start-up and within a time limit stipulated in the authorisation decree, the operator requests the issue of a final commissioning licence by the Ministers for the Environment and for Industry. Its request is substantiated by a final safety analysis report, final general operating rules and a revised version of the on-site emergency plan. These documents must reflect the experience acquired during the operating period since initial start-up.

19.1.2 Research reactor operating licence

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

This so-called "pre-commissioning" licence, requires notification of technical requirements. It is preceded by an examination by the DGSNR 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 for the facility and the on-site emergency plan.

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.

19.1.3 Decommissioning and dismantling licences

As specified in Article 6b of decree 63-1228 of 11 December 1963, when an operator decides, for any reason, to shut down its installation, it must inform the ASN, by sending it:

- a document justifying the selected configuration in which the installation will be left after final shutdown, and indicating the various stages of subsequent dismantling,
- a safety analysis report covering the final shutdown procedures and indicating subsequent plant safety provisions,
- the general surveillance and servicing rules enabling maintenance of a satisfactory safety level,
- an updated on-site emergency plan for the installation concerned.

In compliance with current environmental protection requirements, the operator must also submit an environmental impact assessment pertaining to the proposed provisions.

The implementation of these various provisions is subject to their approval by decree, countersigned by the Ministers for the Environment and for Industry, after assent of the Minister for Health and prior consultation of the Interministerial Commission for Basic Nuclear Installations (CIINB).

In some cases, operations such as the unloading and removal of nuclear material, the disposal of fluids, or decontamination and clean-up operations can be performed under the provisions of the authorisation decree for the plant considered, providing they do not involve non-compliance with previously imposed requirements nor with the safety analysis report and general operating rules currently in force, subject to certain modifications if necessary. In all other cases, such operations come under the provisions of the decommissioning decree.

After these end-of-operation tasks, two successive sets of works have to be carried out:

- final shutdown work, authorised by decree, as mentioned above, which mainly concerns the dismantling of equipment outside the nuclear island which is not required for the latter's surveillance and safety, the preservation or reinforcement of the containment barriers, the production of a radioactivity inventory,
- dismantling work on the nuclear part of the plant. This work can start as soon as the final shutdown operations are completed or can be delayed with a view to benefiting from radioactive decay in certain activated or contaminated materials.

As soon as the installation, although still a BNI, is affected in such a way by the dismantling operations that they alter its nature, it is considered to be a new BNI and consequently a new authorisation decree is required, involving the full procedure previously described including a public inquiry. In most cases, such plants become storage facilities for their own internal equipment.

If dismantling work reaches the stage where the total radioactivity of remaining radioactive substances is below the minimum level necessitating classification as a Basic Nuclear Installation, the plant can be removed from the list of Basic Nuclear Installations, i.e. "declassified". Then, depending on the residual radioactivity level, it could come under the provisions of the law of 19 July 1976 concerning installations classified on environmental protection grounds (articles L.511-1 to L.517-2 of the Environment Code), in which case it would be subjected to registering or licensing procedures.

The decommissioning and dismantling of nuclear installations were the subject on 17 February 2003 of a policy notice from DGSNR, distributed to nuclear operators. Without contradicting the existing regulatory framework, this notice makes it possible to simplify the procedures involved in the end of life of the installations, whereby a single decree deals with decommissioning and the successive dismantling stages. The aim of this note is thus:

- to clarify the definition of the main technical stages in dismantling, to adapt them more closely to the diversity of nuclear installations,
- to encourage complete dismantling initiated immediately, or only slightly deferred,
- to encourage presentation and justification by the operator, upstream of initiation of regulatory procedures, of the chosen dismantling scenario, from the final shutdown decision up to complete dismantling of the installation,
- to clarify the administrative notion of declassification of a basic nuclear installation and the relevant criteria.

19.1.4 Liquid and gaseous effluent release and water intake licences

The normal operation of nuclear plants produces radioactive effluents, release to the environment of which is subjected to stringent conditions stipulated in an administrative licence devised for the protection of personnel, of the public and the environment. This licence concerns liquid and gaseous radioactive effluents, covering both their activity level and their chemical characteristics.

Depending on circumstances, the operation of most nuclear installations also involves the intake of water from the site's immediate environment and release of non-radioactive liquid and gaseous effluents.

In application of decree 95-540 of 4 May 1995 concerning BNI liquid and gaseous effluent release and water intake, the same licence, issued at ministerial level, can where necessary cover both radioactive and non-radioactive liquid and gaseous releases and water intake for a given BNI. The procedure clarified in two interministerial circulars (Health, Industry, Environment) of 6 November 1995 and 20 May 1998, then derives from a single application, formulated accordingly and examined in all cases by the DGSNR.

The procedures stipulated in the aforementioned decree also apply to the installations classified on environmental protection grounds located within the perimeter of a Basic Nuclear Installation. Thus, this decree also enables assessment of the overall environmental impact of an installation's effluent releases and water intake.

19.1.4.1 Submission of the licence application

The effluent release and water intake licence application covers all such operations for which authorisation is required. It is sent to the Ministers for Industry and for the Environment. In addition to various drawings, maps and information, it comprises a description of the operations or activities envisaged and an assessment of their environmental impact, comprising a list of proposed compensatory measures and the intended surveillance provisions.

19.1.4.2 Recommendations of the ministers concerned

The application is forwarded to the Ministers for Health and for Civil Defence and to the Directorate for the Prevention of Pollution and Risks at the Ministry for the Environment for their opinion.

19.1.4.3 Consultation of the public and local authorities and organisations

The Ministers for Industry and for the Environment, after having requested complementary data or modifications where necessary from the applicant, forward the application, together with the recommendations of the ministers consulted, to the Prefect of the department concerned.

The Prefect organises an administrative conference between various decentralised State Departments which he feels should be consulted and submits the application to a public inquiry under conditions similar to those described above for authorisation decrees.

The inquiry is opened in the town or village where the operations in question are to be carried out and also in other towns and villages where the impact of these operations would probably be felt.

Moreover, the Prefect consults the town councils concerned together with various organisations, such as the Departmental Health Council and, where necessary, the regional river Authority or the public agency administering the public domain. He also sends the application file, for information, to the Local Water Committee.

19.1.4.4 Interministerial authorisation order

The Prefect sends the results of the administrative conference, the consultations and the inquiry, together with his recommendations to the Ministers for Industry and for the Environment.

Authorisation is granted by a joint ministerial order signed by the Ministers for Health, Industry and the Environment.

This order stipulates, within the framework of general technical rules defined by a order from the Ministers for Industry, the Environment and Health of 26 November 1999, which has been clarified by a circular to the Prefects, signed by the same Ministers on 17 January 2002:

- a) the intake and release limits with which the operator must comply,
- b) the approved methods of analysis, measurement and monitoring of the structure, installation, work or activity and of surveillance of environmental effects,
- c) the conditions under which the operator shall report the water intakes and releases it has performed to the Ministers for Health and for the Environment and to the Prefect, along with environmental impact surveillance results,
- d) the methods to be used for information of the public.

At the request of the licensee or at their own initiative, the Ministers for Health, for Industry and for the Environment may, after consultation with the Health Council for the department concerned, modify by ministerial order the conditions provided for in the authorisation order.

Finally, any modification planned by the operator to the installation itself or to its operating mode and likely to entail consequences for effluent release or water intake must be submitted beforehand to the Ministers for Industry and for the Environment, who will consult the Minister for Health. If it is then felt that the modification could cause environmental hazards or difficulties, the operator may be required to submit a new licence application.

19.1.5 Operating documents

For operation of nuclear power plants, the personnel refer to various documents. Amongst them, the ASN pays special attention on those relating to safety.

The most important are the General Operating Rules which explain the provisions implemented during reactor operation: they supplement the safety analysis report, which essentially deals with provisions taken at the reactor design stage. Decree 63-1228 of 11 December 1963 amended in particular stipulates that the operator should provide these two documents to substantiate its BNI licence application.

These General operating rules comprise several chapters approved by ASN, the topics of which are indicated for power reactors in § 19.2.2. In particular a chapter describes the Operating Limits and Conditions (OLC) under the form of Technical Operating Specifications.

19.1.6 Incident follow-up

Articles 12 and 13 of the quality order of 10 August 1984, already mentioned, makes provision for anomalies and incidents. Any deviation from a set requirement for the performance or result of a quality-related activity, any situation liable to compromise quality or any situation justifying corrective action with respects to safety, are referred to as "anomalies or incidents" in this order.

The action taken to correct an anomaly or incident is a quality-related activity. A list of anomalies and incidents is kept up to date.

Anomalies or incidents, which are particularly important for safety, shall be identified. Such anomalies or incidents are called "significant anomalies or incidents" in this order.

To this end, for each quality-related activity, a procedure must make it possible to determine which anomalies or incidents are to be considered as significant, on the basis of established criteria insofar as is possible. The procedure shall specify the functions of the individuals in charge of this identification.

Incidents are notified to the ASN within 24 hours in application of the following ten criteria specified by a 1982 letter of the ASN:

- automatic reactor shutdown,
- actuation of safeguards systems,
- incident involving or which could have involved the Operating Limits and Conditions (Technical Operating Specifications) if the same event had occurred in a different state,
- external hazard likely to affect safety,
- actual or attempted malicious act likely to affect safety,
- uncontrolled radioactive release,
- incident in which exposure to ionising radiation is higher than regulatory limits,
- incident of nuclear origin having led to human fatality or severe injury,

- design failure,
- any other anomaly deemed significant by the operator or the Safety Authority and not covered by one of the nine criteria above.

Incidents are systematically rated on the INES scale. The operator must send an analysis report of the event to the ASN within two months.

Practical details of the actions of the Safety Authority are given in § 7.3.

19.2 Measures taken by EDF

19.2.1 Commissioning of EDF reactors

The start-up tests are carried out in accordance with the Test Sequence Programme which, for each system or category of tests, specifies the aim and the list of tests to be carried out to start up the function and the criteria to be met.

The detailed description of the tests to be carried out is to be found in a Test Procedure which specifies the terms and conditions for carrying out each test and its acceptance criteria.

Start-up tests include:

- preliminary tests: dry tests (wire-to-wire checks, compliance of sequences with logic diagrams), pump rotation tests, cleaning of systems, etc.
- collective tests:
 - functional tests with reactor vessel open: tests of safety injection system and residual heat removal system;
 - cold tests: tests of functional assemblies when the reactor coolant system is cold;
 - hot tests: tests of functional assemblies in nuclear steam supply system throughout the entire pressure and temperature range;
 - fuel loading and pre-critical tests prior to going critical;
 - power build-up;
 - performance tests: for example, the thermal balance of the nuclear steam supply system can be used to measure reactor output;
 - "first-of-series" tests are carried out on the first unit in each reactor series, for example verification of how the reactor vessel internals react to vibrations.

Test procedures accompanied by record sheets and test results are known as Test Reports. Test Results Analysis Sheets are prepared for safety-related equipment.

These documents are analysed by the plant personnel and by the corporate engineering departments. Sometimes, the analysis is such that the tests have to be repeated. These documents are then given back to the nuclear operator who is responsible for filing them. The tests are coordinated and scheduled by a group comprising the nuclear operator and the manufacturers.

Incidents that occur during testing are mentioned in the corporate database and if they have an impact on safety, they are declared to the ASN.

A Site Testing Committee meets before each new test stage is begun. It comprises EDF, the manufacturers and representatives from the ASN. They examine the main results of the collective and individual tests. The ASN gives the authorisation to move onto the next stage, depending on the results presented to the Committee (for example, authorisation to go ahead with fuel loading).

The plant manager becomes responsible for the safety of the unit as soon as nuclear fuel has been loaded.

19.2.2 The technical operating specifications for EDF reactors

Installations have to be operated in compliance with the General Operating Rules, a document required by the regulations, comprising ten chapters.

Chapter 1: Organisation at operating level

Chapter 2: Organisation of quality

Chapter 3: Technical Operating Specifications

Chapter 4: Organisation of radiation protection and industrial safety

Chapter 5: Procedures for liquid and gaseous radioactive releases

Chapter 6: Incident and accident operating procedure

Chapter 7: On-site Emergency Plan

Chapter 8: Operating procedures

Chapter 9: Periodic tests of safety-related systems

Chapter 10: Physical tests of reactor core

Chapter 3 of the General Operating Rules concerns the Technical Operating Specifications (or Operating Limits and Conditions - OLC), the primary role of which is to determine the limits of the normal operating range of the unit to prevent the safety limits and design hypotheses of the reactor being exceeded. Its second role is to require the availability of the safety functions that are indispensable for assessment, protection and safeguards, as well as operability of the incident and accident operating procedures, both complementary and last resort. The third role of the Technical Operating Specifications is to lay down the action to be taken if a required safety function is lost or the normal operating range exceeded.

For each area of operations, the Technical Operating Specifications lay down the operating ranges to be complied with, i.e. the limits of the physical parameters (volumes of water, boron concentrations, temperature, pressure, flow rate etc.). These parameters are monitored from the control room by indicators, recorders, alarms, etc.

Most importantly, pressure and temperature in the reactor coolant system must lie within a well-defined range at all times. Any overstepping of these operating limits is prohibited.

For each operating range, the Technical Operating Specifications lay down the safety functions which must be available. These are "required" functions. A system or piece of equipment is available if and only if it can be immediately demonstrated that it is capable of performing its allocated functions with the required performance levels (start-up time in particular):

- in particular, the auxiliary equipment required for operation and by the instrumentation and control system is, itself, available;
- the surveillance test programmes in the General Operating Rules for these items of equipment or systems are carried out in the usual manner (compliance with frequency, including tolerance, and operating procedure) and the results are satisfactory.

An item of equipment that is available may be shut down.

Unavailability may be:

- unplanned: it is the direct result of the chance discovery of an operating fault in the equipment in question, detected by one of the devices available to the nuclear operator. By definition, this type of unavailability occurs in a random manner;
- scheduled: the frequency and cause are known and pre-established (preventive maintenance programme or surveillance tests). By definition, this type of unavailability occurs with a known frequency;

- other: neither unplanned nor scheduled. This is the case of unavailability that arises when modifications are being made, or even re-qualified, or when special checks are being carried out that have nothing to do with detecting faults.

An event is a case of non-compliance with a rule in the Technical Operating Specifications in a unit operating mode in which this rule must be complied with (exceeding a limit in an operating range, unavailability of a required piece of equipment). For each operating range, the Technical Operating Specifications describe the action to be taken after an event occurs: fallback mode, fallback (initiation) time or repair time.

The fallback mode is a reactor mode in which the event either does not affect unit safety at all, or affects it to a lesser extent. The transition from the initial operating mode to the fallback mode is made by applying normal operating procedures.

The actions for moving into the fallback mode absolutely must begin within the required "initiation" period which gives enough time to diagnose and assess the situation, consider repair and prepare for the transition to the fallback mode. The repair period is authorised so that work can be carried out and the required equipment made available again.

Any waiver from the Technical Operating Specifications must be exceptional and cannot come into force until the DGSNR has given its approval. To obtain this approval, a waiver request must be submitted to the ASN specifying: the requirement for which non compliance is intended, the need for the waiver and its acceptability in terms of safety, suggesting additional compensatory measures where appropriate.

19.2.3 Inspection, maintenance and testing of EDF reactors

19.2.3.1 Inspection and testing

Chapter 9 of the General Operating Rules describes the surveillance test and inspection programme for safety-related equipment. To check the availability of this equipment, particularly engineered safety systems that would be required in the event of an accident, tests are carried out regularly to check that it is operating correctly. The action to be taken if the result is negative is described in the Technical Operating Specifications. This type of situation can sometimes oblige the nuclear operator to shut down the reactor while the faulty function is restored.

Surveillance tests make it possible to guarantee the following during unit operation:

- that there is no deterioration in relation to the design reference state;
- that the hypotheses chosen for the design-basis conditions described in the accident studies of the Safety Analysis Report are complied with;
- that the equipment and associated fluids constituting the safety functions required in the Technical Operating Specifications are available;
- that the means essential for carrying out the incident and accident control procedures are available.

The surveillance tests described in Chapter 9 of the General Operating Rules apply to all safety-related systems (including those that are non safety class safety-related) in the nuclear plant. Nonetheless, the following are not included:

- systems that are subjected to other regulatory inspections;
- auxiliary systems whose availability is monitored continuously at all times and whose configuration does not change in emergency situations.

