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AUTORITE DE SURETE NUCLEAIRE

AUTORITE
DE SURETE
NUCLEAIRE

Direction générale
de la sûreté nucléaire
et de la radioprotection

NUCLEAR SAFETY AND RADIATION PROTECTION IN FRANCE IN 2004

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SOMMAIRE

2 Avant-propos

9 Plan stratégique 2005-2007

17 Éléments marquants en 2004
- 1 Projet de loi relatif à la transparence et à la sécurité en matière nucléaire
- 2 La construction de la nouvelle ASN
- 3 La mise en place de l'inspection des activités nucléaires « de proximité »
- 4 La radioprotection des patients et son contrôle
- 5 La sûreté du projet de réacteur EPR
- 6 Le plan national de gestion des déchets radioactifs (PNGDR)
- 7 Le devenir des déchets de haute activité à vie longue
- 8 L'harmonisation de la sûreté nucléaire en Europe
- 9 L'action internationale de l'Autorité de sûreté nucléaire

41 Chapitre 1
ACTIVITÉS NUCLÉAIRES, RAYONNEMENTS IONISANTS ET RISQUES POUR LA SANTÉ
- 1 Dangers et risques liés aux rayonnements ionisants
- 2 Domaines d'activites impliquant des risques radiologiques
- 3 Expositions aux rayonnements ionisants
- 4 Perspectives

61 Chapitre 2
L'ORGANISATION DU CONTRÔLE DE LA SÛRETÉ NUCLÉAIRE ET DE LA RADIOPROTECTION
- 1 Les principes d'action
- 2 L'organisation du contrôle
- 3 Perspectives

85 Chapitre 3
LA RÉGLEMENTATION
- 1 La réglementation de la radioprotection
- 2 La réglementation des INB
- 3 Perspectives

131 Chapitre 4
LE CONTRÔLE DES ACTIVITÉS NUCLÉAIRES
- 1 Le contrôle des INB
- 2 Le contrôle du nucléaire « de proximité »
- 3 Perspectives

153 Chapitre 5
LA PROTECTION DE L'ENVIRONNEMENT
- 1 Domaine d'action
- 2 La surveillance de la radioactivité de l'environnement
- 3 Les rejets d'effluents des INB
- 4 Les rejets des autres installations
- 5 La prévention des nuisances
- 6 Les études déchets
- 7 Les incidents environnementaux
- 8 Perspectives

171 Chapitre 6
L'INFORMATION DU PUBLIC ET LA TRANSPARENCE
- 1 Le développement des relations entre l'ASN et le public
- 2 Les commissions locales d'information et l'association nationale des commissions locales d'information
- 3 Le conseil supérieur de la sûreté et de l'information nucléaires
- 4 L'institut de radioprotection et de sûreté nucléaire
- 5 Autres acteurs
- 6 Perspectives

195 Chapitre 7
LES RELATIONS INTERNATIONALES
- 1 Les objectifs de l'ASN à l'international
- 2 Les conventions internationales
- 3 Les relations multilatérales
- 4 Les relations bilatérales
- 5 Les conférences internationales
- 6 Perspectives

215 Chapitre 8
LES SITUATIONS D'URGENCE RADIOLOGIQUE
1 Les situations d'urgence radiologique
2 Les situations de crise nucléaire
3 Perspectives

237 Chapitre 9
LES ACTIVITÉS RADIOLOGIQUES ET BIOMÉDICALES
1 Présentation des activités médicales utilisant des rayonnements ionisants
2 État du parc des installations
3 Dispositions réglementaires relatives aux applications médicales des rayonnements ionisants
4 Bilan 2004 des instructions des dossiers concernant les installations médicales utilisant des rayonnements ionisants
5 Perception de la radioprotection en milieu médical – point de vue de l'ASN
6 Impact des installations médicales
7 Perspectives

263 Chapitre 10
LES ACTIVITÉS INDUSTRIELLES ET DE RECHERCHE
1 Présentation des activités industrielles et de recherche utilisant des rayonnements ionisants
2 Dispositions réglementaires relatives aux applications industrielles et de recherche
3 État du parc des installations et des mouvements de sources
3 Bilan 2004 des instructions des dossiers et des mouvements de sources
5 Contrôle des sources de rayonnements et des installations
6 Incidents
7 Perspectives

283 Chapitre 11
LE TRANSPORT DES MATIÈRES RADIOACTIVES
1 Présentation générale
2 La réglementation
3 L'analyse des dossiers de sûreté
4 L'inspection et le contrôle sur le terrain
5 Les incidents et accidents
6 L'organisation en cas d'accident
7 Perspectives

303 Chapitre 12
LES RÉACTEURS DE PUISSANCE
1 Généralités sur les centrales nucléaires d'EDF
2 La politique d'amélioration de la sûreté nucléaire et de la radioprotection
3 La sûreté des centrales
4 Radioprotection et protection de l'environnement
5 Bilans
6 Appréciations et perspectives

377 Chapitre 13
LES INSTALLATIONS NUCLÉAIRES DE RECHERCHE ET LES INSTALLATIONS NON DIRECTEMENT LIÉES À L'INDUSTRIE ÉLECTRONUCLÉAIRE
1 Les installations du commissariat à l'énergie atomique
2 Les autres installations nucléaires de base
3 Perspectives

399 Chapitre 14
LES INSTALLATIONS DU CYCLE DU COMBUSTIBLE NUCLÉAIRE
1 Les principaux dossiers communs aux installations
2 Les principales installations
3 Perspectives

423 Chapitre 15
LA SÛRETÉ DE LA MISE À L'ARRÊT DÉFINITIF ET DU DÉMANTÈLEMENT DES INSTALLATIONS NUCLÉAIRES DE BASE
1 Les dispositions techniques et administratives
2 La situation des installations nucléaires en démantèlement en 2004
3 Perspectives
4 Liste des installations nucléaires de base déclassées au 31.12.2004
5 Liste des installations nucléaires de base arrêtées définitivement au 31.12.2004

SOMMAIRE

443 CHAPITRE 16
LES DÉCHETS RADIOACTIFS, L'ASSAINISSEMENT ET LES SITES POLLUÉS
1 LES PRINCIPES DE GESTION DES DÉCHETS RADIOACTIFS
2 LA GESTION DES DÉCHETS TRÈS FAIBLEMENT RADIOACTIFS
3 LA GESTION DES DÉCHETS RADIOACTIFS PAR LEURS PRODUCTEURS
4 L'ENTREPOSAGE DES DÉCHETS RADIOACTIFS ET DU COMBUSTIBLE USÉ
5 LES SITES POLLUÉS PAR DES SUBSTANCES RADIOACTIVES
6 LA GESTION À LONG TERME DES DÉCHETS RADIOACTIFS PAR STOCKAGE
7 PERSPECTIVES

485 ANNEXES
A – INSPECTEURS DES INSTALLATIONS NUCLÉAIRES DE BASE
B – LISTE DES INSTALLATIONS NUCLÉAIRES DE BASE
C – SIGLES ET ABRÉVIATIONS

CONTENTS

2 FOREWORD

9 STRATÉGIC PLAN OF THE FRENCH NUCLEAR SAFETY AUTHORITY 2005-2007

17 MAIN TOPICS IN 2004
- 1 NUCLEAR SAFETY AND TRANSPARENCY BILL
- 2 SHAPING THE NEW ASN
- 3 SETTING UP INSPECTION OF "NON-BNI" NUCLEAR ACTIVITIES
- 4 RADIATION PROTECTION AND MONITORING OF PATIENTS
- 5 THE SAFETY OF THE EPR REACTOR PROJECT
- 6 THE NATIONAL PLAN FOR RADIOACTIVE WASTE MANAGEMENT
- 7 THE FUTURE OF HIGH-LEVEL LONG-LIVED WASTE
- 8 HARMONISING NUCLEAR SAFETY IN EUROPE
- 9 ASN INTERNATIONAL INVOLVEMENT

41 CHAPTER 1
NUCLEAR ACTIVITIES, IONISING RADIATIONS AND HEALTH RISKS
- 1 DANGERS AND RISKS OF IONISING RADIATIONS
- 2 FIELDS OF ACTIVITY INVOLVING RADIOLOGICAL RISKS
- 3 EXPOSURE TO IONISING RADIATION
- 4 OUTLOOK

61 CHAPTER 2
THE ORGANISATION OF SUPERVISION OF NUCLEAR SAFETY AND RADIATION PROTECTION
- 1 PRINCIPLES OF ACTION
- 2 ORGANISATION OF SUPERVISION
- 3 OUTLOOK

85 CHAPTER 3
REGULATIONS
- 1 THE REGULATION OF RADIATION PROTECTION
- 2 BNI REGULATIONS
- 3 OUTLOOK

131 CHAPTER 4
SUPERVISION OF NUCLEAR ACTIVITIES
- 1 BNI SUPERVISION
- 2 "LOCAL" NUCLEAR SUPERVISION
- 3 OUTLOOK

153 CHAPTER 5
ENVIRONMENTAL PROTECTION
- 1 FIELD OF ACTION
- 2 MONITORING RADIOACTIVITY IN THE ENVIRONMENT
- 3 BNI EFFLUENT RELEASES
- 4 RELEASES FROM OTHER INSTALLATIONS
- 5 PREVENTION OF HARMFUL EFFECTS
- 6 WASTE STUDIES
- 7 ENVIRONMENTAL INCIDENTS
- 8 OUTLOOK

171 CHAPTER 6
INFORMATION OF THE PUBLIC AND TRANSPARENCY
- 1 DEVELOPMENT OF RELATIONS BETWEEN THE NUCLEAR SAFETY AUTHORITY AND THE PUBLIC
- 2 THE LOCAL INFORMATION COMMITTEES AND THE NATIONAL ASSOCIATION OF LOCAL INFORMATION COMMITTEES
- 3 THE HIGH COUNCIL FOR NUCLEAR SAFETY AND INFORMATION
- 4 THE INSTITUTE FOR RADIATION PROTECTION AND NUCLEAR SAFETY
- 5 OTHER STAKEHOLDERS
- 6 OUTLOOK

195 CHAPTER 7
INTERNATIONAL RELATIONS
- 1 THE ASN'S INTERNATIONAL OBJECTIVES
- 2 INTERNATIONAL AGREEMENTS
- 3 MULTILATERAL RELATIONS
- 4 BILATERAL RELATIONS
- 5 INTERNATIONAL CONFERENCES
- 6 OUTLOOK

215 Chapter 8
RADIOLOGICAL EMERGENCY SITUATIONS
1 Non-BNI radiological emergency situations
2 Nuclear emergency situations
3 Outlook

237 Chapter 9
RADIOLOGICAL AND BIOMEDICAL ACTIVITIES
1 Presentation of medical activities using ionising radiation
2 Installations inventory
3 Regulations concerning medical applications of ionising radiation
4 2004 summary of dossiers examined for medical installations using ionising radiation
5 Perception of radiation protection in the medical sector – the ASN viewpoint
6 Impact of medical installations
7 Outlook

263 Chapter 10
INDUSTRIAL AND RESEARCH ACTIVITIES
1 Presentation of industrial and research activities using ionising radiation
2 Regulations concerning industrial and research applications
3 Installations inventory and source movements
3 2004 summary of dossier examinations and source movements
5 Checks on radiation sources and installations
6 Incidents
7 Outlook

283 Chapter 11
TRANSPORT OF NUCLEAR MATERIALS
1 General introduction
2 Regulations
3 Assessment of safety documents
4 Inspection and field supervision
5 Incidents and accidents
6 Emergency response provisions
7 Outlook

303 Chapter 12
POWER REACTORS
1 General information on EDF nuclear power plants
2 The nuclear safety and radiation protection improvement policy
3 Plant safety
4 Radiation protection and environmental protection
5 Summaries
6 Assessment and outlook

373 Chapter 13
NUCLEAR RESEARCH FACILITIES AND FACILITIES NOT DIRECTLY LINKED TO THE NUCLEAR POWER GENERATING INDUSTRY
1 Atomic energy commission installations
2 Other basic nuclear installations
3 Outlook

393 Chapter 14
THE NUCLEAR FUEL CYCLE INSTALLATIONS
1 Main topics common to all installations
2 Main installations
3 Outlook

417 Chapter 15
THE SAFETY OF FINAL SHUTDOWN AND DISMANTLING OF BASIC NUCLEAR INSTALLATIONS
1 Technical and administrative provisions
2 The situation of nuclear installations being dismantled in 2004
3 Outlook
4 List of basic nuclear installations declassified as at 31.12.2004
5 List of basic nuclear installations finally shutdown as at 31.12.2004

CONTENTS

437 CHAPTER 16
RADIOACTIVE WASTE, CLEAN UP AND POLLUTED SITES
1 RADIOACTIVE WASTE MANAGEMENT PRINCIPLES
2 MANAGEMENT OF VERY LOW LEVEL WASTE
3 MANAGEMENT OF RADIOACTIVE WASTE BY THE PRODUCERS
4 INTERIM STORAGE OF RADIOACTIVE WASTE AND SPENT FUEL
5 POLLUTED SITES
6 LONG-TERM MANAGEMENT OF RADIOACTIVE WASTE BY DISPOSAL
7 OUTLOOK

477 APPENDIX
A – BASIC NUCLEAR INSTALLATION INSPECTORS
B – LIST OF BASIC NUCLEAR INSTALLATION* (AS OF 31.12.04)
C – ACRONYMS AND ABBREVIATIONS



André-Claude LACOSTE

Paris, March 7th 2005

2004 saw no major nuclear safety or radiation protection problems in France. The Nuclear Safety Authority (ASN) was thus free to build up its experience in radiation protection. Major decisions for the nuclear industry and by the continuing work on harmonising nuclear safety principles and standards in the European Union member states were taken.

It was a year of consolidation for the Nuclear Safety Authority. Pressure was kept up on radiation protection work with the publication of many orders that almost completed transposition of Euratom directives 96/29 and 97/43. Finalising this regulation coincided with the enactment of the Public Health Policy law of 9 August, which instituted radiation protection inspection. This law thus provided a solid base for the ASN's supervision actions in this area by virtue of the Public Health and Labour Codes. Then for the second year running, ASN staffing levels rose with the creation of 22 State-budgeted jobs, which allows it to redouble its supervision mission. A similar increase in staff numbers is provided for in the 2005 budget. Then the ASN set up two new regional divisions in Paris and Nantes on 11 October, which means that it now has presence all over France. This boost to ASN resources was accompanied by the setting up of a pluri-annual strategic plan of actions that transparently formulates its objectives and commitments for forthcoming years. The ASN also set out to continue its work on monitoring patient exposure to ionising radiation and managing radon-related risks in the habitat.

The year 2004 witnessed major events for the nuclear power industry. The first was EDF's decision to build a new EPR-type nuclear reactor at Flamanville (Manche). The National Commission for Public Debate will organise a public debate about it by the autumn of 2005. AREVA announced its intention to build the Georges Besse II uranium enrichment plant employing ultracentrifugation technology on the Pierrelatte site and replace the Eurodif plant half-way through the next decade, which gave rise to a public debate in September and October. Lastly the change to limited company status of EDF through the public service for electricity and gas and electricity and gas utilities law of 9 August, and the Government's announcement of the partial sell-off of EDF and AREVA are among the developments that the ASN is following closely. They must not result in any compromise to the nuclear safety and radiation protection levels of the nuclear facilities operated by these industrial concerns. Granting permission for the EPR reactor, whose safety options the ASN believes globally meet the objective of improving safety, will obviously be a major dossier for years to come.

Works toward harmonization of safety principles and standards across the European Union member states took place in 2004. Firstly the "nuclear package", a set of two proposals for directives, defined the general principles for safety in nuclear installations and the other covering the management of spent fuel and radioactive waste. So far it has been impossible to adopt these proposals, because of opposition by several member states. Then in June the European Council adopted conclusions providing for the implementation of a plan of actions based on most of the provisions contained in these two draft directives, and recommended continuing work on taking forward nuclear safety harmonisation, such as the work carried out by the Western European Nuclear Regulators' Association (WENRA). WENRA's work, in which the ASN pays an active role, aims to harmonise national nuclear safety practices by 2010. This "bottom up" approach com-

plements the "top down" approach of the draft directives, that will have major implications for revising French technical regulation. The ASN generally ascribes importance to developing its relations on an international level as it considers that they are an effective way of advancing the cause of nuclear safety and radiation protection in France and throughout the world. Hence the ASN made a careful examination of conditions in which an accident took place on 9 August causing five fatalities of employees working on the non-nuclear part of the Mihama power plant in Japan.