Surveillance tests are only valid if the level of safety set at the design stage has been reached, which requires that:

- unit design has already been validated by first-of-series tests on at least one unit in the series;

- the manufacturing quality has been checked for each unit in the series by a quality control process involving acceptance or qualification tests on commissioning;
- the acceptance or qualification tests mentioned above have not been jeopardised by maintenance, modifications or any other incident outside the normal operating range that may have impaired the performance levels of an item of equipment or functional sub-assembly. If this is not the case, a new inspection process, known as re-qualification, has to take place before the surveillance test programme can be resumed.

The most important systems in terms of safety are the subject of a document analysing their completeness. This document aims to determine all the checks required to ensure that the equipment is available and able to perform its function.

All systems important for safety are covered by a surveillance test rule which provides the information required for writing the test worksheets: conditions in which the tests are to be carried out, test acceptability criteria (allowable values of parameters and corresponding tolerance intervals) and frequency with which they are to be carried out. The test rules and corresponding tables are submitted to the ASN for approval.

Satisfactory completion of the surveillance test programme contained in the General Operating Rules is one of the conditions for declaring that equipment and systems are available, according to the definition of "availability" given in the Technical Operating Specifications.

Satisfactory completion means that the frequency allocated to a test has been complied with and that the results of the test are satisfactory (the values recorded during the test comply with the prescribed values, the conditions in which the test was carried out comply with the conditions described in the test rule, etc.). If this is not the case, the equipment in question should be declared unavailable.

There is a 25% tolerance on the frequency of tests that are carried out on a calendar basis (daily, weekly, monthly, annually, every thirty effective full power days, etc.). If advantage is taken of this tolerance, the timing of the next test should not be affected.

Chapter 10 of the General Operating Rules describes the physical test programme for reactor cores. It was written in 1997 to group together the existing tests.

19.2.3.2 Maintenance

Preventive maintenance is determined first of all by assessing the consequences of equipment failure. Critical equipment is equipment whose failure has at least one of the following consequences:

- a safety function is affected;
- output is reduced;
- costly repairs are required.

Analysing the failure modes of these types of equipment using available information (manufacturer data, operating feedback from EDF and other nuclear operators, etc.) can also help to determine which checks should be carried out.

Two types of document are prepared:

- maintenance doctrine, which brings together the results of the failure mode analyses and the justification for the checks that have been determined;
- basic preventive maintenance programmes which list the preventive maintenance tasks to be carried out on the different types of equipment.

These programmes include routine maintenance tasks and the associated frequency and the criteria for accepting the state of the equipment as observed during inspections and checks (conditional maintenance).

The doctrine and basic preventive maintenance programmes are modified as operating feedback is obtained on the behaviour of equipment during operation (failures, results of inspections and checks etc.) in order to reach the best compromise between maintenance costs and installation availability. EDF has launched an initiative known as optimisation of maintenance by reliability, aimed at optimising preventive maintenance.

Thus all maintenance programmes for safety-related systems have been modified. Analyses of equipment malfunctions during operation and reliability data are organised in such a way that they may be subsequently updated. In addition to this and with the same aim of optimisation, EDF has begun drawing up conditional maintenance programmes.

The Rules for in-service surveillance of mechanical equipment (RSEM) describes the basic monitoring operations carried out on mechanical equipment and pressure vessels during operation, in compliance with the regulations: inspections, trials, hydrostatic tests, non-destructive tests, monitoring of equipment for radiation, rules for replacing or repairing equipment. The Rules for in-service surveillance of mechanical equipment is taken into account in the basic preventive maintenance programme.

After maintenance work has been carried out or modifications made, and after an operating event has occurred, re-qualification tests are run to check that the performance levels required at the design stage have been maintained or recovered.

Re-qualification usually begins with re-qualification of the equipment (intrinsic re-qualification) and ends with re-qualification of the system or a functional sub-assembly (functional re-qualification). Re-qualification is an integral part of any work carried out. It is planned at the beginning of the operation, whether scheduled or unplanned.

Planning consists in determining:

- whether or not re-qualification is required;
- the nature of the re-qualification tests to be carried out (type of test, operating procedure, criteria to be met, test conditions);
- the additional or compensatory measures required if there are no suitable tests.

The maintenance documents contain the analysis made at the planning stage and the test report with the re-qualification results. The required qualification results have to be obtained and any deviations dealt with before the equipment or systems can be declared available again.

19.2.4 Managing incidents and accidents in EDF reactors

The operating parameters (pressure, temperature, neutron flux, activity, flow rate, etc.) are measured continuously by sensors and all help to indicate how reactor operation is progressing. If these pre-set values are exceeded, the automatic plant systems detect the fault and set off an alarm in the control room to inform the operators of the event and enable them to analyse the situation and take any operating action required, especially that laid down in the Technical Operating Specifications.

By analysing the alarms and physical values, the operator may be guided to an input diagnosis in an incident procedure.

Chapter 6 of the General Operating Rules describes the action to be taken in the event of an incident or accident. It contains the rules that lay down the operating principles adopted for maintaining or recovering the safety functions (controlling reactivity, cooling the core, containing radioactive products) in incident and accident situations and bringing the reactor back to a safe state.

The events postulated at the design stage, as part of the deterministic approach, have been used to identify operating conditions divided into four categories and their potential consequences on the installation and the environment.

The fact that the operating conditions in Category 2 (incidents) and Categories 3 and 4 (accidents) have been identified means that it has been possible to:

- design installations in such a way as to limit the consequences of incidents and accidents;
- determine how the installation should be operated in the medium and long term to keep the reactor in a safe state or make it safe by not exceeding the maximum radiological consequences for the corresponding category.

These studies are carried out on the following assumptions:

- conservative assumptions are made as regards the initial state of the unit and operation of all the systems (protection systems, engineered safety systems, etc.) called on during the transient,
- manual actions resulting from application of the operating procedures by the operators take over from automatic actions.

"Event-oriented" procedures were drawn up on the basis of the foreseeable development of the incident or accident so that the reactor can be brought into a safe state or kept there. These procedures apply if the event occurs in isolation (i.e. if it is not combined with another incident or accident) and if it has been correctly diagnosed.

The approach based on the physical states of the nuclear steam supply system was designed for dealing with an accumulation of human and equipment failures. Indeed, there is an infinite number of event combinations but only a limited number of physical states for the nuclear steam supply system. They can be identified on the basis of a few representative physical parameters. Generally speaking, the action required can be deduced from the knowledge of this state without necessarily having identified the sequence of events that led up to it.

The principles of the state-oriented approach are as follows:

- to identify the overall physical state of the installation, regardless of the situation, on the basis of six state functions: sub-criticality, water inventory in reactor coolant system, decay heat removal, integrity of steam generators and water inventory, containment integrity;
- to determine the general objective of the action to be taken as a direct result of this state (transition to a fallback mode for example);
- to prioritise the state functions;
- to identify all the actions required to bring the situation under control by checking the state functions (if the systems normally used are unavailable, substitute systems will be used in a given order of priority);
- to monitor the overall availability of the main systems used so that the substitute systems can be started up if required or the unavailable systems recovered.

Taken together, identification of the physical state, prioritising and checking the state functions to reach the overall objective constitute an operating strategy.

This process is repeated in cycles.

This operation covers all incidents or accidents described as being thermal hydraulic (loss of coolant accidents, secondary side breaks, core heating, etc.), either single or multiple, possibly combined with loss of systems, loss of off-site power or human failures.

19.2.5 Engineering in the EDF nuclear fleet

The EDF nuclear engineering team comprises two main sections:

- one section which forms part of the Nuclear Operations Department, and whose role is to support the task of the operator, taking responsibility for the performance levels of the reactor fleet over the short to medium term. This section is also responsible for drawing up inspection and maintenance policies, and providing immediate back up to sites dealing with technical hazards;
- the other section is grouped within the Nuclear Engineering Department, whose role is that of the owner-investor, responsible for developing and enhancing the value of its industrial assets. In addition to taking account of event operating feedback, its main tasks are preparing for the future to meet the main challenges of improving reactor safety, radiation protection and economic efficiency, improving fuel performance, and extending operating lifetimes and renewal of the fleet in optimum technical, economic and industrial conditions. The section is also responsible for dismantling shut down installations at the lowest cost, working within the restrictions in place.

Each section includes national bodies that specialise in various fields, and they are also supported by shared site engineering teams. Naturally, both sections are in constant contact, for two reasons: firstly, to ensure that operating requirements are taken into account in designs for changes to reactors; and secondly, to assist the operator in resolving operating problems notably concerning design issues.

19.2.6 Declaration of anomalies and incidents by EDF

EDF declares to the ASN all significant anomalies or incidents as soon as possible after detection. It takes the appropriate action in relation to its service providers. The declaration indicates which measures have been or will be taken to prevent the anomaly or incident from worsening and, where appropriate, to limit the consequences. If the installation is operating, the declaration specifies which steps have been or will be taken to continue or resume operation in satisfactory safety conditions.

Significant anomalies and incidents are analysed in depth to pinpoint both their causes and the direct or indirect consequences they have on safety. Useful lessons are also drawn for the activity whose quality has been affected. Other quality-related activities may also be considered. A file is created and updated for each significant anomaly and incident and contains, amongst other things, the results of this analysis. EDF keeps the ASN regularly informed of the state of this file.

19.2.7 Operating feedback at EDF

Operating feedback is extremely important at EDF since it now covers around 1200 reactor-years. The volume of information submitted by the 58 plants in operation requires a strict prioritisation process so that it can be dealt with in the most appropriate manner as regards safety. EDF has established three levels of priority:

- events that are important for safety are entered in a common database by the plants so that experience can be shared (around 10,000 events per year). These events are dealt with locally and are also examined weekly at corporate level by an interdisciplinary group. In this way, recurring problems and those that are potentially generic can be identified at an early stage.
- events that are significant for safety (around 400 a year) are analysed on site then examined at corporate level. Each plant uses the analysis method described in a guide drafted at corporate level and the appropriate training. Some analyses are made directly with the corporate support services if this is warranted by the importance or generic nature of the event.
- significant events that have the greatest effect on safety (around 40 a year) require assessment of the potential risk of core damage, using a probabilistic approach. The method used makes it possible to identify the most likely degradation scenarios and determine whether the incident is a

precursor of another situation. The corrective measures adopted depend on the extent to which the event is likely to lead to another event.

Grouping incidents of the same type together makes it possible to draw up action plans designed to prevent the recurrence of failure states or inappropriate actions. This is done after a second-level analysis has been carried out. The change in the number of incidents of a given type (alignment errors, non-compliance with the Technical Operating Specifications, etc.) can be considered as an indication of the effectiveness of the measures taken.

The equipment data stored in the database described above is examined periodically to detect any drift in reliability and to measure the beneficial effect of the maintenance measures or modifications applied.

19.2.8 Waste generated by EDF reactors

Waste management comprises the following main stages:

- waste zoning¹ ;
- collection;
- sorting;
- characterisation;
- treatment;
- storage;
- shipping.

Waste management, whether the waste is radioactive or conventional, complies with French regulations on waste removal and the recovery of materials.

Collection is a sensitive stage in the management of waste in nuclear installations. Waste is collected in a selective manner, either directly by the process or by sub-contractors on the work sites. Starting with the collection stage, the physical management of radioactive waste must be kept quite separate from that of conventional waste.

Sorting operations make allowance for the ways in which the waste is to be treated, packaged, transported, disposed of and recycled. Waste is usually sorted according to its physical and chemical characteristics (pre-characterisation): in particular, waste that cannot be disposed of in surface repositories is separated out, as is compactable or combustible waste and, in the case of radioactive waste, sorting makes allowance for activity level and radiochemical composition.

Waste is characterised in a qualitative and quantitative manner, usually once it has been sorted: mass, physical and chemical composition and properties, possible radioactive content, etc. This characterisation is required to comply with existing regulations and the associated technical specifications, particularly as regards the processes for treatment, packaging, disposal and recycling.

Waste for recycling or disposal is shipped only to companies that are authorised to receive waste of this type. There are special requirements for shipping radioactive waste.

It must be possible to trace all the stages of waste management from characterisation to disposal or recycling.

¹ "Waste zoning" divides the installations into zones generating nuclear (or radioactive) waste and zones generating conventional waste. It makes allowance for the design and operating history of the installations and is validated by radiological checks.

Since 1999, techniques exist for melting metal waste and incinerating combustible solid and liquid waste. Low level waste (steel, clothing, maintenance and dismantling equipment) can be treated before being put into surface repositories.

Solid low and intermediate level waste (short lived) is intended for disposal at the Aube repository operated by the ANDRA (French National Agency for Radioactive Waste Management). The volume of this waste is reduced by treatment at the CENTRACO plant prior to disposal at the Aube repository. The year 2003 saw the opening at Morvilliers of a new repository for very low level waste, adjoining the Aube repository. It will provide a means of optimising disposal of this kind of very low level waste, which is produced by both operational sites and installations being dismantled.

In 2003, operational PWR facilities produced 99 m³ of waste per reactor (average volume of solid waste processed over the year). This output has remained relatively stable over the last three years.

19.3 Measures taken for research reactors

19.3.1 Research reactor operating documents

There are three basic documents for the installation imposed by the regulations:

- the safety analysis report that describes the reactor, its components and their characteristics,
- technical requirements,
- general operating rules.

The basic documents are completed by a set of procedures and a set of orders guaranteeing that all operations would be carried out respecting applicable rules. Procedures and set values are managed by the departments concerned.

The operator must make sure that service providers respect these rules.

Exceptionally, the ASN may be requested to make temporary waivers based on a detailed safety analysis and a substantiation file.

Similarly, experimental devices designed and operated in the installations satisfy very strict safety requirements.

In particular, a complete safety analysis shall be carried out taking account of the safety documentation for the reactor, to demonstrate that possible risks have been taken into account and remain within acceptable limits.

Operation of the systems is only possible if an authorisation is received, either:

- internally if operating conditions respect safety rules defined in agreement with the ASN,
- or from the ASN if operating conditions are not within the predefined envelope cases.

This authorisation is given based on a complete file summarising rules adopted for the design and construction along with conclusions of the associated safety analysis.

This file also includes principles adopted for operation, inspection and maintenance of the experimental system.

19.3.2 Inspections, maintenance and tests

Periodic Inspections and Tests are carried out on Equipment Important for Safety (EIS) in each installation, to check that they are operating correctly and to ensure that they are available. Their intervals are defined precisely and they may be either calendar or event-based.

The list of periodic inspections and tests related to EISs is defined in section 9 of the General Operating Rules (RGE) for the installation. This list is much longer for the Phenix reactor than for other lower power reactors.

Satisfactory execution of these tests at their defined intervals, provides a means of declaring that the elements concerned are available. Preventive maintenance operations are also carried out on EISs subject to aging, fatigue, etc. The purpose of systematic maintenance is to guard against failures of this equipment and to keep it in a condition at all times such that it can carry out its function with the required performances. This preventive maintenance is carried out periodically together with periodic inspections and tests in accordance with validated operating methods and accompanied by a risk analysis when the work may have an impact on safety.

The description of these rules mainly concerns the Phenix reactor and their application to other, smaller, reactors is described in less detail.

19.3.3 Incident and accident procedures

Apart from the normal operating procedure, after seeing an analysis of alarms and operating parameters measured on the installation and forwarded to the control room, operators may decide to initiate an incident or accident procedure, or even a hypothetical or last resort procedure. This is the case particularly for the Phenix power station.

These procedures describe the behaviour to be followed in this type of situation, the objectives being to put the reactor into a safe state and to keep it in this state, and to limit the consequences of the incident or accident.

Operating rules to be followed in the case of incident or accident situations are described in section 6 of the General Operating Rules, and procedures for hypothetical and last resort situations are described in its section 10. They are approved by the Nuclear Safety Authority.

The description of these rules mainly concerns the Phenix reactor and their application to other, smaller, reactors is described in less detail.

19.3.4 Processing of anomalies and incidents

Anomalies are described in nonconformity forms and significant incidents are declared to the ASN. Anomalies and incidents are analysed with the personnel concerned. Operating feedback forms an integral part of the treatment of the deviation and the analysis is extended to include all equipment and systems that could result in such a deviation.

There have been very few significant incidents declared for research reactors during the last three years. Note:

- that stored nuclear materials were not included in the Safety Analysis Report,
- incorrect positioning of control chambers during reassembly after major works conducted on an installation,
- isolated loss of ventilation several times during stormy weather situations,
- a sodium - water reaction during restart of the Phenix power station.

All events are declared to the ASN, and they are the subject of a detailed analysis translated into a Significant Incident Report.

Moreover, the Directorate for protection and nuclear safety (DPSN) in the "risk control" Division has set up an operating feedback network with the cooperation of safety teams in the CEA centres. The associated information is passed on to installations during meetings attended by installation managers.