Lastly, it would be impossible not to mention the devastating tsunami that hit South-East Asia on 26 December. The Kalpakkam nuclear power plant sited near Madras, India, was hit. The Indian safety authority has stated that this event had no safety implications.

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Supervising nuclear facilities and the transport of radioactive material

This year a level-2 incident on the INES scale occurred in the operation of EDF nuclear power plants. This generic anomaly affects certain electrical terminal boxes. This type of anomaly underscores the very interest there is in making compliance assessments that guarantee that good safety levels are kept up. It should be mentioned in this particular instance that EDF was positive about embarking on an enquiry to root out any anomalies and put them right. Besides that, safety reassessments and taking feedback on board provide ongoing sources of progress: thus in 2004, EDF made provisions for improving the ruggedness of its facilities to cope with heat waves. The overall verdict on EDF's operation of nuclear power plants is that it is continuing to work on improving radiation protection and environmental responsibility that it started in 2003. However just like last year the ASN stresses the need for EDF to be more vigilant about the quality of the tasks performed by its subcontractors and to improve the thoroughness with which it operates.

As for nuclear facilities not directly related to the nuclear power industry (CEA research centres, radioactive source manufacturing, etc.) this year saw the continued implementation of "internal authorisations". This enables operators of certain operations that do not question installation safety demonstration to decide to carry them out without asking the ASN for authorisation. Naturally these new authorisations are subject to a safety analysis by the operator with an obligation to inform the ASN. This new procedure firstly enables the ASN to devote more resources to issues that have real safety implications, and secondly to shift responsibility to the operators who no longer rely on the public authority to check the quality of their safety records. The ASN will gradually extend the scope of internal authorisations as the procedure's first trials have been positive.

Mention should also be made of the particular case of the CisBio International establishment on the Saclay site that manufactures radioactive source for biomedical applications. The ASN kept this firm under high-level surveillance this year because of the many incidents witnessed in 2003. CisBio International's directors, with the backing of the Schering group, have started a plan of actions and investment that aims to improve safety of the installation and the organisation of its operating and manufacturing processes. The ASN recognises that this plan is beginning to bear fruit but will nonetheless pay special attention to keeping up impetus on the progress made.

More generally the ASN is particularly aware of the difficult budgetary context that afflicts research bodies operating nuclear installations.

The ASN is also keeping a close watch on the international negotiations over the siting of the ITER (International Thermonuclear Experimental Reactor) project. The ASN made a positive

appraisal of the safety options of this project and considers that the choice of a French site for ITER at Cadarache does not lead to any particular nuclear safety problems. However the ASN will be on the alert for consequences arising from this costly project for the nuclear safety and radiation protection research sector.

The Georges Besse II ultracentrifugation enrichment plant construction project will no doubt make a contribution to nuclear safety in the fuel cycle area, primarily by reducing the amount of radioactive material present in the facility when compared with the Eurodif plant currently in service. The ASN continues to take a positive view of the thorough, professional way in which operations at the La Hague installations are conducted. Incidentally, when the FBFC fuel manufacturing plant for nuclear reactors at Romans-sur-Isère had its safety reassessment, the ASN wanted to draw on the experience of its German, British, Belgian and Swedish counterparts. After these installations had been visited and a seminar held, the ASN presented its feedback on this consultation at the IAEA-organised nuclear safety conference at Beijing in October 2004. This illustrates the ASN's constant desire to compare its procedures with those practised in other countries that host a nuclear power industry, and to draw on the experience of other safety authorities for one-off installations in France.

The ASN's remit also covers supervising the safety of radioactive material in transit. It is a major activity accounting for about 10% of the ASN's nuclear safety inspections. In 2002 it was my wish that France ask the IAEA to organise an assessment of our organisation looking at the transport of radioactive material and the application of international regulations. The "TranSAS" (Transport Safety Appraisal Service) mission took place from 29 March to 8 April. The team that conducted the mission comprised 14 experts from 9 different countries. The mission report, which is available on the ASN web site, identifies three recommendations, sixteen suggestions and twelve good practices. Overall a very positive impression comes out of report. Naturally the ASN will set about implementing the recommendations of this mission, that basically consist of improving the formalization of existing practices in our documents. In connection with transport, we must mention the accidental death of a protester on 6 November when vitrified waste from La Hague was being transported by rail to Gorleben in Germany.

Radiation protection regulation and the supervision of "non-BNI" nuclear activities

Since 2001 the ASN has updated the legislative and statutory provisions for radiation protection by transposing Euratom directives 96/29 and 97/43. Five main orders were published between 2001 and 2003 after the legislative parts of the Public Health and Labour Codes were revised. Since then 20 application orders have been published including those that complete the setting up of a new statutory framework for radiation protection for patients and managing the risk related to radon in premises open to the public. To complement other orders expected in 2005, the ASN is preparing the transposition of Euratom directive 2003/122 on the supervision of high activity and orphan sources, and completing the transposition of Euratom directive 89/618 of 27 November 1989 on keeping the public informed in radiological emergency situations.

This regulation writing activity calls for considerable efforts by the ASN in relation with many ministerial partners, learned societies and professional organisations. I also called for the ASN to set about updating and simplifying the statutory provisions of the Public Health Code at the same time, on the basis of experience acquired on granting licences for nuclear activities since 2002.

An ASN milestone in radiation protection supervision was the establishment of the radiation protection inspectorate by the Public Health law of 9 August that I mentioned in my introduction. However the ASN has made a point of

developing supervision of nuclear activities in the medical and industrial sectors for over two years without waiting for these legislative provisions to come into force.

The ASN now feels that as regards radiotherapy and nuclear medicine, the radiation protection rules are generally known and accepted in medical circles even though administrative, financial or technical constraints sometimes curb their implementation. The ASN often recognizes that other medical applications can be slow to apply radiation protection regulations, as they are viewed as overweight in relation to the perceived low risks. However the ASN notes the positive effect of the information and awareness work of the various learned societies and professional bodies, particularly in radiology. The ASN also believes that a major effort is needed to get a better appraisal of the impact of using radiation for medical uses, primarily with regard to patients and the environment.

The ASN has made a priority in the industrial sector of addressing the suppliers of sources and the most dangerous applications such as gamma radiography. The ASN recognizes that knowledge of the radiation protection rules is inadequate and that the impact of these nuclear activities is underestimated just as it is in the medical sector. The ASN also considers that training and awareness-raising efforts must be made in radiation protection. Because of the very high number of users, the ASN will set out to develop a 2nd level of supervision, the 1st level being provided by bodies accredited by the Public Health and Labour Ministries. The ASN initiative will be specifically aimed at ensuring that these bodies are relevant and competent.

Research orientation and improving knowledge on radiation protection

My hope is that the ASN's action will not be restricted to producing regulations and checking compliance with them. The ASN must keep close track of and possibly provide guidance in developing research and knowledge in the fields of health and ionising radiation and international thinking on radiation protection.

Accordingly the ASN asked the Institute for Radiation Protection and Nuclear Safety (IRSN) and the National Health Monitoring Institute (InVS) to deliberate on the scientific watching brief and research priorities, with a particular aim at analysing progress made in knowledge of the biological effects of ionising radiation and as needed reduce the associated health risk uncertainties, primarily with low doses.

The ASN is also keeping in its sights the work of the International Commission on Radiological Protection (ICRP) which in the past has often been drawn on to produce European regulations and IAEA standards. Thus the ASN, along with other radiation protection authorities, is taking steps to forestall an upheaval to the radiation protection system through the forthcoming ICRP recommendations, so that the recommendations are not solely founded on consensual scientific considerations.