19.3.5 Research reactor waste

Waste production is also monitored continuously to reduce waste.

Three actions have been taken to reduce waste production:

- increased personnel awareness,
- an information campaign using posters,
- a selective sorting campaign.

19.4 Analysis by the regulator of nuclear reactor operation

19.4.1 Power reactor operation

As mentioned at the beginning of this report, nuclear reactors have not experienced significant events in recent years. This enabled the continuation of a more detailed review of their design and operating conditions, which may lead to the discovery or the rediscovery of hitherto underestimated hazards. This is for example what happened with the reassessment of the seismic risk or the review of the study into the possible clogging of reactor building sumps in the event of a primary leak, which resulted in the announcement of a modification plan for all reactors. Highlighting risks in this way is not in itself indicative of falling safety, and is on the contrary a means of improving it by taking a fresh look at problems that were wrongly considered to have been resolved. The following paragraphs mention the main current issues in terms of analysis of the operational safety of power reactors.

19.4.1.1 Maintenance rules

19.4.1.1.1 In-service inspection of primary and secondary systems (CPP and CSP)

In 2003, the various work programmes initiated by EDF for application of the ministerial order of 10 November 1999, concerning main primary and secondary system operation, were as follows:

- reference dossiers: in 2003, the ASN continued to examine the reference dossiers, supplemented by EDF on several issues, and carried out site inspections to assess the implementation of the documentation systems,
- maintenance works: the ASN took two decisions in May 2003 concerning the review of maintenance files and the classification of maintenance work respectively,
- qualification procedures of non-destructive tests: the ASN carried out inspections to assess the EDF's work programme designed to ensure that it is in possession of all qualified applications by the regulatory deadline of 29 November 2004.

19.4.1.1.2 The CPP and CSP reference dossiers

Article 4 of the Order of 10 November 1999 requires that the operator draw up reference dossiers for the reactor main primary and secondary systems. These dossiers, based upon the initial design and manufacturing files of these systems and on the consideration of operating feedback, must justify that equipment integrity of these systems is maintained with time. The operator must regularly update these dossiers and periodically incorporate operating feedback.

In 2003, the ASN continued the review of these files, in particular on the issues related to the justification of operating conditions, to the mechanical behaviour of equipments and to prevention of sudden rupture. The conclusions of this review will allow in addition to enhance the data needed for the review of in-service inspection programmes.

The implementation of regulatory requirements has also resulted at each site in the implementation of a documentation system offering easy access to the findings likely to concern sustained equipment integrity (manufacturing files, incidents, operating conditions, maintenance works on equipments, etc.).

The ASN has observed, during inspections conducted in 2003, that the implementation of documentation systems has begun on the sites, albeit incompletely, in particular for monitoring of the parts of the main secondary systems subjected to high cycling loads.

19.4.1.1.3 The revision of the primary and secondary systems maintenance work programme

Ministerial decision DGSNR/SD5/030191, signed on 13 May 2003 and implementing article 10 of the order of 10 November 1999, sets the terms for reviewing the dossiers related to maintenance works on the main primary or secondary systems of pressurised water reactors.

Among the maintenance works on primary or secondary systems, not all have the same complexity or the same importance. The decision thus categorises the works as: light, medium or heavy. The dossiers may be reviewed either regionally by the competent DSNR or nationally by the BCCN. In this latter case, EDF must designate a central correspondent who is responsible for the design of the maintenance work. The classification also determines the conditions for requalification of the work, guaranteeing its quality and the subsequent ability of the reactor to operate.

Decision DGSNR/SD5/030191 does not specify the principles for the technical classification of the maintenance works. The operator has to define a category for each maintenance task and to inform the ASN of the principles chosen for this. However minimum criteria are specified in decision DGSNR/SD5/030192, signed by the ASN on 15 May 2003. The operator is bound to apply these criteria until such time as it has issued requirements in construction code RSE-M, considered by the ASN to be in conformity with the order of 10 November 1999 and its implementing circular.

These criteria link the technical classification of a maintenance work not only to its risk to the integrity of the equipment, but also to the checks performed after the work in order to requalify the equipment. For instance a manual weld on a pipe requalified by two distinct volumetric checks can be classified as medium, whereas one with only a single volumetric check would be considered as heavy.

The technical classification rules are being codified in the RSE-M code. They were the subject of an amendment to the code which is under review by the ASN in order to check its compliance with the principles of decision DGSNR/SD5/030192.

19.4.1.1.4 Maintenance work on primary and secondary systems

Article 8 of the Order of 11 November 1999 specifies that “non-destructive testing processes used on operational equipment must be qualified prior to use by an entity [...]” whose competence and independence must be proven.

The aim of this procedure, resulting from discussions at international level, is to demonstrate that the examination method used is suitable for detecting the damage it is supposed to be looking for. A description of the qualification process has also been codified in the in-service surveillance rules for mechanical equipment (RSE-M). Depending on the case it is either to demonstrate that the checking technique used allows the detection of damage as described in the specifications or to clarify the performance of the method.

A stipulation in the Order of 10 November 1999 is that the responsibility of declaring qualification should be entrusted to a qualification commission apart from the ASN, but duly recognised as competent and independent of both the reactor operators and those directly involved in developing the processes. This commission was accredited by the COFRAC (French Committee for Accreditation). It must assess the representativeness of the mock-ups used and any defects incorporated and must then check that the examination method effectively meets the performance required to satisfy specifications on the basis of the qualification results.

Implementation of these new measures will require a period of transition. The Order thus provides for the use up until 29 November 2004 of non-destructive test processes, for which qualification has not yet been confirmed.

At the request of the ASN, the operator in 2002 proposed a programme which should enable it to be in possession of all the qualified applications by the end of the transitional period. The inspections carried out by the ASN in 2003 to assess the implementation of this programme have highlighted shortcomings in the knowledge of and compliance with the deadlines by the entities concerned. This led the ASN to ask the operator to set up a more rigorous organisation in order to comply with the regulatory deadline. After assessing the situation, the operator at the end of 2003 signalled its intention to request a waiver to the 10 November 1999 order for part of the checks to be performed during in-service inspection.

19.4.1.1.5 Maintenance optimisation through reliability

In 2003, the Nuclear Safety Authority reviewed the new method for maintenance of active, mainly electromechanical equipments (pumps, valves, etc.), installed by EDF in the mid-1990s. This method, derived from American practices known as "Reliability Centred Maintenance", was adapted by EDF under the name "Maintenance optimisation by reliability" (OMF). It is intended to improve the effectiveness, the rationality and the traceability of basic programmes for preventive maintenance depending on safety, availability and cost issues.

The OMF method derives from a functional approach which determines the maintenance to be performed as a function of the consequences of the equipment failure and not only as a function of their causes as in the traditional approach.

The ASN feels that adopting this approach entails not major safety drawback. The ASN however asked EDF to provide it with a quantitative and detailed report of its implementation and to add clarification, in particular with respect to the conditions for taking account of common mode failures. EDF has begun modification of this method, leading to "OMF 2nd generation", which is gradually being implemented in the NPPs. The ASN will soon review this new method and its implementation.

19.4.1.2 The general operating rules (RGE)

19.4.1.2.1 Operating Limits and Conditions

In 2002 and 2003, the ASN reviewed and approved a number of changes to the technical operating specifications (STE) containing the Operating Limits and Conditions (OLC) applicable to all plant series. The particular purpose was to take account of operating feedback and changes in fuel management. Examination of these changes led it to make a number of requests prior to the implementation of these OLC amendments on the sites.

19.4.1.2.2 Waivers with respect to OLCs

When an operator feels that, on safety grounds, it is unable or does not wish, to comply strictly with OLCs during an operating phase or a maintenance operation, it must apply to the Nuclear Safety Authority for a waiver, on a case by case basis. The Nuclear Safety Authority examines the request and decides whether it is acceptable, imposing compensatory measures for non-compliance with OLC requirements where appropriate.

However, the DGSNR attaches importance to the precedence of the OLCs and remains vigilant regarding limitation of the number of waivers. To this end, the Nuclear Safety Authority has, since 1993, undertaken continuous action aimed at obtaining from EDF:

- a review of the grounds on which the waiver application is submitted in order to identify those which justify OLC adaptations,

- anticipation by Head office departments of site requirements, notably those related to nationally imposed modifications and to periodic testing.

This action has resulted in a limitation of the number of waivers: 75 waivers examined in 2003 as compared with the 128 waivers examined in 2000.

19.4.1.2.3 Periodic tests

The ASN continued its examination of changes in the periodic tests programme within the general operating rules (RGE). This mainly resulted, on CPY and N4 series, in the achievement of consistency between periodic tests and the other chapters of the RGE.

In addition, following the inspection of EDF corporate division upon the metrology topic, the ASN has recalled the need to consider the measurement uncertainties when elaborating periodic testing rules and requested EDF to propose deadlines for the revision of test rules with taking into consideration this issue.

19.4.1.3 Incident and accident operation

19.4.1.3.1 Implementation of state-oriented approach (APE)

Until 1989, reactor operating procedures for incident and accident situations were based on an event-oriented approach. The event-oriented procedures proved unable to manage situations involving combinations of human or equipment failures in addition to the initiating event. EDF consequently decided to gradually replace the event-oriented approach by the new state-oriented approach (APE) whereby plant operation is adapted to actual NSSS conditions. The objective of the APE operating procedures is then to restore the degraded function or functions by following an action plan defining priorities.

The implementation of APE procedures on French nuclear fleet was almost completed at the end of 2003. In 1989, the ASN authorised adoption of APE operation for the 1300 MWe/P'4 reactors series, subsequently extended in 1996 to cover the 1300 MWe/P4 series, followed by the N4 reactor series as of initial startup. In 2001, the ASN approved a further development of the APE procedures for the 1300 MWe reactor series covering all operating condition of these reactors. In 1998, the ASN authorised adoption of the APE procedures for the 900 MWe/CPY series of reactors. The first application of these procedures to this series, on the Tricastin -1 and -2 reactors, was subject to prior authorisation, in view of the issues at stake related to its first implementation. During the course of 2000, only Tricastin -3 and -4 were authorised to switch to APE operation. In 2003 the APE operation was extended to the entire 900 MWe/CPY series with the exception of Saint-Laurent-1 and -2 due to switch to APE during 2004. As regards the 900 MWe/CP0 series, the ASN in 1999 and 2000 authorised adoption of the APE procedures for the Fessenheim and Bugey reactors.

19.4.1.3.2 Reactor operation in severe accident situations

Severe accidents, not taken into account at the initial PWR design stage, are nonetheless the subject of specific provisions to limit their consequences for the environment and the public. These provisions are of technical nature (containment venting system, passive autocatalytic hydrogen recombiners, etc.), of documentary nature (Guide for intervention in severe accident case, "ultimate" beyond design procedures) and organisational nature (the management of severe accident is explicitly provided for in on-site and off-site emergency plans).

Their assessment is associated with no regulatory deadline such as a periodic safety review. In addition it is based on no clearly defined safety requirement reference system. In view of available knowledge in this respect at the present time, the ASN considers that such a reference system should now be defined for operating power reactors. It should define the approach and objectives regarding prevention and mitigation of the risks associated with severe accidents, the studies required to demonstrate regard for

the defined objectives together with the practical provisions adopted and their design basis. In 2002, EDF forwarded a draft "severe accident" reference system to the ASN. This draft reference system has been submitted to the Advisory Committee for nuclear reactor for examination in 2004.

19.4.1.4 Analysis of incidents and operating feedback

Significant anomalies or incidents are subjected to thorough analysis to accurately determine their causes and their direct or potential safety consequences and to derive useful lessons for the quality-related activity affected and, where appropriate, for other quality-related activities. A dossier is prepared and kept updated for each significant anomaly or incident, notably containing the elements of this analysis. The operator periodically provides the ASN with information on the stage reached in this dossier.

Over the period 2001-2003, the number of significant events in EDF nuclear power plants remained relatively stable at around 500 per year, about one hundred of which were each year rated at INES level 1 and about one per year rated at level 2 on the same scale; no incident was rated above level 2. To this number should be added the incidents related to radiation protection which are also declared since 2002 and the number of which reached 150 in 2003.

The programme proposed and implemented by EDF to cope with safety significant events is monitored by the ASN.

Four events that occurred in nuclear reactors over the last three years were rated at level 2 on the INES scale by the ASN:

- in April 2001: an error in the refuelling sequence resulted in incorrect positioning of 113 fuel assemblies in the Dampierre-4 reactor core (rated level 2 in October),
- in January 2002: an error during maintenance of an electrical switchboard in Flamanville-2 led to the loss of one of the two redundant power supply channels and of the I&C system with damage to several safety-related pumps,
- in December 2003, generic anomaly: anomaly affecting the sump strainer filters likely to result in them becoming clogged in the event of a LOCA,
- in April 2004, generic anomaly: anomaly likely to affect some electrical connection boxes needed for operation of some equipment in accident conditions if steam or water is present in the reactor building.

19.4.1.5 Waste management

The ASN took a decision on 10 November 2000, aimed at improving onsite very low level (VLL) waste interim storage conditions. Some difficulties with disposal channels had indeed led to the accumulation of some of this waste on the sites. This decision in particular required that, within a period of two years, provisions should be made for interim storage on the sites of highly calorific VLL waste in better adapted, long-term installations. Pending availability of these installations, limits were also imposed on the provisional utilisation of the former interim storage areas. The situation has become today acceptable.

The ASN asked the Advisory Committees for nuclear reactors and for waste to undertake an assessment of EDF management of the waste produced by its nuclear installations. This assessment notably concerned measures taken with a view to improving waste management, from production to final disposal. Its conclusions were then transformed into ASN requests at the end of 2002. In particular, the situation of certain onsite storage facilities requires further safety analysis, which is currently being examined by EDF.

The waste surveys play an important part in the assessment requested from the Advisory Committees. These surveys were imposed under the interministerial order of 31 December 1999 concerning general environmental provisions and were made available for all EDF nuclear power plants before the cut-off date of 15 February 2001. In the light of a preliminary examination of these waste surveys, the DGSNR has informed all nuclear operators of the main principles to be taken into account.

19.4.2 Research reactor operation

A specificity of a number of research reactors is the frequent change in the reactor core configuration, together with the introduction, sometimes for a very short period, of experimental irradiation devices within the reactor core.

The ASN is particularly vigilant with regard to these operations, owing to the corresponding risks, in particular concerning control of reactivity (chain reaction) and damage to fuel elements.

Significant work was done in 2003 concerning experimental devices. At the beginning of 2004, the ASN issued a note providing a framework for the conditions of design, manufacturing and authorisation of these devices. This note requires that periodic safety reviews be conducted on all experimental devices every ten years, which is an innovation with very positive safety implications.

An inspection campaign into the management of research reactor core configurations was organised at CEA in 2001 and works to improve supervision of configuration modification operations will begin in 2004.

19.5 Operational safety review by international organisations

France's international co-operation in terms of nuclear safety is presented in Chapter 20. In this context, mention should be made in this chapter of the safety assessments carried out, at France's request, by experts from foreign countries acting on behalf of two international organisations already mentioned: the International Atomic Energy Agency (IAEA) and the World Association of Nuclear Operators (WANO).

19.5.1 IAEA assessments

For many years France has asked the International Atomic Energy Agency to perform OSART missions, and also ASSET missions, on French nuclear power plants. Finally, a PROSPER mission to assess the overall system of operating feedback analysis was carried out at the EDF corporate division at the end of 2003. French experts also take part in similar missions in foreign countries. The following table lists all the missions carried out and scheduled as at the end of July 2004.

| Date | Mission | NPP |
|-----------------------|-----------------|-------------------------------|
| October 1985 | OSART | Tricastin |
| October-November 1988 | OSART | Saint-Alban |
| January 1992 | OSART | Blayais (limited to 3 topics) |
| March 1992 | OSART | Fessenheim |
| May 1992 | ASSET | Fessenheim |
| March-April 1993 | OSART | Gravelines 3 and 4 |
| November 1993 | ASSET | Paluel |
| March 1994 | OSART | Cattenom |
| November 1994 | OSART Follow-up | Gravelines 3 and 4 |
| January-February 1995 | OSART | Flamanville |
| June 1995 | OSART Follow-up | Cattenom |
| June 1996 | OSART Follow-up | Flamanville |
| November 1996 | OSART | Dampierre |

| Date | Mission | NPP |
|------------------------|-----------------|------------------------|
| January 1998 | OSART | Paluel |
| June 1998 | OSART Follow-up | Dampierre |
| October-November 1998 | OSART | Golfech |
| February 1999 | OSART | Bugey |
| June 1999 | OSART Follow-up | Paluel |
| March 2000 | OSART Follow-up | Golfech |
| June 2000 | OSART Follow-up | Bugey |
| October 2000 | OSART | Belleville |
| January 2002 | OSART | Tricastin |
| May 2002 | OSART Follow-up | Belleville |
| January-February 2003 | OSART | Nogent |
| May 2003 | OSART | Civaux |
| November 2003 | OSART Follow-up | Tricastin |
| November-December 2003 | PROSPER | EDF Corporate Division |
| November 2004 | OSART Follow-up | Nogent |
| November-December 2004 | OSART | Penly |
| December 2004-2005 | OSART Follow-up | Civaux |
| Mai 2005 | OSART | Blayais |

The reports of all these missions are made public..

19.5.2 WANO peer reviews

Similarly, in order to increase the number of outside opinions on its installations and their operation, EDF welcomes review missions from the World Association of Nuclear Operators (WANO "Peer Reviews") and takes part in similar assessments abroad.

The table below indicates the WANO missions already carried out and scheduled in France.

| Date | NPP |
|-------------|--------------------------------|
| 1994 | Nogent-sur-Seine |
| 1996 | Chinon |
| 1996 | Blayais |
| 1997 | Penly |
| 1998 | Saint Laurent |
| 1999 | Saint Alban |
| 2000 | Cruas |
| 2001 | Flamanville |
| 2002 | Chooz |
| 2003 | Fessenheim; Corporate division |
| 2004 | Cattenom; Dampierre |
| 2005 | Golfech; Paluel |

France benefits greatly from these external assessments and intends to continue this policy of regular recourse to international experts.

20 Planned activities to improve safety

France is committed to continuing to look for ways in which the safety of its nuclear installations can be improved.

20.1 National measures

20.1.1 Objectives of the Nuclear Safety Authority

With this national objective in mind, the top priorities of the Nuclear Safety Authority concern:

- improving the consideration of human factors and organisational problems by the operators, these problems being the cause of numerous events,
- improving radiation protection monitoring in order to reach the same level as that obtained for nuclear safety,
- ensuring better consideration of environmental issues, in particular when renewing release licences,
- anticipating ageing problems, in particular through exhaustive preparation of the ten-yearly outages so that when the time comes, decisions can be taken regarding continued operation of the reactors beyond these milestones, this in particular concerns the power reactor third ten-yearly outages,
- issuing regulatory texts to better formalise requirements and practices which are currently enforced informally, in order to ensure that the ASN's position is clear in a future context in which the economic constraints on the operators will be both greater and more uncertain.

20.1.2 Objectives of the operators

20.1.2.1 Objectives of EDF

EDF aims to raise the economic performance of its industrial resources, whilst improving safety, radiation protection and environmental protection. With this in mind, the operator considers the following to be priority actions:

- consolidating future reactor operation by taking full advantage of operating feedback (including international feedback). In particular, this means successfully completing projects associated with this operating feedback, notably those concerning external flooding and the heatwave;
- guaranteeing and extending the lifetime of reactors in optimal conditions. In particular, this means successfully preparing and conducting ten-yearly outages, and monitoring and controlling the ageing of facilities;
- ensuring that reactors comply with the requirements set out in the safety reference system, by dealing with any deviations from them in a rigorous and suitable manner;
- stabilising requirements reference systems by accepting only those changes that present the most advantages in terms of the safety cost/benefit ratio;
- reducing the cost of fuel and raising the potential availability of reactors through improved fuel management techniques and better quality fuel.

20.1.2.2 Objectives of the CEA

The CEA works continuously in the safety field and also in the radiation protection, environment and quality fields, to guarantee maximum safety in the operation of its installations.

The CEA's priority objectives are as follows:

- provide the training courses necessary for maintaining the safety culture,

Conclusion - Planned activities to improve safety

- obtain the ISO 9000 - V2000 certification to ensure that good methods are maintained in the long term and to guarantee that the reference documentation is kept up to date,
- analyse and take account of operating experience feedback,
- control ageing of installations and guarantee that components are replaced at the end of their life,
- develop application of the ALARA method, in order to reduce personnel doses.

20.1.2.3 Objectives of the ILL HFR

A continuous improvement process is carried out for the intrinsic and operational safety of the HFR. It should be noted that current emphasis is on resistance to earthquakes. Similarly, in the context of the renewal of the release licence, all operating processes are reviewed in order to optimise liquid and gaseous effluents. For example, this analysis leads to a commitment to install a buffer tank enabling a certain number of gaseous releases from the reactor to be delayed. The purpose of these studies and improvements is to achieve an impact on the environment and neighbouring populations, of about one hundredth of the limit for the general public, which is a value conventionally considered as "residual".

20.2 International co-operation measures

20.2.1 The Nuclear Safety Authority's international involvement

20.2.1.1 General policy

The Nuclear Safety Authority (ASN) is entrusted with international assignments which, like its other activities, have developed and expanded with the passing years, the objectives of which are the following:

- develop exchanges of information with its foreign counterparts on regulatory systems and practices, on problems encountered in the nuclear safety field and on the steps taken, with a view to enhancing its approach, to become better acquainted with the actual operating practice of these Nuclear Safety Authorities, from which lessons could be learned for its own working procedures, feeding technical discussions with the French operators by practical knowledge of conditions abroad,
- make known and explain the French approach and practices in the nuclear safety field and provide information on measures taken to deal with problems encountered,
- provide the countries concerned with all relevant information on French nuclear installations located near their frontiers.

These objectives are pursued within the framework of bilateral agreements but also through ASN participation in proceedings organised by international bodies like the IAEA, the OECD and the European Union, together with those of Nuclear Regulator associations.

Within the framework of this policy, France has ratified several international Conventions dealing with nuclear safety and in particular the present Convention.

20.2.1.2 Multilateral relations

The ASN is closely involved in IAEA activities in the nuclear safety field, the aim of which is to make known and promote practices enabling a high level of nuclear plant safety to be achieved in all the member states. In this respect it takes part in the work of the Commission on Safety Standards and its four specialised Committees for nuclear installation safety standards (NUSSC), radiation safety standards (RASSC), radioactive waste safety standards (WASSC) and radioactive material transport

safety standards (TRANSSC). They develop standards describing the safety principles and practices that can be used by Member States as a basis for their national regulation. The ASN also calls upon IAEA services intended to give advice on specific issues relating to installations safety. Since 1991, an OSART mission has been performed each year in France, together with a follow-up mission since 1994. Since this same date, the Safety Authority has been using the International Nuclear Event Scale (INES), intended to promote consistency in public information at international level. Finally the Safety Authority takes part in numerous assistance programmes set up by IAEA at the request of the Member States.

The ASN participates in the work of OECD/NEA specialised committees. Firstly, it takes part in the work of the Committee on Nuclear Regulatory Activities (CNRA) created in 1989, which ensures regular consultation between regulators of member states.

The ASN regularly takes part in the activities of working groups on reactor safety set up by the European Commission within the framework of a Council resolution dated 22 July 1975. This resolution acknowledges the value of a common approach to technological issues relating to nuclear safety, with due consideration to the duties and responsibilities incumbent on national authorities.

The ASN also takes part in the work of associations of heads of regulatory authorities:

- the International Nuclear Regulators' Association (INRA) thus, since 1997, brings together Canada, France, Germany, Japan, Spain, Sweden, the United Kingdom and the United States,
- since 1999, the Western European Nuclear Regulators' Association (WENRA) brought together the heads of Regulatory Authorities from western European countries with nuclear installations (nine EU countries and Switzerland). Since early 2004 WENRA now also includes the heads of the Safety Authorities of the new member states and of the 2 candidates with nuclear installations (7 other countries). The objectives of the association are twofold: to develop a common approach to nuclear safety and regulation, in particular within the European Union and to provide the European Union with an independent capability for examining nuclear safety and regulation in applicant countries.

Finally, the FRAREG Nuclear Regulators Association (FRAmatome REGulators) was officially created in May 2000. It includes the heads of the Belgian, Chinese (People's Republic), South African, South Korean and French Safety Authorities. Its main objectives are to exchange experience gained from supervising the operation of reactors designed by the same company and to compare approaches adopted to deal with generic problems and assess installation safety.

20.2.1.3 Bilateral relations

Close relationships, managed by liaison committees that meet at least once a year, have been established between the ASN and about fifteen foreign Safety Authorities. They are an essential part of the ASN's international cooperative programmes.

One of the means adopted to achieve this objective is to promote staff exchanges between the ASN and Nuclear Safety Authorities in other countries. Provision is made for several types of exchange:

- very short term actions (1 to 2 days), where cross-inspections are proposed to ASN counterparts: they consist in inviting foreign inspectors to take part in inspections carried out by inspectors of the country concerned. Since 1997, 8 to 10 cross-inspections have taken place each year, either in France, or in the border countries (Belgium, Germany, Spain, the United Kingdom and Switzerland),
- short term assignments (a few weeks), aimed at studying a specific technical topic. Since 1997 the ASN has sent four engineers abroad and has welcomed five foreign engineers for such assignments,
- long term exchanges (about 3 years), aimed at studying in detail the working procedures of foreign Nuclear Safety Authorities. Since 1997 six ASN engineers have been seconded for three years to foreign Safety Authorities (USA, Canada, United Kingdom and Spain). Since 2000, two inspectors

from the Spanish Safety Authority and two inspectors from the UK Safety Authority joined the ASN, each for a 9 to 18 month period.

20.2.1.4 Assistance programmes and their coordination

The Munich G7 Summit of the world's seven most industrialised countries in July 1992 had defined the priority areas for assistance to Eastern European countries in the nuclear field:

- contribute to improving the operating safety of existing reactors,
- provide funding for short-term improvements to the least safe reactors, in exchange for firm closure commitments,
- improve safety supervision organisation, making a clear distinction between the responsibilities of the different entities concerned and reinforcing the role and scope of local Nuclear Safety Authorities.

The first two topics come within the competence of safety assessment organisations, nuclear plant operators and manufacturers.

As regards assistance to Safety Authorities, covered by the third G7 priority area, the ASN takes part in the RAMG (Regulatory Assistance Management Group) programmes funded by the European Union within the framework of the PHARE and TACIS budgets for assistance to the Eastern European countries.

Generally speaking, these programmes initially consist of transfer of methodology and practices to enable beneficiary countries to better determine or specify their regulatory systems.

A second step in these assistance programmes is to advise these countries in setting up the regulatory system that they have decided to adopt, for instance by performing a critical review of their draft regulatory texts.

20.2.2 The IRSN's international involvement in reactor safety

Within the scope of the duties assigned to it by the Public Authorities, the Institute for Radiation Protection and Nuclear Safety (IRSN) develops international relations with regard to research and expertise in such activities as nuclear plant safety, radioactive material transport safety, human and environmental protection, safeguard of nuclear materials as well as organisation and training to emergency situation management.

The IRSN international activities are aimed at three basic objectives:

- increase the scientific and technical knowledge required for a better assessment of risks and their management,
- contribute to the creation of international consensus both for technical questions and establishment of guides, recommendations and standards,
- take part in the implementation of projects aimed at increasing radiation protection, nuclear safety and security abroad.

These activities are conducted within the scope of bilateral and multilateral co-operations, works performed under the auspices of such international organisations as the IAEA, the OECD Nuclear Energy Agency (NEA), the United Nations Scientific Committee on the Effect of Atomic Radiation (UNSCEAR), the International Commission on Radiological Protection (ICRP) or the European Commission, but also during services or co-operation projects developed by the IAEA, the European Commission or the European Bank for Reconstruction and Development. Some of them are conducted to support the ASN's international activities.

The description of the IRSN international activities provided in this report mainly concerns the power reactor safety.

20.2.2.1 Increasing scientific and technical knowledge

Knowledge increase relies on the development of research programmes and experience sharing.

With regard to research, the IRSN implements various research programmes, together with foreign partners and, for some of them, with the European Commission, covering severe accidents on pressurised water reactors (PHEBUS-FP programme), design basis or beyond design basis accidents on fast neutron reactors (CABRI-RAFT programme completed in 2001) and reactivity accidents in pressurised water reactors (CABRI-REP programme).

Furthermore, the IRSN is involved in numerous research activities conducted abroad and more specially the study of in-vessel or ex-vessel corium behaviour (NEA MASCA and MCCI programmes), the study of PWR vessel rupture modes (NEA OLHF programme) or in projects of the European framework programme for research and development (5th and 6th PCRD) devoted to severe accidents. In this respect one should mention the IRSN's coordination of the SARNET excellence network, as part of the 6th PCRD, one of its objectives being to make the ASTEC integrated code, the reference European code for severe accidents.

Finally, in association with partners from Europe, Eastern Europe and Japan, the IRSN, is using this research as a basis for work on qualifying and improving the computer codes used for PWR safety studies mainly with regard to modelling of severe accidents, determining possible releases in the event of a severe accident with core melt and hydrogen behaviour within the reactor containment in the event of a such an accident.

20.2.2.2 Intensified international consensus

The IRSN is actively involved in the activities of NEA specialised committees, and more specially those of the Committee on Safety of Nuclear Installations (CSNI) dedicated to operating experience, comparison of computer codes and in-depth analysis of topics essential for safety.

Similarly, the IRSN is involved in the IAEA's works on drafting recommendations, guidelines and standards, especially to support the ASN on the specialised committees of the Commission for Safety Standards (CSS).

Finally, the IRSN is developing numerous bilateral co-operative programmes for experience sharing and progress towards harmonised technical safety practices. Among the main topics currently being dealt with in this respect, are probabilistic safety assessments, the safety reviews of installations and the safety assessment of digital protection systems. In this respect, the assessment work conducted by the IRSN and GRS on the safety options for the EPR (European Pressurised water Reactor) project is an example of harmonisation based on the assessment of a French-German industrial project. It should also be mentioned that the GRS, IRSN and AVN have initiated a comparative analysis of the safety assessment methods they use and of the main aspects to be considered in the analysis of safety issues encountered, in order to facilitate experience sharing, the performance of common or complementary works and the comparison of results obtained.

20.2.2.3 International co-operation

The IRSN is involved in consultations organised by the French authorities, the European Commission and the EBRD with regard to co-operation programmes to be implemented to contribute to the improvement of safety in foreign nuclear plants.

The IRSN also takes part in implementing of co-operative projects conducted with safety organisations abroad and intended for transferring methods and regulatory practices, adapting and transferring analysis tools and conducting safety assessment works.

In recent years, these co-operative projects primarily involved Chinese and Eastern European partners.

20.2.3 EDF's international activities concerning reactor safety

EDF engages in international activity in four main areas:

- it exchanges operating feedback with other bodies; this process includes "twinning", which provides information and knowledge that can be used to improve the levels of safety and competitiveness at French installations;
- EDF sends acknowledged experts to take up positions in international institutions;
- it acts in a consultancy role and provides services in the form of contracts;
- it prepares tomorrow's reactors and carries out a technological watching brief.

20.2.3.1 Exchanges of experience

Around thirty "twinning" agreements between French nuclear plants and facilities on other countries form the main framework of these exchanges. Reciprocal visits and seminars provide a forum for direct exchanges between operators from different cultures, who work in contrasting political or economic environments.

Two new agreements were signed in 2000, one between the Saint-Laurent nuclear plant and the Japanese facility at Tokai (JAPCO), the other between the Chinon nuclear plant and the American DC. Cook facility (AEP). Recently in 2003, a twinning agreement was signed between the Cruas plant and the Chinese operator of the Qinshan 2 facility (two 600 MW units with a dual circuit reactor, which was designed along similar lines to the French 900 MW reactors). The Nuclear Operations Department has also recently signed a cooperation agreement with Qinshan 2.

There have been exchanges of engineers between French and American plants or visits to foreign installations. These initiatives have focused on specific activities such as reactor outages, maintenance, safety or radiological cleanliness management. Information relays have also been established to help promote safety and mutual technical improvements. During the summer of 2004, an EDF engineer will be seconded for 2 years to an American plant owned by SNC (Southern Nuclear Company), which operates 6 nuclear reactors. In exchange, SNC will take part in several technical missions in France.

20.2.3.2 International institutions

International institutions promote cooperation between governments or nuclear operators across the world (World Association of Nuclear Operators – WANO), with the aim of strengthening the global safety and operating reliability of nuclear plants. In 2003, the Director of the Nuclear Operations Department was elected president of the Paris WANO centre. In this capacity, he sits on the world governing board, which defines and approves the policies of the various WANO centres. The Paris WANO centre includes 7 engineers seconded from the Nuclear Operations Department, including the Centre Manager.