The ASN is also working on improving the monitoring of patients exposure and of radon in the habitat. In view of that, the ASN together with the IRSN and the InVS published the first national plan of actions aimed at assessing exposure to medically-induced ionising radiation (PASEPRI). The purpose of this plan is to smooth implementation of the regulation and take it forward if necessary, to ensure patients are afforded optimum protection. I would also like to emphasis that the ASN is drawing up the first plan of actions on managing the risk related to radon in the habitat on the basis of the orientations retained in the national health-environment plan adopted by the Government in June 2004.

Management of radioactive waste and polluted sites

Radioactive waste management is a major topic for public opinion. The ASN makes a point in

ensuring that this management is handled safely and uniformly regardless the origin of the waste or disposal methods. Thus the ASN has circulated for consultation the first draft of the national radioactive waste management plan (PNGDR) within a working party that draws together waste producers and disposal companies, administrative bodies and also elected officials and representatives of environmental protection associations. It is the ASN's wish that once the comments made during the consultation phase have been taken on board, this document will throw light on the debate around the production of the draft bill heralded by the act of 30 December 1991 on research into long-lived high-level waste disposal channels. Alongside the work being conducted by the Parliamentary Office for Assessment of Scientific and Technological Options (OPECST), the ASN is playing an active part in the government's preparation for this legislative deadline, and is ensuring that the various projects developed within this context provide a credible and acceptable technical solution to the safety plan in the long term. Furthermore, the ASN is working towards the provision of an outlet, in time, for each category of radioactive waste. Accordingly the ASN monitors the design projects for new waste repositories (graphite, radium-bearing), primarily looking at the impact of the disposal facilities and the methods used to assess their safety. The ASN also invites waste producers to make their waste management policy more consistent, by recovering legacy waste, storing it safely, avoiding the production of waste that has no disposal channel and by pooling their efforts to devise new disposal channels.

Up to now I have mentioned issues related to the current nuclear operations. However former industrial activities have left us with the obligation today to manage sites polluted by radioactive substances. These situations often have major consequences for firms or individuals to whom the clean-up task is transferred. As the management of polluted sites is a new activity for the ASN, I organised a colloquium on 4 May, in conjunction with the Director for Pollution and Risk Prevention (DPPR) at the Ministry of Ecology and Sustainable Development. This colloquium resulted in the drawing up of major lines of a plan of actions on polluted sites for the ASN. This plan provides for consolidating and completing the inventory of potentially contaminated sites, continuing ongoing action on former uranium mining sites, strengthening prevention measures, coming up with suitable disposal channels for waste from cleanup operations, creating a dedicated web gateway, giving priorities to public authority actions and revising the applicable regulations.

Information of the public

Lastly one of the ASN's essential missions is its duty to inform the public. The ASN dedicates major resources to this. In this sense the opening of our public information and documentation centre in our premises at 6 place du colonel Bourgoin in Paris on 31 March makes it easier for the public to have full access to documentation on ASN's actions and its scope of supervision. This centre gives direct access to numerous publications, but also enables specific requests of associations, elected officials, journalists and research workers to be met. This duty to inform the public is enshrined in the new State budgetary structure that will come into force on 1 January 2006. This structure leads the State to identify the missions, programmes and actions to which precise objectives and indicators to measure the results obtained are attached. I have thus decided that the strengthening of public information by pursuing the policy of transparency to which we are committed will be one of the objectives retained by the ASN as part of the "nuclear safety and radiation protection supervision" action. Two indicators will be linked to this action to create a real barometer. They are the general public and informed public's rate of awareness of the ASN, and the satisfaction rate of people who know the ASN with the information that it provides. These two indicators will be set up in 2005. The ASN wishes to broaden its consultation of stakeholders when it drafts

statutory documents of a general scope out of the same desire for transparency and take into account the concerns of the public. Test runs will be carried out in 2005.

On the basis of an ASN proposal, the IAEA has suggested that member countries test a new INES scale element relating to radiation protection incidents. As this new element closely resembles the French proposal, I decided to test it as of 1 January 2005 for incidents occurring in nuclear facilities. Its application will gradually be extended to the industrial and medical sectors.

The ASN's technical support

This round-up of nuclear safety and radiation protection in France for 2004 would be incomplete if I failed to mention the major role that the IRSN plays in providing the ASN with technical support. I have often stated that the ASN would be unable to operate properly without the IRSN's efficient backing. This backing is generally efficient, even if the operation of the IRSN, particularly in the field of radiation protection has not yet been fully optimised. The close relations between the ASN and the IRSN, based on mutual confidence, are now enshrined in a permanent convention that was signed by both parties this year. In addition the ASN takes care to ensure that the IRSN has sufficient funds in its budget to carry out its work properly.

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Everything mentioned above demonstrates the breadth of the tasks accomplished and in progress, and also all the ground that the ASN has yet to cover to ensure that supervision in France is thorough, no longer solely in nuclear safety, but also in radiation protection. Last year I suggested that it would take the ASN five years to bring radiation protection to a mature level. Today I confirm that the aim of achieving the same performance in radiation protection as the ASN delivers in nuclear safety by 2009 is possible, provided of course that it continues to increase its workforce at such a pace that it employs 500 officers between now and that date. As it builds up in power, the ASN must organise its action applying a quality approach on a par with the latest standards in this area. It is also important that ASN accounts for its acts transparently and that its action over time meets precise objectives. That is why I have decided to implement a pluri-annual strategic plan of actions (2005-2007) that is moreover explicitly part of the State's new budgetary structure in which the ASN is identified by the "nuclear safety and radiation protection supervision" action. Furthermore, aware as I am that an outside view is needed if the ASN is to make progress, I intend to ask the IAEA to organise an IRRT (International Regulatory Review Team) mission, which is an audit of a safety authority by its peers in France at the end of 2006 or in 2007.

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I have every trust in the professionalism, competence and devotion of the men and women who work at the ASN to achieve these ambitious objectives.



André-Claude LACOSTE



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Strategic Plan of the French Nuclear Safety Authority 2005-2007

Making strides in nuclear safety and radiation protection



The Nuclear Safety Authority (ASN) groups the Directorate General for Nuclear Safety and Radiation Protection (DGSNR), reporting to the Ministries for Health, Environment and Industry, and the devolved services of the State on which it relies for nuclear safety and radiation protection supervision, primarily DRIRE, DRASS and DDASS.

OUR MISSION

The ASN provides the **supervision of nuclear safety and radiation protection on behalf of the State in France to protect workers, patients, the public and the environment** from nuclear activity-related risks and nuisance, and more generally from ionising radiation, and contributes to **informing citizens about these subjects**.

OUR VALUES

The ASN, the men and women who make it up, carry out the mission given to them to uphold four key values:

Competence

Independence

Thoroughness

Transparency

OUR AIMS

The ASN identifies and sets itself three permanent aims in pursuance of its mission and its values:

1 - To provide efficient supervision of nuclear safety and radiation protection, by actions that are proportionate to the challenges, carried out within programmed timescales, and that encourage all the stakeholders to develop a nuclear safety and radiation protection culture.

2 - To enable everybody to form an opinion of the nuclear and radiological risks and take part in the decision-making process.

3 - To build up a set of men and women who are competent and motivated by interesting responsibilities, open-ended careers and a favourable working environment.

To achieve these aims the ASN must have the necessary resources and use them with an ongoing concern for efficiency.

OUR STRATEGY

The ASN's strategic plan sets the orientations that it intends to follow over a 3-year period.

This plan is developed and detailed on a practical level by the various ASN units. It is annually revised and updated if needed. Thus it enables the action of the ASN to be structured without diluting the strength of the proposition and the responsiveness that are essential to its effectiveness.

The context in which the ASN operates will be presented by the activities of the ASN followed by its orientations for the 2005-2007 period.

CONTEXT

The aim of nuclear safety and radiation protection is to protect workers, patients, the public and the environment from nuclear-related risks and nuisances and more generally from ionising radiation. The following table gives an overview of nuclear activities in France:

Civilian basic nuclear installations (BNI):	
- nuclear power reactors	58 out of 19 sites
- fuel cycle installations	10 out of 6 sites
- research installations	61 out of 4 sites
- installations being dismantled	10 out of 7 sites
- waste repositories	2 out of 2 sites
Non-BNI nuclear activities:	
- medical activities:	
• licensed, such as radiotherapy	1 500
• declared, such as radiology	49 000
- industrial and research activities	5 000
Packages of radioactive material transported in 2004	300 000

Source : ASN

It is relevant to mention that besides nuclear activities, radiation protection also involves situations in which natural radioactivity is enhanced, often because of the presence of radon, primarily in the habitat, in premises open to the public and the working premises of some French areas.