Every year, EDF participates in OSART (Operating Safety Assessment Review Team) missions carried out at the request of national safety authorities (see § 19.5). In 2000, EDF sent two representatives for two OSART missions outside France (North-Anna/USA and Temelin/Czech Republic), while the Belleville nuclear plant received an OSART in October and the plants at Golfech and Bugey received their OSART follow-up.

In the same spirit, WANO is developing "Peer Reviews". These are plant assessments which cover technical and managerial fields, and which are carried out by foreign operators (see §19.5). Peer

Conclusion - Planned activities to improve safety

Reviews are also an opportunity for productive exchanges between the assessment team and the operators of the plant being inspected. In 2000, 34 such "peers" from the Nuclear Operations Department took part in 11 Peer Reviews organised by 4 WANO centres around the world. This participation of many EDF peers in Peer Reviews organised by WANO continued in 2001, 2002 and 2003. Every year one or two of EDF's Nuclear power plants hosts a WANO Peer Review : Cruas in 2000, Flamanville in 2001, Chooz in 2002, Fessenheim in 2003, Cattenom and Dampierre in 2004. At the end of the year 2003, the Director of the EDF Nuclear Operations Division asked WANO to carry out a corporate peer review. It was the first time in France and in the world that such a peer review has been performed. It was designed to evaluate the efficiency of the Division's management system, the relationships between Nuclear Power Plants and corporate level and the quality of technical support provided by the engineering bodies to the Nuclear Power Plants

At the end of 2003, the director of the Nuclear Operations Department also decided to invite foreign counterparts to take part in the internal inspection programme carried out by the Nuclear Inspectorate, to obtain an outside view of these audits. EDF has also played an active role in other programmes developed by WANO, notably those concerning operating feedback, technical meetings (environmental workshop at Chinon in December) and performance indicators. In particular, the events at the Blayais (partial flooding in December 1999) and Tricastin plants (exposure of a radiation protection technician to radiation in March 1999) were examined in extended reports, circulated on the WANO network. All sites are able to connect to the WANO network, and take advantage of the lessons learned as a result of the experiences of other operators. In particular, access to SOERs is promoted, thereby ensuring that the recommendations resulting from WANO assessments are taken into account as close to the field as possible.

Furthermore, EDF is a member of the Framatome Owners Group (FROG), whose Steering Committee convened recently at the beginning of 2004. These meetings provided an opportunity to organise technical exchanges, notably on recent events that have been experienced by nuclear operators who belong to the association, and to review studies conducted jointly by the different partners.

EDF is also a member of the Westinghouse Owners Group (WOG), whose first European conference was held in France at EDF on 20 and 21 October 2003. Its aims were to strengthen relations between European and American electricity utilities and to identify areas for cooperation. The discussions mainly concerned materials (the impact of ageing), safety and human factors and the issue of maintaining skills.

EDF is a member of the Electric Power Research Institute (EPRI), which has become a pre-eminent body in the field of R&D for the electrical industry, not just in the United States but worldwide (in the nuclear field, EPRI represents three quarters of the plants currently in operation worldwide). The EPRI's nuclear-related activities cover 4 main areas: materials, asset management, plant technology and non destructive evaluation (NDE).

EDF is also represented within the INPO (Institute of Nuclear Power Operators) in the United States, by a seconded engineer and actively participates in International Participant Advisory Committee (IPAC) with the INPO.

In addition, EDF is present within the IAEA in Vienna, where it is represented by an engineer seconded to the Nuclear Safety of Nuclear Installations Division.

EDF also has a representative with the European Commission in Brussels, and has a look on all new developments in terms of regulations. An EDF representative in Luxembourg has the same task.

EDF plays an active role in moves to standardise control and instrumentation in nuclear plants, under the auspices of the International Electrotechnical Commission (CEI).

20.2.3.3 Advisory or service activities

EDF's commitment to the operators of Daya Bay (China) was formally set down in a cooperation agreement signed in December 2000 by the director of the Nuclear Operations Department and the directors of GNPS (Guangdong Nuclear Power Station) and LNPS (Lingao Nuclear Power Station). For the last few years, a team of around ten engineers has been assisting the Chinese in the fields of technical operations, nuclear safety, training and engineering. They have also been helping with the organisation of the new company DNMC (Daya Bay Nuclear Management Company), which operates the 4 reactors according to the same organisational principles as the 4 reactor sites in France. The nuclear plants at Gravelines and Tricastin, via the twinning agreements, support the overseas teams for operations, training and maintenance. In addition, numerous units of the Nuclear Operations Department and the Nuclear Engineering Department provide the Chinese operators with the benefit of their expertise through seminars and specific missions. The end of 2004 will see the first ten-yearly outage at Daya Bay, for which EDF will provide active support on the Periodic Safety Review (PSR).

EDF also provides support to the operator of Koeberg (South Africa). This support takes the form of 2 engineers, who work within the plant's engineering department. The plants at Blayais and Gravelines are also twinned with the Koeberg plant. Technical task forces are organised, both in France and at Koeberg, in various technical fields (civil engineering, training, chemistry, etc.).

Under cooperation or twinning agreements financed by EDF or the European Union, partnerships have been established with several nuclear operators in Eastern Europe (mainly Rosenergom, the Russian nuclear operator and Energatom, the Ukrainian operator), notably in the field of emergency response organisation. The twinning agreements concern Russia (Novovoronej with Penly and Balakovo with Paluel), Ukraine (Rovno, where an EDF engineer is on secondment, with Golfech and Khmel'nitsky with Chinon) and Bulgaria (Kozloduy with Bugey). Where needed, the Nuclear Operations Department plays an active role in programmes aimed at improving safety in Eastern Europe. These schemes are piloted and financed by the EC, and implemented by the CIDEN.

20.2.3.4 Preparation for future reactors and technology watch

EDF's international activity mainly concerned:

- developing the European Utilities Requirements (EUR), a set of specifications common to future light water nuclear plants, which was initiated in 1992 in conjunction with Europe's main producers of electricity by nuclear means. Significant gains are expected both in terms of development costs and construction costs. In 2003, the EUR organisation welcomed the Russian nuclear operator Rosenergom as the project's eleventh partner.

The EUR document, which is currently at version C, is now fully usable: the technical specifications applied during calls for tender for construction of Finland's fifth nuclear reactor used approximately 80% of the text of the EUR document.

A number of projects are underway to prepare for a medium term revisions to the chapters describing safety policies.

Within this context, the first report by WENRA (Western European Nuclear Regulator's Association) on moves to harmonise European safety regulatory requirements has been examined. The results of this assessment, which will continue in 2004 and 2005, have been presented to WENRA. A process of consultations with WENRA should now be introduced.

In addition, a detailed review of the applicable texts enabled a list to be drawn up indicating points where revisions were either necessary or desirable, based on foreseeable developments in the regulatory and industrial context over the next five to ten years. One or two major chapters of the EUR document are set to be completely restructured. The EUR organisation has made its position clear with regard to EU moves to harmonise safety rules.

Conclusion - Planned activities to improve safety

A major operation was undertaken in 2003, which looked at moves to harmonise the conditions under which future nuclear reactors will be connected to the European EHV transmission grids. This could change the boundary conditions for the safety studies.

Comparisons between the European and American regulatory approaches began in 2003, along with an examination of the differences between the positions adopted by the EUR and the IAEA. These studies are set to continue in 2004.

Finally, a risk-informed approach to design is currently being developed within the framework of the EUR.

Thus, by 2006 there should be a firm basis for developing a new version D of volumes 1 and 2, properly adapted to the new European context. This revised version could be published in 2007.

Relations with sellers are continuing under volume 3 of the EUR. Each section of volume 3 focuses on a project drawn up for the European market and supported by the EUR electricity companies. It contains a description of the project, an assessment of the extent to which the project complies with the requirements stipulated in volume 2, and with any specific requirements as applicable. The EUR organisation made two decisions in 2003:

- it decided to assess Westinghouse's AP1000 project, for which US certification should be obtained in 2004;
- following the conclusion in 2003 of a preliminary compliance analysis between the Russian industry and EDF, initiate EUR assessment of the VVER AES92 project, for which series production is now scheduled in Russia.

These two analyses are focused on the only two designs for passive safety PWR reactors that currently appear likely to be built in the short term. They may be finished by the end of 2005 and published in 2006.

- technology watch on future light water reactor projects, in particular taking part in Westinghouse's EPP 1000 project, General Electric's ESBWR and Framatome-ANP's SWR 1000.
- monitoring of regulatory developments concerning design and licensing requirements, and also international operating feedback on events likely to affect design.
- technology watch on the development of high temperature reactors (HTR). Among the six reactor designs short listed at the Generation IV International Forum, the VHTR (Very High Temperature Reactor) and the GFR (Gas-cooled Fast Reactor) are helium-cooled reactors. They are distinctive insofar as they produce heat at very high temperatures (950°C and more). In addition to the high levels of output achieved (around 50%), this temperature can be used for the production of hydrogen or co-generation of hydrogen and electricity. The VHTR, a thermal reactor with a graphite moderator derived from the GT-MHR design, should precede the GFR. The DOE (US Department of Energy) plans to commission a 600 MWth prototype by 2016: the NGNP project (Next Generation Nuclear Plant).

Over the last few years, the CEA and FRAMATOME-ANP have played a prominent role in developing this reactor concept. Consequently, in 2003 EDF decided to initiate a process of particularly close collaboration with its major partners in the nuclear field. In addition to this cooperation in France, EDF's aim is to associate itself with international initiatives and to exchange knowledge and know-how, until feedback is obtained concerning operation of this type of reactor. As a result of its long term prospects in terms of the hydrogen economy, the VHTR appears to have serious development potential.

20.2.4 CEA international activities on reactor safety

The CEA is a scientific and technical research organisation working in the nuclear field, and develops its activities in all fields concerned, and particularly safety: these activities result in a large number of international cooperative ventures.

Within the context of safety applied to its own installations, the CEA participates in work done by the IAEA on research reactors. It has also organised regular exchanges with several foreign counterpart organisations: these exchanges relate to operating experience with installations, and particularly information drawn from incidents. Close contacts on fast neutron reactors have also been maintained with Russia and Japan.

20.2.5 International activities of the ILL dealing with reactor safety

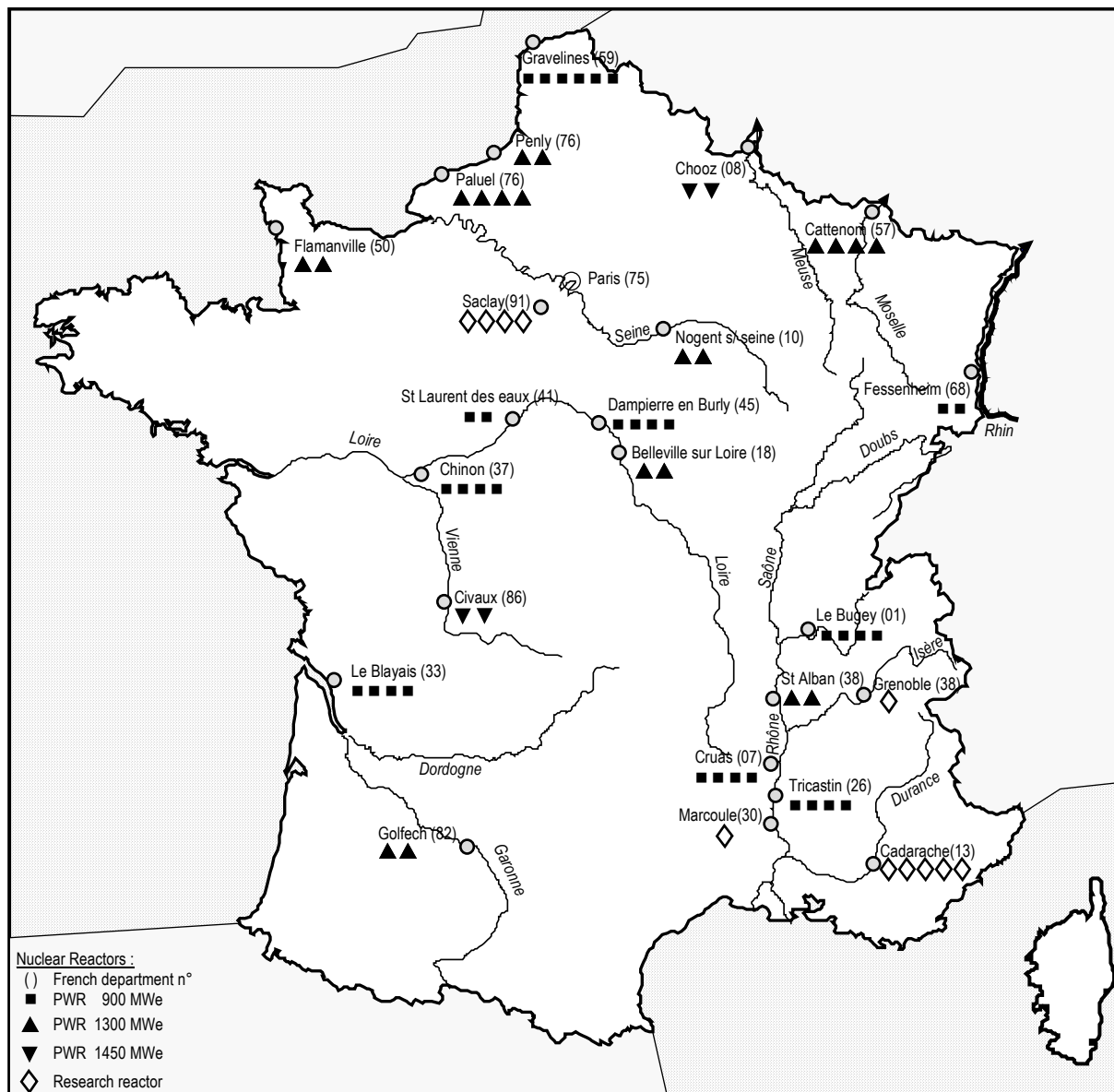
Most international activities of the ILL are related to fundamental research. However, the ILL contributes to information sharing and operating experience through research reactor operator clubs in which it participates, and particularly across Europe.

APPENDICES

Appendix 1 – List and location of nuclear reactors in France

A.1.1 Location of nuclear reactors

The 58 nuclear power reactors and the 11 nuclear research reactors in operation on 30 June 2004 are located around France as indicated on the following map.



Map of France locating nuclear reactors in operation

The gross power generation capability installed in France is about 63,000 MWe.

The 58 pressurized water reactors located on 19 sites are operated by EDF. The Phenix prototype fast reactor and 9 other research reactors, of a pool type, are operated by the CEA. The HFR research reactor is operated by the ILL.