OUR ACTIVITIES

The ASN has seven main levers of action to achieve its aims that involve six occupations:

1 - Producing the general nuclear safety and radiation protection regulations.

2 - Granting applications for individual licenses and accepting declarations.

3 - Supervising nuclear activities.

4 - Organising human radiological monitoring and radiological monitoring of the environment.

5 - Preparing for the management of emergency situations and if necessary implementing it.

6 - Contributing to informing the public on nuclear safety and radiation protection.

7 - Explaining French approaches in European Community and international work.

An indication of the corresponding volumes of activities are presented in the next table. When it is relevant, targets have been set:

ACTIVITIES OVER THE YEAR Y	UNIT	2003	2004	TARGET 2005	TARGET 2006	TARGET 2007
General regulation decrees and orders published	number	7	14	15	10	5
Licenses issued on:						
- basic nuclear installations (BNI)	number	30	30	-	-	-
- non-BNI nuclear activities	number	1 900	2 100	-	-	-
- transport of radioactive material (TRM)	number	85	100	-	-	-
Inspections (or investigations) carried out on:						
- BNIs	number	670	700	700	700	700
- non-BNI nuclear activities	number	100	200	400	500	600
- TMR	number	56	65	60	60	60
Emergency situation simulation exercices conducted	number	9	10	10-12	10-12	10-12
Press briefings	number	15	15	15	20	20
Press releases	number	8	9	10	12	15
Community and international actions	man. days	1 700	2 000	-	-	-

Source : ASN

These are not one-off actions but are pursued over time: a high level of nuclear safety and radiation protection cannot be achieved once and for all. If that level is to be maintained, or rather improved, supervision of new or old nuclear activities must be an ongoing process.

Thus the following orientations do not account for all of the ASN's action for the 2005-2007 period, but simply present the most important emphases given to this action to pursue the defined aims.

OUR ORIENTATIONS

Firstly, in order to achieve its aims the ASN must enjoy good internal organisation and well-established external relations. Subsequently over the 2005-2007 period the ASN will have to:

- Continue cultivating cross-disciplinary exchanges internally.
- Extend its action to the whole of France with the DRIREs, in conjunction with DARPMI and the DR-DDASS.
- Finalise its quality system and in time have it tested by an international audit.
- Build up collaboration with the other interested administrative bodies (DSND, DPPR, DRT, …) and the health agencies.
- Consolidate the ASN relationship as an "intelligent customer", with its technical support providers, primarily the IRSN.
- Develop its research tracking and scientific watch brief action.

The ASN will not achieve its objectives unless it has support functions that deliver. Subsequently over the 2005-2007 period the ASN will have to:

- Perfect its recruitment, training, accreditation and career management processes.
- Incorporate the new budgetary and accounting practices, primarily the LOLF.
- Make full use of its shared information system and extend it to radiation protection.

The ASN will be in a position to carry out its occupations with the right organisation and good support functions. These may not be new occupations but they are not rigid either. Both in terms of methods and finality they must evolve if they are to fit the context and continuously improve. In terms of methods over the 2005-2007 period the ASN will have to:

- Improve national nuclear safety and radiation protection regulations in the interests of effectiveness and simplicity, and contribute to harmonising the nuclear safety standards within the European Union.
- Use suitable actions to back implementation of the regulations, with the emphasis on information, awareness-raising and encourage over the nuclear activity operators or their representatives.
- Modify the licensing or declaration procedures to improve compliance with the principle that prime responsibility lies with the operators.
- With IRSN support, take more programmed individual decisions, primarily with better discipline over the time taken to issue licenses.
- Enhance its capability to build and formulate a structured appraisal of the operators' nuclear safety and radiation protection performance levels.
- Continue building on the supervision of non-BNI nuclear activities and transporting radioactive materials, and at the same time define the role and working arrangements of the accredited bodies.
- Have in place a well-established system for decision-making, issuing notices and sanctions on legislative and statutory levels and implement that system.
- Supervise the setting up and operation of a reliable, pluralistic and transparent national network for measuring radioactivity in the environment.
- Adapt crisis organisations, and primarily emergency plans to non BNI situations and take part in producing a doctrine followed by an organisation for the post-accident phase.
- Continue its efforts to inform different sectors of the public and foster transparency and develop consultation with the stakeholders on the statutory documents of general scope.
- Develop and organise its radiation protection action on an international level.

In terms of the finality of its occupations over the 2005-2007 period, and as appropriate to the case, the ASN must redouble its regulation, supervision, encouragement or awareness-raising action in the following areas:

- Human and organisational factors.
- The priority given to nuclear safety and radiation protection in a more competitive context.
- The facilities currently at construction or design stage, primarily the EPR (European Pressurized water Reactor) and the Georges Besse II plant.
- Feedback, ageing and dismantling of installations.

- Setting up safe, coherent and clear treatment channels for all types of radioactive waste.
- Limiting and optimising worker exposure to radiation.
- Managing the risk related to radon in premises open to the public, in the habitat and in the workplace.
- Knowledge of the doses received by patients and justification of procedures with a view to optimising them.

WE ARE ACCOUNTABLE

The ASN, since its inception, has reported on its activity, primarily through its publications (www.asn.gouv.fr, its bimonthly magazine *"Contrôle"*, and its annual report *"Nuclear Safety and Radiation Protection in France"*). Quantitative indicators are a useful tool for measuring our effectiveness and reporting on the implementation of our plan of actions: they are no substitute for a qualitative analysis but can supplement and enhance it.

Lower down a distinction is made between direct indicators, such as those that OECD views as relating to the efficiency and effectiveness of nuclear regulations, which primarily depends on the ASN, and indirect indicators that also depend on the operators. That is because in line with France's international commitments, particularly those of the nuclear safety Convention signed at Vienna on 20 September 1994, and the international standards laid down by the IAEA, the organisation of nuclear safety and radiation protection supervision in France rests on the principle of prime responsibility lying with the operators, according to which the responsibility for nuclear activities is incumbent on those who undertake or operate them while the public authorities check that the operators bear this responsibility.

The following two tables provide a very incomplete and simplified presentation of nuclear safety and radiation protection in France. Although it is impossible to single out the input of the public authorities to these indirect indicators, we have set targets, whenever they appeared relevant, that if exceeded would call for an in-depth examination, not only of the operators' action, of course, but also of our own action.

The following table covers incident and accident risk prevention. Nonetheless it should be stressed that the long term probability of a serious accident occurring cannot be deduced directly from the number of incidents detected and declared over a year in a country.

NUMBER OF EVENTS DECLARED OVER YEAR Y	2003	2004	TARGET 2005	TARGET 2006	TARGET 2007
Level 1 incidents	148	92	-	-	-
Level 2 incidents	1	1	< 5	< 5	< 5
Level 3 incidents	0	0	≤ 1	≤ 1	≤ 1
Level 4-7 accidents	0	0	0	0	0

Source: ASN, classification on the international nuclear events scale (INES).
As of 2005, these criteria will include those that relate to radiation protection, which will probably lead to an increase in the number of declared events.

The following table covers limitation of human exposure to ionising radiation. The indicators relating to patients and exposure due to radon in establishments open to the public have yet to be defined and will be refined as knowledge of these types of exposure improves.

HUMAN EXPOSURE OVER THE YEAR Y	2002	2003	2004	TARGET 2005	TARGET 2006	TARGET 2007
Number of workers exposed to more than 20 mSv (measured) over the year	74	104	N.D.	< 120	< 120	< 120
Maximum calculated exposure of BNI site area residents (µSv/year) patient indicator	10	10	10	< 20	< 20	< 20
Patient indicator			Definition in progress			
General public indicator			Definition in progress			

Source: ASN, IRSN database

In addition to the above indirect indicators, direct indicators have been selected to track specific fixed orientations whenever it appeared useful. It must be remembered that these indicators present limitations and bias in the same way as most other indicators. They could even present some pernicious effects if imprudently used as objectives. However if properly used they may help us improve our efficiency.

Most of the individual licence applications filed by operators require technical appraisal prior to making a decision. This appraisal, partly based on objective criteria, partly on expert appraisal, may take from several hours to several months to complete depending on the complexity of the subjects, uncertainties and issues raised. The ASN has a duty to pronounce programmed decisions for the operators, particularly in terms of timescale. The indicators chosen are a guide to how these timescales are observed.

ORIENTATION: TAKING, MORE PROGRAMMED DECISIONS PARTICULARLY IN TERMS OF TIMESCALE, WITH THE IRSN'S ASSISTANCE	UNITS	2004	TARGET 2005	TARGET 2006	TARGET 2007
Indicator: observance of timescales					
Individual decrees and orders over the year Y:					
- published within the timescale	%	40	50	50	60
- published with a delay of less than 30% of the full timescale%	20	30	40	30	
ASN decisions over the year Y:					
- taken within the timescales	%	70	75	80	80
- published with a delay of less than 30% of the full timescale%	20	25	20	20	
Mean time lapse of application unresolved on 31/12					
- draft orders	months	12	11	10	10
- requests for an ASN decision	months	5	4	3	3

Source: ASN

The ASN has a major information policy to enable everybody to form an opinion of the nuclear risks and take part in the decision-making process. Thus all the letters addressed to the BNI operators following inspections carried out by the ASN are posted up on its web site: www.asn.gouv.fr. The same goes for the "*Nuclear Safety and Radiation Protection in France*" report that the ASN produces every year. This policy should be extended further. The indicators selected can help in gauging the impact of this policy on the various targets.

ORIENTATION: PURSUE THE PUBLIC INFORMATION EFFORT AND DEVELOP PUBLIC CONSULTATION	UNITS	2003	2004	TARGET 2005	TARGET 2006	TARGET 2007
Indicator: Awareness and satisfaction rates						
Awareness rate with:	%		Assessment in progress			
- the general public						
- the informed public (elected officials, associations, the media)						
Satisfaction rate of people who know of the ASN	%		Assessment in progress			

Source: ASN

Main topics in 2004

1 – Nuclear Safety and Transparency bill

2 – Shaping the new ASN

3 – Setting up inspection of “non-BNI” nuclear activities

4 – Radiation protection and monitoring of patients

5 – The safety of the EPR reactor project

6 – The national plan for radioactive waste management

7 – The future of high-level long-lived waste

8 – Harmonising nuclear safety in Europe

9 – ASN international involvement

1 Nuclear Safety and Transparency bill

The Nuclear Safety and Transparency bill was tabled before the Senate on 18 June 2002 by the Minister for Ecology and Sustainable Development. It was then incorporated, with a few amendments, into the guideline energy bill of which it constituted section V and posted up for consultation on the ASN and Ministry for Ecology web sites on 7 November 2003. Then in March 2004 it was decided that the provisions relating the nuclear safety and transparency would be removed from the guideline energy bill and examined at a later date.

Following the report submitted by the deputy for Meurthe-et-Moselle, Jean-Yves Le Déaut, to the Prime Minister on 7 July 1998, "on the French system of radiation protection, supervision and nuclear safety", this bill will supplement the general legislative framework for nuclear activities as defined by the Health Code. It aims to prevent the hazards and problems for man and the environment linked to nuclear activities, and to increase available information on the risks associated with these activities and the steps taken to prevent them.

Basic nuclear installations classified as secret by the Prime Minister, defence-related facilities and the transport of radioactive and fissile materials for military purposes are, in the same way as the facilities and activities covered by this law, subject to an obligation of information and supervision. This obligation will be implemented in conditions laid down by decree of the *Conseil d'Etat*, in such a way as to reconcile the principles of the organisation of nuclear safety and radiation protection with the requirements of national defence.

1 - The consultation bill gives the key definitions and broad outlines to be implemented with regard to nuclear activities

It defines nuclear security, nuclear safety and protection against ionising radiation, while recalling the role of the State, which determines nuclear safety and radiation protection policy, organises and implements supervision in these fields and guarantees information of the public and transparency.

It states the principles to be adhered to in the performance of nuclear activities: the principle of precaution, the principle of preventive action and the principle of polluter-pays, provided for in the Environment Code. It stipulates that the prime responsibility for the safety of a nuclear facility lies with the operator of said facility.

It also states that the general principles of radiation protection (principles of justification, optimisation and limitation) apply to all nuclear activities.

2 - The consultation bill organises nuclear transparency

The Government's duties in the field of informing the public are clarified: it is responsible for informing the public regarding nuclear safety and radiation protection supervision procedures and results and presents to Parliament the annual report produced by the ASN.

The right to access information held by the operators of nuclear facilities and persons responsible for nuclear transports is created. This innovation distinguishes the nuclear industry from other industrial activities, which are not subject to such an obligation of transparency.

On each site hosting a basic nuclear installation (BNI), a local information committee (CLI) is set up. This committee is created at the initiative of the local General Council. It may take the form of an association. Its general role is one of information and debate. It may call on experts, and have environmental measurements or analyses conducted. It is financed by allocation of a part of the revenue from the BNI tax and may receive public subsidies. A CLI federation is also created.

The High Committee for nuclear safety transparency is the guarantor of access to information and the principles of transparency laid down in the bill. It takes part in producing and distributing information and may be referred to by the Government, the Chairman of the Parliamentary Office for the assessment of scientific and technological options, the CLI chairmen and the BNI operators, with regard to any reform of a general nature such as to improve nuclear safety, radiation protection and supervision.

It comprises members appointed by decree for a five year period (members of Parliament, CLI and association representatives, the Chairman of

the Administrative Documents Access Commission (CADA), operator and trade union representatives).

3 - The consultation bill revises the administrative framework for nuclear facilities, clarifies and reinforces the supervision system and applicable penalties

A special framework is set up for large nuclear facilities, known as "Basic Nuclear Installations" (BNI). This framework applies to nuclear reactors, industrial and commercial enrichment, fabrication and processing facilities, nuclear fuel storage and disposal facilities, and installations containing radioactive or fissile materials, according to thresholds set by decree of the *Conseil d'Etat*, and certain particle accelerators.

In its broad outlines, the authorisation framework reuses the system contained in the 11 December 1963 decree no. 63-1228. It also includes new provisions such as the creation of a system of public utility constraints which maintain a protective perimeter around existing sites and the land occupied by the facilities after their dismantling, and such as the new obligation on the operator to produce a financial bond designed to cover the cost of dismantling the facility and cleaning up the site.

The nuclear safety inspectors, appointed by the administrative authority, are responsible for policing the facilities. They have the power to conduct criminal investigations into violations brought to their attention.

The violations are of the same type as those covered by other risk prevention laws, in particular those of the Environment Code for installations classified for environmental protection. In terms of administrative and penal penalties, the text takes account of the specific nature of the risks inherent in BNIs and the transport of radioactive materials. If necessary, the facility or installation may be closed or its activities suspended.

A European Council framework decision on 27 January 2003 relating to the protection of the environment by penal law and its applicable penal penalties is currently being transposed into French Law. A bill including a number of provisions to adapt to community law takes up some of the nuclear safety and transparency bill provisions relating to penal penalties and could be examined in Parliament by the end of 2004 or early in 2005.

Finally, the provisions applicable in the event of a nuclear or other incident or accident, entail a general obligation to inform the authorities.

The bill provides for the creation of a new radiation protection inspection system, in particular in care establishments and research centres using radioactive sources. The provisions were incorporated into law no. 2004-806 of 9 August 2004 on Public Health policy published in the Official Journal on 11 August 2004, of which they constitute article 82. They have supplemented the nuclear safety and radiation protection supervision reforms and the reorganisation of the services in charge of this supervision, which took place in 2002.

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The provisions of this bill, which may be examined by summer of 2005, may be consulted on the Nuclear Safety Authority web site: www.asn.gouv.fr

2 Shaping the new ASN

The French nuclear safety authority (ASN) has been responsible for supervising nuclear safety in France since 1973. Throughout that period, its missions, financial and human resources, working methods and structures have constantly evolved. The French nuclear supervision reform voted through in 2002 marked the beginning of a new stage in the ASN's development.