Appendix 1 – Nuclear reactors in France

A.1.2 List of nuclear power reactors

The nuclear power reactors in operation are the following basic nuclear installations :

| BNI No. | NAME AND LOCATION OF THE INSTALLATION | Operator | Type of installation | Declared on : | Authorised on : | Official Gazette (O.G.) of : | REMARKS |
|---------|---|----------|----------------------------------|---------------|-----------------|------------------------------|---|
| 75 | FESSENHEIM NUCLEAR POWER PLANT (reactors 1 and 2) 68740 Fessenheim | EDF | 2 PWR reactors CP0 900 MWe | | 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 | 2 PWR reactors CP0 900 MWe | | 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 | 2 PWR reactors CP1 900 MWe | | 14.06.76 | 19.06.76 | |
| 85 | DAMPIERRE NUCLEAR POWER PLANT (reactors 3 and 4) 45570 Ouzouer-sur-Loire | EDF | 2 PWR reactors CP1 900 MWe | | 14.06.76 | 19.06.76 | |
| 86 | BLAYAIS NUCLEAR POWER PLANT (reactors 1 and 2) 33820 Saint-Ciers-sur-Gironde | EDF | 2 PWR reactors CP1 900 MWe | | 14.06.76 | 19.06.76 | |
| 87 | TRICASTIN NUCLEAR POWER PLANT (reactors 1 and 2) 26130 Saint-Paul-Trois-Châteaux | EDF | 2 PWR reactors CP1 900 MWe | | 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 | 2 PWR reactors CP1 900 MWe | | 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 | 2 PWR reactors CP1 900 MWe | | 27.07.76 | 17.08.76 | Modification to perimeter : decree of 10.12.85 (O.G. of 18.12.85) |
| 96 | GRAVELINES NUCLEAR POWER PLANT (reactors 1 and 2) 59820 Gravelines | EDF | 2 PWR reactors CP1 900 MWe | | 24.10.77 | 26.10.77 | |
| 97 | GRAVELINES NUCLEAR POWER PLANT (reactors 3 and 4) 59820 Gravelines | EDF | 2 PWR reactors CP1 900 MWe | | 24.10.77 | 26.10.77 | |
| 100 | ST-LAURENT NUCLEAR POWER PLANT (reactors B1 and B2) 41220 La Ferté-St-Cyr | EDF | 2 PWR reactors CP2 900 MWe | | 08.03.78 | 21.03.78 | |
| 103 | PALUEL NUCLEAR POWER PLANT (reactor 1) 76450 Cany-Barville | EDF | 1 PWR reactor P4 1300 MWe | | 10.11.78 | 14.11.78 | |
| 104 | PALUEL NUCLEAR POWER PLANT (reactor 2) 76450 Cany-Barville | EDF | 1 PWR reactor P4 1300 MWe | | 10.11.78 | 14.11.78 | |
| 107 | CHINON NUCLEAR POWER PLANT (reactors B1 and B2) 37420 Avoine | EDF | 2 PWR reactors CP2 900 MWe | | 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 | 1 PWR reactor P4 1300 MWe | | 21.12.79 | 26.12.79 | |
| 109 | FLAMANVILLE NUCLEAR POWER PLANT (reactor 2) 50830 Flamanville | EDF | 1 PWR reactor P4 1300 MWe | | 21.12.79 | 26.12.79 | |
| 110 | BLAYAIS NUCLEAR POWER PLANT (reactors 3 and 4) 33820 Saint-Ciers-sur-Gironde | EDF | 2 PWR reactors CP1 900 MWe | | 05.02.80 | 14.02.80 | |
| 111 | CRUAS NUCLEAR POWER PLANT (reactors 1 and 2) 07350 Cruas | EDF | 2 PWR reactors CP2 900 MWe | | 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 | 2 PWR reactors CP2 900 MWe | | 08.12.80 | 31.12.80 | |
| 114 | PALUEL NUCLEAR POWER PLANT (reactor 3) 76450 Cany - Barville | EDF | 1 PWR reactor P4 1300 MWe | | 03.04.81 | 05.04.81 | |
| 115 | PALUEL NUCLEAR POWER PLANT (reactor 4) 76450 Cany - Barville | EDF | 1 PWR reactor P4 1300 MWe | | 03.04.81 | 05.04.81 | |

Appendix 1 – Nuclear reactors in France

| BNI No. | NAME AND LOCATION OF THE INSTALLATION | Operator | Type of installation | Declared on : | Authorised on : | Official Gazette (O.G.) of : | REMARKS |
|---------|--|----------|----------------------------------|---------------|-----------------|------------------------------|--|
| 119 | SAINT-ALBAN - SAINT-MAURICE NUCLEAR POWER PLANT (reactor 1) 38550 Le Péage-de-Roussillon | EDF | 1 PWR reactor P4 1300 MWe | | 12.11.81 | 15.11.81 | |
| 120 | SAINT-ALBAN - SAINT-MAURICE NUCLEAR POWER PLANT (reactor 2) 38550 Le Péage-de-Roussillon | EDF | 1 PWR reactor P4 1300 MWe | | 12.11.81 | 15.11.81 | |
| 122 | GRAVELINES NUCLEAR POWER PLANT (reactors 5 and 6) 59820 Gravelines | EDF | 2 PWR reactors CP1 900 MWe | | 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 | 1 PWR reactor P4 1300 MWe | | 24.06.82 | 26.06.82 | |
| 125 | CATTENOM NUCLEAR POWER PLANT (reactor 2) 57570 Cattenom | EDF | 1 PWR reactor P4 1300 MWe | | 24.06.82 | 26.06.82 | |
| 126 | CATTENOM NUCLEAR POWER PLANT (reactor 3) 57570 Cattenom | EDF | 1 PWR reactor P4 1300 MWe | | 24.06.82 | 26.06.82 | |
| 127 | BELLEVILLE NUCLEAR POWER PLANT (reactor 1) 18240 Léré | EDF | 1 PWR reactor P4 1300 MWe | | 15.09.82 | 16.09.82 | |
| 128 | BELLEVILLE NUCLEAR POWER PLANT (reactor 2) 18240 Léré | EDF | 1 PWR reactor P4 1300 MWe | | 15.09.82 | 16.09.82 | |
| 129 | NOGENT NUCLEAR POWER PLANT (reactor 1) 10400 Nogent-sur-Seine | EDF | 1 PWR reactor P4 1300 MWe | | 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 | 1 PWR reactor P4 1300 MWe | | 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 | 2 PWR reactors CP2 900 MWe | | 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 | 1 PWR reactor P4 1300 MWe | | 03.03.83 | 06.03.83 | |
| 136 | PENLY NUCLEAR POWER PLANT (reactor 1) 76370 Neuville-lès-Dieppe | EDF | 1 PWR reactor P4 1300 MWe | | 23.02.83 | 26.02.83 | |
| 137 | CATTENOM NUCLEAR POWER PLANT (reactor 4) 57570 Cattenom | EDF | 1 PWR reactor P4 1300 MWe | | 29.02.84 | 03.03.84 | |
| 139 | CHOOZ B NUCLEAR POWER PLANT (reactor 1) 08600 Givet | EDF | 1 PWR reactor N4 1450 MWe | | 09.10.84 | 13.10.84 | Postponement of commissioning : decrees of 18.10.1993 (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 | 1 PWR reactor P4 1300 MWe | | 09.10.84 | 13.10.84 | |
| 142 | GOLFECH NUCLEAR POWER PLANT (reactor 2) 82400 Golfech | EDF | 1 PWR reactor P4 1300 MWe | | 31.07.85 | 07.08.85 | |
| 144 | CHOOZ B NUCLEAR POWER PLANT (reactor 2) 08600 Givet | EDF | 1 PWR reactor N4 1450 MWe | | 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 | 1 PWR reactor N4 1450 MWe | | 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 | 1 PWR reactor N4 1450 MWe | | 06.12.93 | 12.12.93 | Postponement of commissioning : decree of 11.06.99 (O.G. of 18.06.99) |

A.1.3 List of nuclear research reactors

The nuclear research reactors in operation are the following basic nuclear installations:

| BNI No. | 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 0.10 MW-th | 27.05.64 | | | |
| 24 | CABRI (Cadarache) 13115 Saint-Paul-lez-Durance | CEA | Reactor 25 MW-th | 27.05.64 | | | |
| 39 | MASURCA (Cadarache) 13115 Saint-Paul-lez-Durance | CEA | Reactor 0.005 MW-th | | 14.12.66 | 15.12.66 | |
| 40 | OSIRIS (Saclay) 91191 Gif-sur-Yvette Cedex | CEA | Reactor 70 MW-th | | 08.06.65 | 12.06.65 | |
| | ISIS (Saclay) 91191 Gif-sur-Yvette Cedex | CEA | Reactor 0.70 MW-th | | 08.06.65 | 12.06.65 | |
| 42 | EOLE (Cadarache) 13115 Saint-Paul-lez-Durance | CEA | Reactor 0.0001 MW-th | | 23.06.65 | 28 and 29.06.65 | |
| 67 | HIGH FLUX REACTOR A (RHF) 38041 Grenoble Cedex | Max von Laue Paul Langevin Institute | Reactor 57 MW-th | | 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 563 MW-th (350 MW-th since 1993) | | 31.12.69 | 09.01.70 | |
| 92 | PHÉBUS (Cadarache) 13115 Saint-Paul-lez-Durance | CEA | Reactor 40 MW-th | | 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 0.0001 MW-th | | 21.09.77 | 27.09.77 | |
| 101 | ORPHÉE (Saclay) 91191 Gif-sur-Yvette Cedex | CEA | Reactor 14 MW-th | | 08.03.78 | 21.03.78 | |

Appendix 2 – Main legislative and regulatory texts

A.2.1 Laws and regulations

Law 61-842 of 2 August 1961 – Law on the prevention of atmospheric pollution and odours, 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 High Council for Nuclear Safety and a Central service for Nuclear Installation Safety.

Law 80-572 of 25 July 1980 – Law on the protection and supervision of nuclear materials.

Ministerial order of 10 August 1984 – Order on the quality of design, construction and operation of basic nuclear installations.

Decree 95-540 of 4 May 1995 – Decree on liquid and gaseous releases from and water intake into basic nuclear installations.

Ministerial order of 11 March 1996 – Order setting the threshold above which facilities for preparing, manufacturing or transforming radioactive substances, as well as facilities intended for storage, use or disposal of radioactive substances, including waste, are considered as basic nuclear installations.

Inter-ministerial order of 10 November 1999 – Order related to the surveillance of operation of PWR main primary and secondary systems.

Inter-ministerial order of 26 November 1999 – Order laying down the general technical requirements concerning the limits and methods relative to BNI intakes and releases subject to authorisation.

Ministerial order of 31 December 1999 – Order setting the general technical regulations for preventing and limiting detrimental effects and external hazards resulting from the operation of basic nuclear installations.

Decree 2002-255 of 22 February 2002 - Decree amending decree 93-1272 of 1 December 1993 and creating a Directorate General 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.

Decree 2003-865 of 8 September 2003 – Decree creating the Interministerial Committee for nuclear or radiological emergencies.

A.2.2 Basic safety rules

A.2.2.1 Rules related to pressurised water reactors

RFS 2002-1 – Basic safety rule 2002-1 related to the development and the utilisation of probabilistic safety studies for pressurised water reactors (26 December 2002).

RFS-I.2.a – Inclusion of hazards related to aircraft crashes (5 August 1980).

RFS-I.2.b. – Inclusion of hazards related to missile emission following the turbine generator bursts (5 August 1980).

RFS-I.2.d. - Inclusion of hazards related to the industrial environment and communication routes (7 May 1982).

Appendix 2 – Main legislative and regulatory texts

RFS-I.2.e. – Inclusion of external flooding hazard (12 April 1984).

RFS-I.3.a. – Use of the single failure criteria in safety analyses (5 August 1980).

RFS-I.3.b. – Seismic instrumentation (8 June 1984).

RFS-I.3.c. – Geological and geotechnical site studies; Determination of soil characteristics and study of soil behaviour (1st August 1985).

RFS-II.2.2.a. – Design of containment spray system (5 August 1980); revision 1 (31 December 1985).

RFS-II.3.8. – Manufacturing and operating the main secondary system (8 June 1990).

RFS-II.4.1.a – Safety related software for electrical equipment (15 May 2000).

RFS-IV.1.a. – Classification of mechanical equipment, electrical equipment, structures and civil works (21 December 1984).

RFS-IV.2.a. – Requirements to be considered in the design of safety-related mechanical equipment, carrying a fluid or containing a fluid under pressure and classified level 2 and 3 (21 December 1984).

RFS-IV.2.b. - Requirements to be considered in the design, qualification, implementation and operation of electrical equipment included in safety-related electrical system (31 July 1985).

RFS-V.1.a. - Determination of the activity released outside the fuel to be considered in accident safety studies (18 January 1982).

RFS-V.1.b. – Means for meteorological measurements (10 June 1982).

RFS-V.2.b. – General rules applicable to the construction of civil works (ref.: RCC-G code), (30 July 1981).

RFS-V.2.c. - General rules applicable to the manufacturing of mechanical equipment (ref.: RCC-M code), (8 April 1981) ; revision 1 (12 June 1986).

RFS-V.2.d. - General rules applicable to the manufacturing of electrical equipment (ref.: RCC-E code), (28 December 1982) ; revision 1 (23 September 1986).

RFS-V.2.e. - General rules applicable to the manufacturing of fuel assemblies (ref.: RCC-C code), (28 December 1982) ; revision 1 (25 October 1985) ; revision 2 (14 December 1990).

RFS-V.2.f - General rules related to fire protection (ref.: RCC-I code), (28 December 1982).

RFS-V.2.g. – Earthquake design or civil engineering works (31 December 1985).

RFS-V.2.h. - General rules applicable to the construction of civil engineering works (ref.: RCC-G code), (4 June 1986).

RFS-V.2.j. - General rule related to fire protection (20 November 1988).

Note SIN 3130/84 of 13 June 1984 related to the conclusions of the review of the document entitled : "Design and construction rules for PWR nuclear power plants. Handbook of rules related to processes - 900 MWe units" (ref.: RCC-P code).

A.2.2.2 Rules related to other basic nuclear installations

RFS-I.1.a – Inclusion of hazards related to aircraft crashes (7 October 1992).

RFS-I.1.b – Inclusion of hazards related to the industrial environment and communication routes (7 October 1992).

Appendix 2 – Main legislative and regulatory texts

RFS-I.2.a – 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 level (8 November 1982 – revision of 19 June 1984).

RFS-I.2.b – Basic design of ionisers (18 May 1992)

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, processing, 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, processing, 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, processing, 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, processing, 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 geological formations, in order to ensure safety after the operational life of the repository (1 June 1991).

A.2.2.2 Other basic safety rules

RFS 2001-01 – Determination of seismic movements to be taken into account for the safety of facilities (revision of RFS-I.2.c and RFS-I.1.c - 16 May 2001).

RULE SIN C-12308/86 (RR1). Cleaning systems equipping research reactor ventilation systems for (4 August 1986).

RULE SIN A-4212/83 related to meteorological measurement means (12 August 1983).

RULE SIN C-12670/9-1 (RR2). Protection against fire hazard in nuclear research reactors (1st July 1991).

A.2.3 Guidelines for safety report content (preliminary, provisional and final)

The appendix to the instruction of 27 March 1973 related to the application of Decree 73-278 of 13 March 1973 provides the following guidelines for the content of safety reports (preliminary, provisional and final):

- Volume I - Introduction and general background
 - Chapter I - Introduction.
 - Chapter II - Site.
 - Chapter III – General characteristics. Main technical options.

Appendix 2 – Main legislative and regulatory texts

- Chapter IV – General safety principles
- Chapter V – Summary of the safety analysis : radiological consequences of accidents for the site.
- Chapter VI - Storage, monitoring and disposal of radioactive waste and effluents.
- Chapter VII - Organisation at the construction and operation stages. Staff protection.
- Chapter VIII – Personnel training and qualification.
- Volume II – Plant equipment and operation
 - Chapter I - General.
 - Chapter II – Civil engineering. Buildings.
 - Chapter III – Nuclear steam supply system and associated safety systems:
 - a) Fuel.
 - b) Reactor system, main primary system.
 - c) Fuel handling.
 - d) Associated safety systems.
 - Chapter IV – Containment building and associated safety systems.
 - Chapter V – Nuclear auxiliary systems.
 - Chapter VI – Secondary system.
 - Chapter VII – Common auxiliaries.
 - Chapter VIII – Electrical auxiliaries.
 - Chapter IX – Instrumentation and Control.
 - Chapter X – Reactor core physics.
 - Chapter XI - Operation.
- Volume III – Safety analysis
 - Chapter I – Quality of the manufacturing:
 - a) General construction rules.
 - b) Quality control.
 - Chapter II – Tests for verifying the validity of safety design assumptions.
 - Chapter III – Detailed safety analysis (prevention, surveillance, operation means):
 - a) Core.
 - b) Primary system.
 - c) Primary containment.
 - d) Containment building.
 - e) Handling safety.
 - f) Secondary systems safety.
 - g) Safety of auxiliary installations.
 - Chapter IV – Accident scenarios and accidental releases.
 - Chapter V – Radiation protection :
 - a) Organisation of personnel protection.
 - b) Monitoring effluents and releases.
 - Chapter VI – Lessons learned from commissioning tests.

Appendix 3 - Organisation of the nuclear reactor operators

A.3.1 Organisation of EDF

EDF was founded in 1945, and is France's main electricity producer. It is the only company in France to operate nuclear power reactors. Nuclear safety and radiation protection apply to all the basic nuclear installations operated by the Company and also to the nuclear materials used in them.

In the case of installations operated by subsidiaries of the EDF Group, responsibility for nuclear safety and radiation protection lies with the operator named in the official decree authorising the creation of the facility in question (or the equivalent document in other countries).

Nuclear safety and radiation protection concern all personnel working or present in a basic nuclear installation for any reason. However, where personnel from outside companies are concerned, the provisions detailed below in no way absolve the managers of the companies concerned of their safety responsibilities.

A.3.1.1 The President

Under the powers granted him by the Board of Directors, the President has all the authority required for EDF to function as a nuclear operator. In particular, he decides which strategies are to be adopted with regards to nuclear safety. He sets down the general organisational principles EDF requires in order to fulfil its responsibilities as a nuclear operator.