Implementing the nuclear supervision reform, primarily in radiation protection is a complex undertaking that presents the ASN with considerable challenges. The "new" ASN has thus provided itself with a framework, the "Strategic Plan for 2005-2007" that encompasses goals for developing its missions and organisation for the years to come.

Update on the shaping of the "New ASN" as of 1 January 2005:

1 - Progress made in the ASN's supervision activities

The ASN has developed a corpus and approved working methods on the strength of its 30 years' experience in basic nuclear installation (BNI) supervision. The ASN constantly improves its practices. Putting "the onus of responsibility on the operators" is one of the major lines of progress in BNI supervision. The ASN is currently enhancing its practices and finalizing its approach to supervision in the quite different field of radiation protection where the number of stakeholders is very much higher. The establishment of the radiation protection inspectorate by the law of 9 August 2004 should be followed in 2005 by a decree stipulating the conditions for appointing inspectors. Furthermore the ASN is conducting major statutory work on transposing the European directives on radiation protection. The ASN has decided to entrust the DSNR with activities, primarily in the areas of issuing licences and declarations, that were hitherto carried out centrally.

Lastly the ASN expects the "transparency and nuclear safety" law will lay down the general legal framework for nuclear activities, improve transparency mainly by giving the Local Information Committees status, and bolster the nuclear supervision system and applicable sanctions in France.

2 - Progress made on the ASN's structures

With the establishment of the Paris and Nantes DSNRs in 2004, the ASN has now a network of 11 inter-regional divisions operating inside the DRIREs that enable it to perform its various supervision activities effectively. The DRIRE directors act as ASN spokespersons for their own region and can call on the direct or delegated services of a DSNR. The ASN also relies on the DRASS and DDASS network, as provided for by the decree creating the DGSNR, primarily for carrying out radiation protection work in connection with radon and environmental health issues (circular of 29 July 2004).

As far as accommodation is concerned, the ASN now has functional premises for its central services in Paris and Fontenay-aux-Roses. Advisory committee meetings have been held in the capital's place Bourgoin premises since 2003. In keeping with its mission the ASN opened a public information and documentation centre in Paris in 2004. The ASN had over 18000 visitors to its Paris premises during the various working meetings held in 2004. The DSNRs attached to the DRIREs have appropriate working conditions for performing their missions.

3 - Progress on the ASN's running

Human resources:

By 1 January 2005 the ASN had 332 officers (179 at the DGSNR and 153 in the DSNRs). The ASN should eventually have a workforce of over 500 officers.

In application of the 2002 reform the ASN has taken on officers from the various bodies charged with official radiation protection missions (OPRI, CIREA, DGS). The ASN has also committed to a multiyear plan to create 225 jobs including 150 radiation protection inspectors, 66 of whom have been taken on since 2003. The ASN's policy is to hire people from diverse backgrounds and cultures. The reform has effectively broadened the scope for this liberal attitude primarily with the arrival of officers from the medical and paramedical sectors to fill the wide range of missions with which it has been entrusted. The ASN has always made it a matter of duty to give its officers sound training. Accordingly over 3000 training days, primarily

based around a full radiation protection reference set, were provided to ASN officers in 2004.

ASN finances:

Since the "basic nuclear installation supervision" foundation's budget based on charges levied on the nuclear operator was revised in 2000, the ASN has been financed by budget allocations passed by the Finance Bill. A new budgetary approach for the ASN will be applied when the constitutional bylaw on budget acts (LOLF) comes into force in 2006. All the financial resources – operating and investment and human resources budgets – of the DGSNR and the devolved services working for the ASN will be reallocated to "nuclear safety and radiation protection supervision". However it should be noted that about 54 million euros of credits from expert assessments carried out by the IRSN by way of technical support to the ASN will not be reassigned. That issue is a line of progress that could give Parliament and the public full information on the true cost of nuclear safety and radiation protection supervision in France.

Information and knowledge management:

The ASN has developed an information system, the SIASN, a proprietary, new information technology-based system, that is shared by its officers. Since 1 January 2005 the so-called Oasis intranet offers all the ASN's officers access to all of SIASN component computer applications. This information system is currently being extended to the ASN's new missions. Developing the SIASN and more generally the management of information, are a major perpetual challenge for the ASN that matches the scope of the ASN's missions, its responsibilities to the public authorities and citizens and the service life of the supervised installations.

The ASN's management and quality plan:

The ASN has been prompted to revise its internal running to cope with its extended remit and the increase in staffing levels. In 2005 the ASN will embark on major efforts to adapt its internal quality system to prepare for an international audit by peers (IRRT) in 2007.

4 - Progress on the ASN's public information mission

Informing the public is one of the ASN's three major missions on a par with regulation and supervision. Since 2002, the ASN has broadened the scope of its actions to inform the public on radiation protection issues. As of 1 January 2005, use of INES scale will be extended to informing the public about radiation protection incidents. The ASN has pioneered transparency by posting up inspection follow-up letters on basic nuclear installations on its web site, www.asn.gouv.fr since 2002. In 2005 it will also publish advisory notices on the checks it conducts during EDF power plant units outages.

Primarily with the LOLF in mind, the ASN has decided to invest in a barometer to gauge the public's awareness and satisfaction with its information actions in 2005.

5 - Progress made on the ASN's relations with its environment

External relations:

The ASN has always recognised the need to nurture ties with all stakeholders. The richly-endowed "map" of bodies in contact with the ASN has become denser as its radiation protection missions have extended, populated by national and international public powers, research bodies, nuclear industry operators, trades unions, local information committees, environmental protection associations, and learned societies. Thus the ASN has made contact with all the stakeholders: professional bodies, the medical and paramedical professions, source owners, etc. More generally the new



ASN's headquarters in Paris



ASN's public information center

ASN intends to forge strong, unequivocal ties with all of its sector's "constituents" and involve them flexibly, when relevant to the subjects addressed, in formulating its decisions. The ASN aims to develop the way it operates using methods inspired by "new governance".

International action:

From its outset the ASN has considered the development of international exchanges as crucial to progress in nuclear safety. In respect of its new missions the ASN has decided to forge close ties with its foreign counterparts and take part in various international radiation protection forums and institutions. For example the ASN keeps a close watch on the work of the ICRP. More generally the ASN promotes the emergence of a WENRA equivalent in radiation protection.

Relations with the technical support organisation:

The ASN has always wanted to be able to call on solid, competent technical support, having the benefit of proven know-how in the area of expert assessment and research into nuclear safety and radiation protection. Since 2002 the ASN has taken part in the IRSN's technical and financial guardianship, primarily when its target contract was defined and it takes an interest in safeguarding the IRSN's interests. As the IRSN's main customer, the ASN has a duty to enjoy relations with the Institute that are enshrined in a framework. Thus the relations between the ASN and the IRSN are now governed by an annual protocol. Lastly the ASN diversifies its sources of expertise and has forged other relations in the area of radiation protection expertise, in particular with the InVS.

3 Setting up inspection of "non-BNI"nuclear activities

Since it was created in 2002, the ASN has worked to gradually set up an organised system for inspecting "non-BNI" nuclear activities. The adoption of new legislative provisions in August 2004, to create radiation protection inspection is an important step in the approach instigated in 2002. These inspectors will have the task of simultaneously checking compliance with the radiation protection provisions of the Public Health Code and Labour Code for one and the same nuclear activity, and they will be given enforcement powers that they lacked.

In the light of the prerogatives introduced in its establishment order, the ASN has placed the supervision of so-called non-BNI nuclear activities in addition to inspections conducted in basic nuclear installations at the centre of its actions. Work has been going on to organise its inspection system and to pilot the inspection visits.

1 - ASN actions to prepare radiation protection inspection

Radiation protection supervision practices have been initiated to cover "non-BNI" nuclear activities thanks to the "reconnaissance" mission conducted by the DRIREs of the Basse-Normandie and Rhône-Alpes regions in 2003. This mission was carried out in parallel with another mission entrusted to an independent advisory committee led by Professor Vrousos, responsible for proposing radiation protection action priorities.