He ensures that where the basic directions and actions taken by the various sections of the Company may potentially affect nuclear safety and radiation protection, they are entirely consistent. This includes areas such as purchasing of goods and services, the implementation of training programmes, research and development, etc.

The President is the Company's principal contact with the Safety Authority. He chairs the Nuclear Safety Board.

The Inspector General for Nuclear Safety and Radiation Protection ensures that nuclear safety and radiation protection concerns have been properly taken into account at the Company's nuclear installations, and reports to the President.

A.3.1.2 The Director of the Energies Branch

With the powers granted him by the President of the Board of Directors, the Director of the Energies Branch decides what investments are to be made and how the company's existing assets are to be maintained; he takes all measures required for the operation of the production facilities under his authority and all decisions concerning the organisation of the services attached to him; he is responsible for taking individual decisions on recruitment, management, salaries and disciplinary measures for the personnel under his authority, apart from management executives; in their case, and with the exception of any directors or deputy directors who reports to him directly, he may take any individual decision concerning their appointment, their contribution or discipline.

His Deputy ensures proper control over all the Branch's nuclear safety or radiation protection-related activities, and also that all measures for managing nuclear risks are globally consistent.

A.3.1.3 The Directors of the Nuclear Operations Department and the Nuclear Engineering Department

Under the powers delegated to him by the Director of the Energies Branch, and under his authority, the Director of the Nuclear Operations Department acts as the representative for the EDF Nuclear Operator, for all installations in operation. The Director of the Nuclear Operations Department takes any measures

necessary for EDF to function as a nuclear operator; in particular, at every stage of the process for which the company is responsible, he proposes and implements the organisational and operating principles that guarantee compliance with rules on nuclear safety and radiation protection. He also ensures that EDF meets its responsibilities as a nuclear operator.

Under the powers delegated to him by the Director of the Energies Branch, the Director of the Nuclear Engineering Department is responsible for drawing up the reference system applied for the design of installations, in accordance with the regulations in force. He does this in agreement with the Director of the Nuclear Operations Department. He is also responsible for ensuring that the said reference system is properly taken into account during the construction of installations. Concerning facilities in operation, the Director of the Nuclear Engineering Department is responsible for any changes made to the installation design reference system. Again, this is in agreement with the Director of the Nuclear Operations Department. The Director of the Nuclear Operations Department is responsible for ensuring that changes to the installation operating reference system are properly taken into account. He is supported in this task by both the Director of the Nuclear Engineering Department and the Director of the Nuclear Fuels Division.

Finally, the Director of the Nuclear Engineering Department is also responsible for implementing the dismantling programme decided upon by the Director of the Energies Branch: strategy, technical and industrial decisions, budget, general planning, etc. The corresponding decisions, which affect nuclear safety and radiation protection, are approved by the Director of the Nuclear Operations Department. He remains the representative of the EDF Nuclear Operator for any installations in the process of being dismantled, unless exception.

Part of the Nuclear Engineering Department Director's job is to organise the contribution of the study and engineering units within his Department, for the benefit of the Director of the Nuclear Operations Department.

Each of the Departmental Directors takes all decisions regarding the organisation of the services placed under their respective authority; each is responsible for taking individual decisions on recruitment, management, salaries and disciplinary measures for the personnel under his authority, with the exception of management executives. In the case of the latter, the Department Director defines their duties and evaluates whether they have been properly completed. He constantly monitors and guarantees the safety of internal and external personnel working on the premises and worksites attached to his services.

Each Departmental Director defines the specific measures to be implemented in his field, as well as the policy and strategy to be adopted in terms of nuclear safety and radiation protection. He delegates the necessary powers to each unit director concerned, so that they are able to act as a representative of the EDF Nuclear Operator. He sets the objectives they are to achieve and distributes resources between units. He ensures that, at all times, unit directors have the authority, skills and resources required to meet their objectives, either within their respective units, or in the form of collective resources available to them, within or outside the Department.

The Director of the Nuclear Operations Department ensures that the tasks entrusted to Unit Directors are properly implemented. He does this by examining information received from the directors, and ordering assessments of units' overall performance and the extent to which they respect nuclear safety and radiation protection requirements. He is assisted in this task by a Director for Nuclear Safety and a Director for Radiation Protection. The Director of the Nuclear Operations Department is the main contact with the relevant authorities in the field of nuclear safety and radiation protection, for the generic aspects of the BNIs he operates. He is assisted in this task by the Director of the Nuclear Engineering Department.

As part of his responsibility as a representative of the EDF Nuclear Operator for BNIs under his authority, the Director of the Nuclear Engineering Department must ensure that the Unit Directors properly fulfil the missions entrusted to them. He does this by examining information received from the directors, and ordering assessments of the extent to which units respect nuclear safety and radiation protection requirements. He is assisted in this task by a Director of Engineering Quality and Nuclear Safety. He is also the main contact with the relevant authorities in the field of nuclear safety and radiation protection for these basic nuclear installations.

A.3.1.4 The Unit Director

The Unit Director represents the EDF Nuclear Operator for the installations under his authority, i.e. those delegated to him by the Director of his Department. Working under the authority of the Department Director in question, the Unit Director takes any measures necessary to exercise his responsibilities. In particular, at every stage of the process for which the company is responsible, he proposes and implements the organisational and operating principles that guarantee compliance with rules on nuclear safety and radiation protection. He also ensures that the Company meets its responsibilities as a nuclear operator. This responsibility may only be delegated to the person he has expressly appointed, in the event that he should be absent or unable to carry out his duties. Where he is representing the nuclear operator for installations being dismantled, he approves the decisions put forward by the Department in charge of Nuclear Engineering, and ensures that nuclear safety and radiation protection requirements are met.

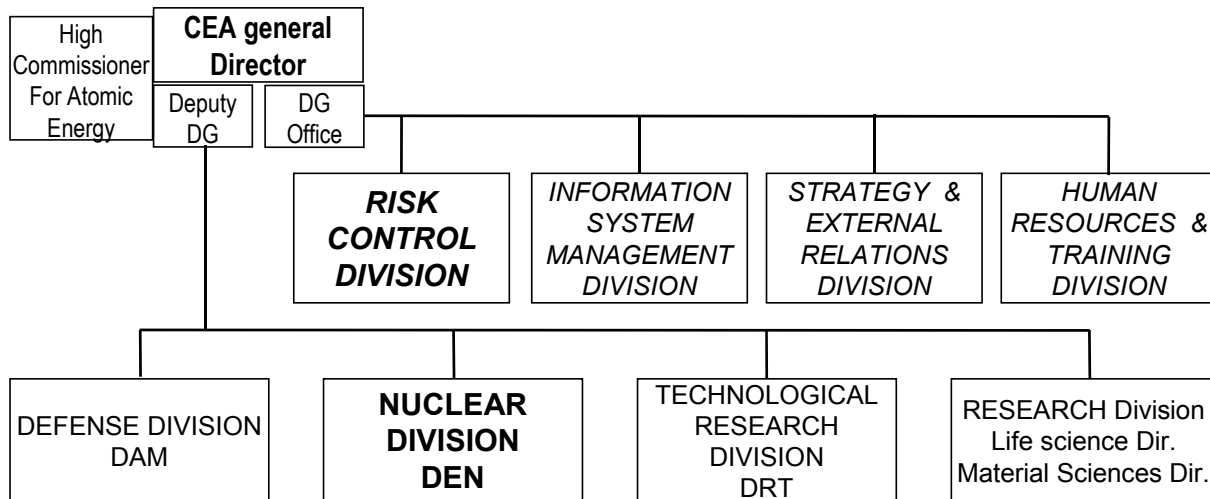
The Unit Director takes all measures necessary for the operation of installations under his responsibility. He takes all decisions relating to the organisation of services under his authority; he takes all individual decisions relating to recruitment, appointments (excluding management executives), management, salaries and the contribution of the personnel working under him. He is entitled to hand down disciplinary measures against operational and supervisory personnel. He ensures that health, safety and working conditions are taken into account permanently for both internal and external personnel, on the premises and on worksites within his sphere of responsibility.

The Unit Director announces internal measures likely to promote respect for nuclear safety and radiation protection requirements. He orders suitable internal audits to ensure that these requirements are adhered to. He brings information relating to nuclear safety and radiation protection to the attention of his Division Director. He acts as the contact with the relevant national and local authorities in the field of nuclear safety and radiation protection, for issues specific to the installations under his responsibility.

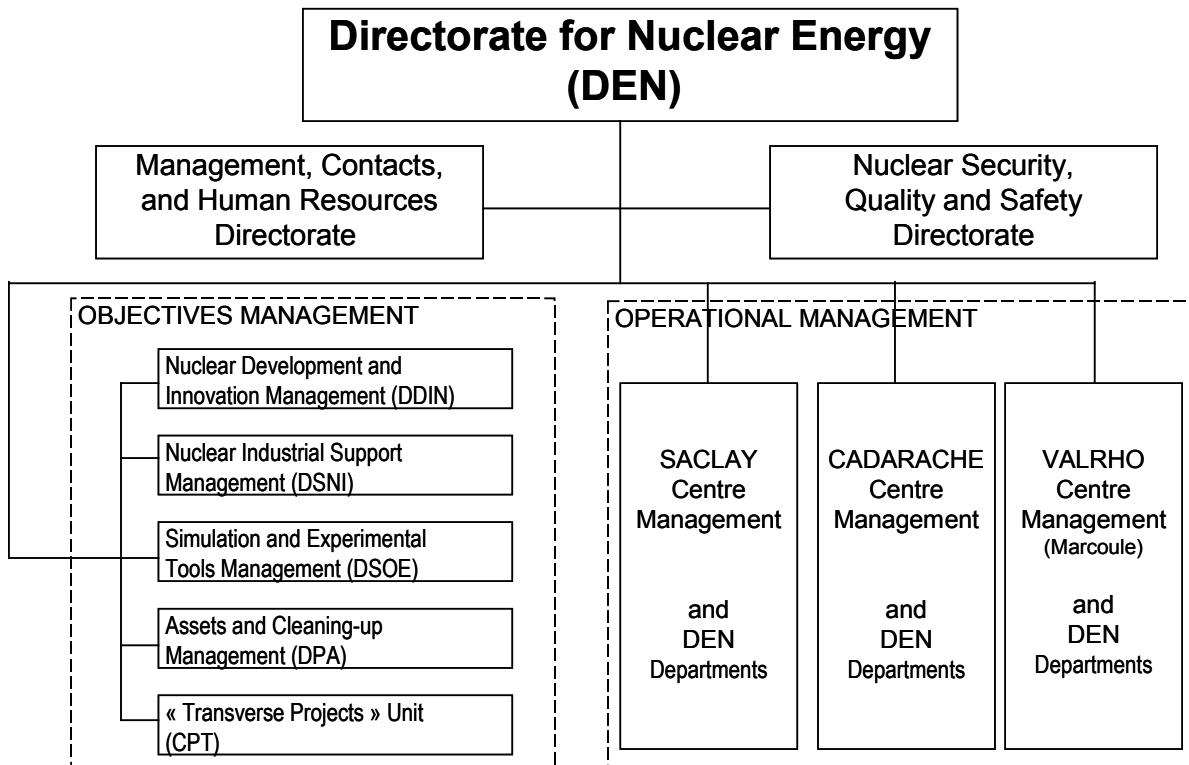
A.3.2 Organisation of the CEA

The CEA is a public research organisation created in 1945. In 2001, it set up an operational organisation based on the creation of 4 "divisions" corresponding to its main activity fields as illustrated on the following organisation chart: nuclear energy division, technological research division, fundamental research division and defence division. In addition four functional divisions, including the "Risk control" division, complete the organisation.

Each operational division is provided with resources (general management, objectives departments, internal functional resources) that it uses to develop, plan and control all its activities.



All civil nuclear aspects of nuclear reactors described in this report form part of the nuclear energy division (nuclear energy Directorate). The nuclear security quality safety Division (which is a functional department) forms part of the nuclear energy Directorate that is organised as shown in the following diagram.



A.3.3 The ILL organisation

Germany, France and the United Kingdom founded the Laue-Langevin Institute in January 1967 in order to obtain a very intense neutron source entirely dedicated to civil fundamental research. It is managed by these three founding countries in association with its partner countries (Spain, Italy, the Czech Republic in association with Austria, Russia and Switzerland).

It is currently organised into four Divisions managed by the Director:

- the science Division includes all scientific activities,
- the projects and techniques Division manages infrastructures necessary for carrying out experiments. It also includes activities for the development of experimental techniques and techniques for the construction or modification of experimental devices,
- the administration Division is responsible for normal administrative activities and some general services,
- the reactor Division is responsible for the reactor and its installations and auxiliary equipment.

The safety, protection, health and environment Unit reports directly to the Director. It in particular includes the radiation protection Department.

Concerning management of the BNI and installations defined in the safety analysis report, the Director can delegate his responsibility as operator to the reactor Division leader. The reactor Division leader is the Director's Assistant concerning safety and management of the BNI and installations defined in the safety analysis report. In this respect, he is responsible for making the final decision about the safe operation of the reactor, instruments and experimental devices.

Appendix 4 – Monitoring the environment

A.4.1 Monitoring stations

A.4.1.1 Teleray network (ambient gamma dose rate)

The ambient dose rate is monitored by the Teleray network comprising stations continuously measuring the ambient gamma radiation and situated around the country in 12 Parisian historic buildings, 78 prefectures, sub-prefectures or town-halls, 38 nuclear sites, 17 airports, 5 IRSN laboratories and 9 mountain peaks. This network also comprises 21 recorders abroad and in the overseas territories.



Location map of the Teleray network

A.4.1.2 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 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 | Sampling | Analysis |
|-------------|--|--|
| Atmosphere | Integrating dosimeter (6-monthly) | Ambient γ radiation |
| Aerosols | Filter (daily) | Total β (daily), γ spectrometry (monthly) |
| Rainwater | 0,2 m ² collector (monthly) | Total β , γ spectrometry, ^3H , ^{90}Sr |
| Soil | Depth 20 cm (quarterly) | Total β , γ spectrometry, ^{90}Sr |

| Environment | Sampling | Analysis |
|-------------|--------------------------------------|--|
| Plant | Harvest 6 m ² (monthly) | Total β , γ spectrometry, ⁹⁰ Sr (annual mix) |
| Animals | Milk (2-monthly) Bone (quarterly) | Total β , γ spectrometry, ⁸⁹ Sr, ⁹⁰ Sr Total β , ⁹⁰ Sr (annual mix) |

A.4.1.3 Atmospheric monitoring

Apart from the measurements in the 7 reference stations, atmosphere is monitored by 35 stations near the nuclear sites and 27 stations near towns. It comprises some 23,000 samples and 46,000 measurements annually, specified as follows.

| Environment | Sampling | Analysis |
|-------------|--|--|
| Atmosphere | Teleray recorder (continuous) Integrating dosimeter (6-monthly) | ambient γ radiation |
| Aerosols | Filter (daily) | Total β (daily), γ spectrometry (monthly) |
| Rainwater | 0,2 m ² collector (monthly) | Total β (daily), γ spectrometry |

A.4.1.4 Water monitoring

Water monitoring concerns rainwater (28 nuclear sites, 16 weather stations, 7 reference stations), mineral and main 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 | Sampling | 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 α + K, ²²⁶ Ra, U (mines) + γ spectrometry, ³ H, ⁹⁰ Sr (Rhône valley) |
| Main waters | For health approval | Total α , Total β , K, ³ H, ⁹⁰ Sr, ²²² Rn, ²²⁶ Ra, U |
| Mineral water | 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) |

A.4.1.5 Food-chain monitoring

Food-chain monitoring includes milk (90 departmental co-operatives, 29 nuclear sites and 7 reference stations), wheat (290 silos in 84 departments and 26 nuclear sites), particular foodstuffs (fish, honey, bovine thyroids) and food served in three canteens. It comprises some 1,800 samples and measurements annually, specified as follows.

| Subject | Sampling | 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 (flats and rounds) | 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) |

A.4.1.6 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 one nuclear site. It comprises about 300 samples and 1,700 measurements annually, specified as follows.

| Subject | Sampling | Analysis |
|-----------------------|---|--|
| French coastline | - Molluscs (annual) - Crustaceans (annual) - Algae (annual) - Marine plants (annual) | Total α , total β , K, ^{90}Sr , γ spectrometry ditto + ^{210}Po , U, ^{238}Pu , ^{241}Am ditto ditto + U, Th |
| Seine Bay | - Molluscs (annual) - Crustaceans (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 , γ spectrometry β (Sr + Lanthanides), ^{90}Sr (6-monthly) |

A.4.1.7 Monitoring around the nuclear sites

Radioactive releases 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 regulatory monitoring of the environment of a BNI differs slightly depending on whether it is a power reactor or a plant or a laboratory. The types of measurements associated with each environment monitored are presented in the following two tables.

A.4.1.7.1 Regulatory monitoring of the environment of a nuclear power plant

The principle of regulatory monitoring of the environment around a power reactor can be summarised as follows.

| Environment monitored | Samples and checks required of the operator by the regulations |
|---------------------------------------|---|
| Air at ground level | <ul style="list-style-type: none"> - 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 - continuous sample under the prevailing wind with quarterly measurement of atmospheric carbon 14 |
| Rain | - 1 station under the prevailing wind (monthly collector) with total β and tritium measurements on monthly mix |
| Ambient γ radiation | <ul style="list-style-type: none"> - 4 stations at 1 km with continuous measurement and recording (10 nGy/h to 10 Gy/h) - 10 integrating dosimeters around the site perimeter (monthly reading) - 4 stations with continuous measurement at 5 km (10 nGy/h to 0.5 Gy/h) |
| Plants | <ul style="list-style-type: none"> - 2 grass sampling points (monthly check) - Main agricultural crops (annual check) <p>Measurements: total β, γ spectrometry</p> |
| Milk | 2 sampling points (monthly check) with β measurement (excluding ^{40}K) |
| Liquid releases reception environment | <ul style="list-style-type: none"> - 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 weekly 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 |

A.4.1.7.2 Regulatory monitoring of a CEA site

The principle of regulatory monitoring of the environment around a plant or a laboratory can be summarised as follows.

| Environment monitored | Samples and checks required of the operator by the regulations |
|---------------------------------------|---|
| Air at ground level | <ul style="list-style-type: none"> - 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 β and tritium |
| Ambient γ radiation | <ul style="list-style-type: none"> - 4 stations with continuous measurement and recording - 10 integrating dosimeters around the site perimeter (monthly reading) |
| Plants | <ul style="list-style-type: none"> - 4 grass sampling points (monthly check) - Main agricultural crops (annual check) <p>Measurements: total β, γ spectrometry</p> |
| Milk | 1 sampling point (monthly check) with β measurement (excluding ^{40}K) |
| Liquid releases reception environment | <ul style="list-style-type: none"> - 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 |

A.4.2 Measurements in the environment around nuclear sites

A.4.2.1 Gaseous releases from nuclear sites in 2003

Gaseous releases from the main basic nuclear installations are given, together with their corresponding authorised limits in the following tables, according to the radioactive product categories defined in the licences in force in 2003.

- Limits and values of gaseous releases from EDF sites with original licence

In these licences, issued for nuclear power reactor sites on the basis of the 1974 specifications, gaseous releases are placed in two categories and their values are only checked against a given measurement threshold, which is given below.

| Site | Rare gas + tritium | | Halogen + aerosols | |
|--------------------|--------------------|---------|--------------------|---------|
| | Limit | Release | Limit | Release |
| | (TBq) | (TBq) | (GBq) | (GBq) |
| Le Bugey | 2590 | 1.73 | 111 | 0.066 |
| Cattenom | 3300 | 7.12 | 110 | 0.186 |
| Chooz | 330 | 2.05 | 11 | 0.327 |
| Civaux | 330 | 1.50 | 11 | 0.059 |
| Cruas-Meyssse | 2300 | 3.80 | 75 | 0.069 |
| Dampierre-en-Burly | 2220 | 3.72 | 74 | 0.086 |
| Fessenheim | 1480 | 0.93 | 111 | 0.014 |
| Golfech | 1650 | 2.74 | 55 | 0.083 |
| Gravelines | 3400 | 12.3 | 110 | 0.499 |
| Nogent-sur-Seine | 1650 | 11.3 | 55 | 0.046 |
| Penly | 1650 | 28.7 | 55 | 0.161 |
| Le Tricastin | 2220 | 9.64 | 74 | 0.107 |

- Limits and values of gaseous releases from EDF sites with renewed licences

In these new licences, issued on the basis of the 1995 specifications for nuclear power reactor sites on the occasion of their renewal, gaseous releases are now split into five categories, including C14 which is also measured

| Site | Rare gases | | Tritium | | Carbon 14 | | Iodine | | Others | |
|------------------------|------------|---------|---------|---------|-----------|---------|--------|---------|--------|---------|
| | Limit | Release | Limit | Release | Limit | Release | Limit | Release | Limit | Release |
| | (TBq) | (TBq) | (TBq) | (TBq) | (TBq) | (TBq) | (GBq) | (GBq) | (GBq) | (GBq) |
| Belleville-sur-Loire | 45 | 1.40 | 5 | 1.86 | 1.4 | 0.405 | 0.8 | 0.172 | 0.8 | 0.0150 |
| Le Blayais | 72 | 2.27 | 8 | 0.37 | 2.2 | 0.502 | 1.6 | 0.051 | 1.6 | 0.0064 |
| Chinon | 72 | 0.67 | 8 | 1.13 | 2.2 | 0.575 | 1.6 | 0.023 | 1.6 | 0.0028 |
| Flamanville | 45 | 0.90 | 5 | 2.03 | 1.4 | 0.416 | 0.8 | 0.108 | 0.8 | 0.0049 |
| Paluel | 90 | 2.02 | 10 | 3.64 | 2.8 | 0.806 | 1.6 | 0.070 | 1.6 | 0.0127 |
| Saint-Alban | 45 | 2.41 | 5 | 3.66 | 1.4 | 0.426 | 0.8 | 0.0231 | 0.8 | 0.0126 |
| Saint-Laurent-des-Eaux | 36 | 1.01 | 4 | 0.44 | 1.1 | 0.272 | 0.8 | 0.0113 | 0.8 | 0.0027 |

Appendix 4 – Monitoring the environment

- Limits and values of gaseous releases from research reactor sites

The current licences include two or four categories depending on the Centres.

| Site | Rare gases + Tritium | | | Halogen + aerosols | | |
|--------------|----------------------|------------|-----------|--------------------|--------------|--------------|
| | Limit | RG release | T Release | Limit | Hal. Release | Aer. Release |
| | (TBq) | (TBq) | (TBq) | (GBq) | (GBq) | (GBq) |
| Phenix - CEA | 400 | 4.86 | 0.01 | 40 | 0.00133 | 0.00024 |

| Site | Rare gases + Tritium | | Halogen + aerosols | |
|-----------------|----------------------|---------|--------------------|---------|
| | Limit | Release | Limit | Release |
| | (TBq) | (TBq) | (GBq) | (GBq) |
| Cadarache - CEA | 555 | 166 | 18.5 | 0.0207 |

| Site | Rare gases | | Tritium | | Halogen + aerosols | |
|----------------|------------|---------|---------|---------|--------------------|---------|
| | Limit | Release | Limit | Release | Limit | Release |
| | (TBq) | (TBq) | (TBq) | (TBq) | (GBq) | (GBq) |
| Grenoble - ILL | 75 | 0.92 | 75 | 34 | 10 | 0.018 |

| Site | Rare gases | | Tritium | | Halogen | | Aerosols | |
|--------------|------------|---------|---------|---------|---------|---------|----------|---------|
| | Limit | Release | Limit | Release | Limit | Release | Limit | Release |
| | (TBq) | (TBq) | (TBq) | (TBq) | (GBq) | (GBq) | (GBq) | (GBq) |
| Saclay - CEA | 750 | 44.8 | 550 | 19.1 | 20 | 0.263 | 40 | 0.063 |

A.4.2.2 Liquid releases from nuclear sites in 2003

Liquid releases from the main basic nuclear installations are given, together with their corresponding authorised limits in the following tables, according to the radioactive product categories defined in the licences in force in 2003.

- Limits and values of liquid releases from EDF sites with original licence

In these licences issued for nuclear power reactor sites on the basis of the 1974 specifications, gaseous releases are placed in two categories

| Site | Tritium | | Others | |
|--------------------|---------|---------|--------|---------|
| | Limit | Release | Limit | Release |
| | (TBq) | (TBq) | (GBq) | (GBq) |
| Le Bugey | 185 | 49.4 | 2035 | 2.08 |
| Cattenom | 160 | 73.3 | 2200 | 0.78 |
| Chooz | 80 | 28.1 | 222 | 0.76 |
| Civaux | 80 | 24.2 | 222 | 0.61 |
| Cruas-Meyssse | 110 | 48.9 | 1500 | 2.10 |
| Dampierre-en-Burly | 111 | 33.1 | 1480 | 1.54 |
| Fessenheim | 74 | 22.3 | 925 | 0.71 |
| Golfech | 80 | 67.5 | 1100 | 1.37 |
| Gravelines | 166 | 59.1 | 2180 | 2.89 |

Appendix 4 – Monitoring the environment

| Site | Tritium | | Others | |
|------------------|---------|---------|--------|---------|
| | Limit | Release | Limit | Release |
| | (TBq) | (TBq) | (GBq) | (GBq) |
| Nogent-sur-Seine | 80 | 47.7 | 1100 | 1.01 |
| Penly | 80 | 26.3 | 100 | 2.03 |
| Le Tricastin | 111 | 44.3 | 1480 | 1.32 |

- Limits and values of liquid releases from EDF sites with renewed licence

In these new licences, issued on the basis of the 1995 specifications for nuclear power reactor sites on the occasion of their renewal, liquid releases are now split into four categories, including Carbon 14, which is also measured.

| Site | Tritium | | Carbon 14 | | Iodine | | Other | |
|------------------------|---------|---------|-----------|---------|--------|---------|-------|---------|
| | Limit | Release | Limit | Release | Limit | Release | Limit | Release |
| | (TBq) | (TBq) | (GBq) | (GBq) | (GBq) | (GBq) | (GBq) | (GBq) |
| Belleville-sur-Loire | 60 | 40.9 | 400 | 30.4 | 0.1 | 0.028 | 25 | 0.85 |
| Le Blayais | 80 | 36.4 | 600 | 37.6 | 0.6 | 0.035 | 60 | 1.58 |
| Chinon | 80 | 35.1 | 600 | 43.1 | 0.6 | 0.021 | 60 | 1.60 |
| Flamanville | 60 | 59.9 | 400 | 31.2 | 0.1 | 0.015 | 25 | 1.19 |
| Paluel | 120 | 113 | 800 | 60.5 | 0.2 | 0.045 | 50 | 3.09 |
| Saint-Alban | 60 | 53.6 | 400 | 32.0 | 0.1 | 0.021 | 25 | 1.13 |
| Saint-Laurent-des-Eaux | 40 | 17.4 | 300 | 20.4 | 0.3 | 0.020 | 30 | 0.95 |

- Limits and values of liquid releases from research reactor sites

Current licences for CEA sites include three categories.

| Site | Tritium | | Alpha emitters | | Others | |
|-----------------|---------|---------|----------------|---------|--------|---------|
| | Limit | Release | Limit | Release | Limit | Release |
| | (TBq) | (TBq) | (GBq) | (GBq) | (GBq) | (GBq) |
| Cadarache - CEA | 1.85 | 0.037 | 0.37 | 0.018 | 3.7 | 0.105 |
| Saclay - CEA | 7.4 | 0.053 | 0.74 | < 0.104 | 37 | 0.896 |

Current licences for the ILL include two categories.

| Site | Tritium | | Others | |
|----------------|---------|---------|--------|---------|
| | Limit | Release | Limit | Release |
| | (TBq) | (TBq) | (GBq) | (GBq) |
| Grenoble - ILL | 1.5 | 0.098 | 3.7 | 0.093 |

It should also be mentioned that liquid releases from the Phenix reactor are managed jointly with those from the classified CEA Marcoule installation. In 2003 they amounted to about 0.046 TBq.

These results as a whole confirm the ASN's policy of scaling down its release licences, in accordance with the general principle of environmental protection, bringing them closer into line with the operating requirements of the installations.

Appendix 5 - References

A.5.1 Documents

- /1/ Convention on Nuclear Safety (CNS), September 1994.
- /2/ Guidelines regarding national reports under the Convention on Nuclear Safety, AIEA - INFCIRC/572/Rev.2, September 2002.
- /3/ Convention on Nuclear Safety – Second national report on the implementation by France of the obligations of the Convention, September 2001.
- /4/ Sûreté nucléaire en France - Législation et Réglementation (in French) - Recueil n°1606 - Les éditions du Journal officiel, 4^{ème} édition, May 1999.
- /5/ Annual report : Nuclear safety in France in 2001, March 2002.
- /6/ Annual report : Nuclear safety in France in 2002, March 2003.
- /7/ Annual report : Nuclear safety in France in 2003, March 2004.
- /8/ Nuclear Safety 2001 : Nuclear safety report by EDF's Inspector general, 2002.
- /9/ Nuclear Safety 2002 : Nuclear safety report by EDF's Inspector general, 2003.
- /10/ Nuclear Safety 2003 : Nuclear safety report by EDF's Inspector general, 2004.
- /11/ Nuclear Safety and Radiation Protection : Year 2003 performance review, by EDF – Industry Branch, 2004.
- /12/ Report on the safety of CEA nuclear installations from 1999 to 2001 – CEA Directorate for safety and quality, November 2002.

A.5.2 Web Sites

The above mentioned documents, or at least most of their content are available on the Web, along with other relevant information related to this report. The following web sites are of particular interest:

| | | |
|--------------|--|---|
| Legifrance : | www.legifrance.fr | (most legislative and regulatory texts) |
| ASN : | www.asn.gouv.fr | (includes previous report for the CNS) |
| CEA : | www.cea.fr | |
| EDF : | www.edf.fr | |
| ILL: | www.ill.fr | |
| IAEA : | www.iaea.org | |

Appendix 6 – List of main abbreviations

| | |
|-------|--|
| ASN | Autorité de Sûreté Nucléaire (Nuclear Safety Authority) |
| BCCN | Bureau de Contrôle des Chaudières Nucléaires (NSSS Control Office) |
| BNI | Basic Nuclear Installation |
| CNRA | NEA Committee on Nuclear Regulatory Activities |
| CEA | French Atomic Energy Commission |
| CICNR | Interministerial committee for nuclear or radiological emergency |
| CNPE | Centre Nucléaire de Production d'Electricité (Nuclear Power Plant - EDF) |
| CP xx | 900 MWe reactor series No. 'xx' |
| CPP | Main primary circuit - PWR |
| CSNI | NEA Committee on Safety of Nuclear Installations |
| CSP | Main secondary circuit - PWR |
| DDSC | Directorate for defence and civil security |
| DGSNR | Directorate General for Nuclear Safety and Radiation Protection |
| DPN | Division production nucléaire (Nuclear Operations Department - EDF) |
| DRIRE | Regional Directorate for Industry, Research and the Environment |
| DSNR | Division for nuclear Safety and Radiation Protection within DRIRE |
| EDF | Electricité de France |
| EPR | European Pressurised Reactor |
| ESP | Pressure vessel |
| EU | European Union |
| GP | Avisory Committees (GP-R = advisory committee for nuclear reactors) |
| IAEA | International Atomic Energy Agency |
| ICRP | International Commission on Radiation Protection |
| IGSN | EDF general inspectorate for nuclear safety and radiation protection |
| ILL | Max von Laue Paul Langevin Institute |
| INES | International Nuclear Event Scale |
| INRA | International Nuclear Regulator's Association |
| IPS | Important for safety |
| IRSN | Institute for Radiation Protection and Nuclear Safety |
| NEA | Nuclear Energy Agency of the OECD |
| OECD | Organisation for Economic Co-operation and Development |
| OLC | Operating Limits and Conditions |
| OSART | Operational Safety Review Team (IAEA) |
| PC | Command post (emergency response) |
| PIC | Programme for supplementary investigation |
| PPI | Off-site emergency plan |
| PSA | Probabilistic Safety Assessment |
| PTD | Technical reference document edition |
| PUI | On-site emergency plan |
| PWR | Pressurised Water Reactor |
| RCC | Rules for design and construction |
| REX | Operating experience feedback |
| RFS | Règle Fondamentale de Sûreté (Basic Safety Rule) |
| RGE | Règles générales d'exploitation (General Operating Rules) |
| STE | Spécifications techniques d'exploitation (= OLC: Operating Limits and Conditions) |
| VD'n' | PWR 10-yearly outage No. 'n' |
| WANO | World Association of Nuclear Operators |
| WENRA | Western European Nuclear Regulators' Association |