The lessons of the reconnaissance mission

The primary goal of the "reconnaissance" mission was to identify the scope of radiation protection supervision by the DSNRs through mapping of the ASN's local contacts and local radiation protection issues. It also began to define the content of radiation protection inspections. This mission comprised two phases: learning and understanding, then preparing to inspect.

Learning and understanding

This phase highlighted the need for close collaboration with the many institutional stakeholders concerned, including the inspectorate for classified installations within the DRIREs, the devolved services of the Ministry for Health (Departmental Directorates for Health and Social Affairs and Regional Directorates for Health and Social Affairs – DRASS and DDASS), the regional hospitalisation agencies, the regional social security agencies, the devolved services of the Ministry for Labour (Departmental Directorates for Labour, Employment and Training, Regional Directorates for Labour, Employment and Training – DRTEFP, DDTEFP).

The reconnaissance mission also showed the key role of the companies approved by the administration for providing radiation protection training, first level inspections and analyses. Outside inspection by service providers offering all the required skills is necessary, especially because of the high number of users involved. On this particular point, the competences formerly entrusted to the Ministry for Labour for granting accreditation applications filed by inspection bodies are henceforth entrusted to the DGSNR. In 2004 the DGSNR renewed these accreditations. In 2005 it will define the terms for second level inspections of these bodies, and the means to be allocated up to ensure that the DGSNR is rapidly informed of any potentially dangerous situations.

Preparing for inspection

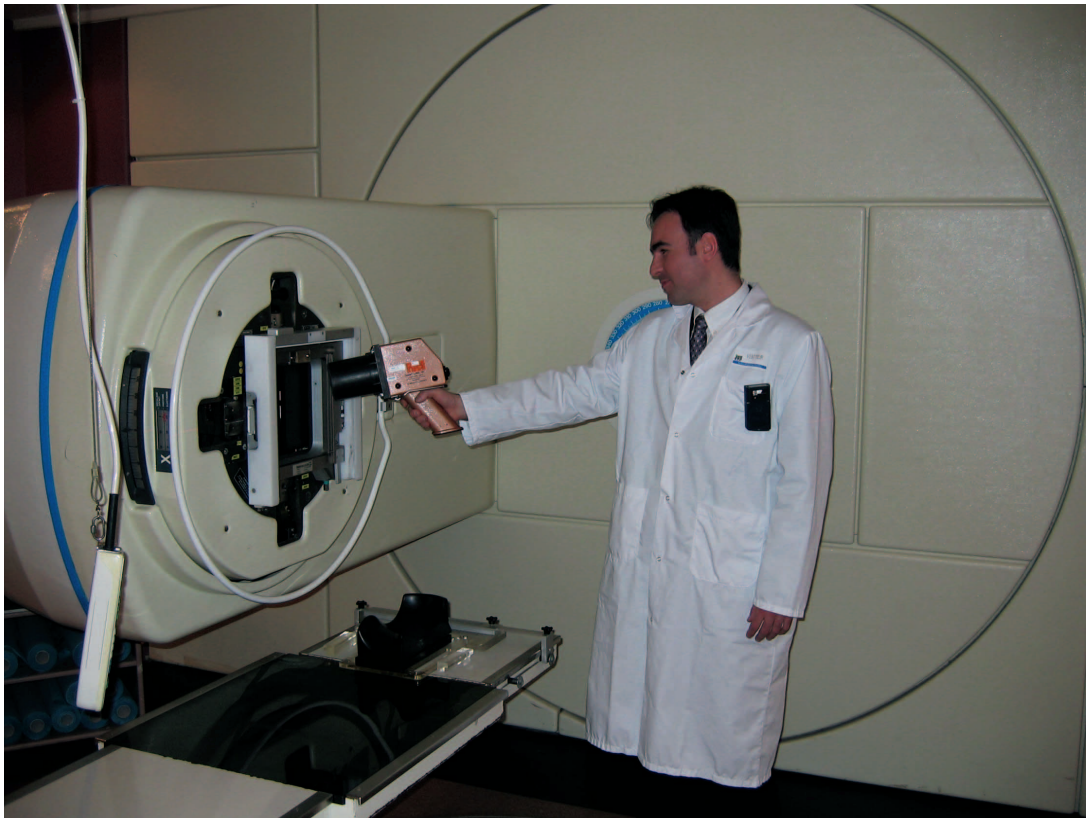
Another aim of the reconnaissance mission was to prepare a radiation protection inspection methodology and tools.

In 2004 the inspection methodology was defined based on seasoned BNI inspection practices and feedback from the reconnaissance visits. Inspection guides were also written (industrial gammagraphy, etc.). A 2005 inspection programme involving approximately 400 visits all over France was built.

Relations with the DDASS and DRASS

The devolved services of the Ministry for Health (DDASS and DRASS) operate as part of the ASN for specific radiation protection tasks. Their remit in this field was finalized in July 2004, in the light of environmental health missions given to them by the Directorate General for Health. The terms of their input to the ASN inspection programme will be defined in 2005, primarily in relation to the inspection of

1. Article 82 of Law no. 2004-2006 of 9 August 2004 on public health policy (*Official Journal* of 11 August 2004) – see articles L.1333-19 - 21 and L.1336-1 - 9



Radiotherapy accelerator control

accredited bodies that measure radon in premises open to the public.

DRIRE organisation

To ensure comptencies blending, it has been decided to mainly rely on the DRIRE's inter-regional organisation to develop the supervisory mission for "non-BNI" nuclear activities. Two new DSNRs have been set up in Paris and Nantes to complete national coverage, the former to cover the Paris region, the French West Indies, Guyana and Reunion Island, the latter to cover the Pays-de-la-Loire and Brittany regions.

The interface between the licensing and declaration system for installations classified for environmental protection (ICPE) and the system of licenses required by the Public Health Code for possessing radioactive sources has been clarified with the departments of the Ministry for Ecology and Sustainable Development. This work resulted in a DPPR circular dated 19 January 2004 and a DPPR and DGSNR memorandum dated 16 June 2004 specifying the respective competences of the services and collaboration methods to be set up between the DSNRs and the inspectorate of classified installations, in terms of granting applications and inspecting activities.

2 - Strengthening the statutory framework

The creation of radiation protection inspection

Provided that they are responsible for environmental, industrial or health matters, the law enables officers working for the ASN or other State services to be appointed as radiation protection inspectors. This possibility extends to officers of the DRIRE for instance, who are responsible for inspecting classified installations where radioactive sources are in use. The inspector of classified installations appointed as the radiation protection inspector will additionally verify compliance with the radiation protection provisions of the Public Health and Labour Codes. The other inspectors of classified installations attached to the veterinary services or to the Paris Prefectural Police Force could also be appointed. The DGSNR will set up the necessary contacts with the DPPR and central administrations that employ these officers to define the practical arrangements for appointing inspectors and organising inspections.

A decree currently being drafted will specify the inspector appointment and oath-taking procedures.

Statutory work (2003-2004)

The legislation and regulations make up the baseline for radiation protection inspections. The national system has been supplemented since 2001 to enable the latest Euratom directives to be transposed to domestic law. When this transposition work was carried out the existing legislative and statutory provisions were fully revised. The DGNSR has successfully completed writing 4 implementing decrees for the new legislative provisions contained in the Public Health and Labour Codes, in conjunction with the Ministry of Labour since February 2002.

The publication of these fully coded decrees, then led to the writing of implementing orders. Between July 2003 and December 2004, 20 implementing orders were published, 16 of which were drawn up by the DGSNR and the other 4 by the DRT. This statutory work will be continued through to 2006.

In 2004 the DGSNR took over the transposition work on the Euratom 2003/122 directive that relates to the supervision of high-level and orphan sources. The first deliberations have led to the preparation of two decrees: one to introduce the new system of financial guarantees that suppliers of radioactive sources must present to cover any defaults by the owners and the other to strengthen the statutory provisions of the Public Health Code with regard to the licensing system and management of these sources.

3 - Outlook for 2005

Workforce

ASN numbers will be increased in 2005 in line with previous years to improve the structure of bodies responsible for radiation protection inspection. Thus 22 jobs will be created in 2005 and added to the incumbent officers. About 80 officers will undertake the first inspections in this area once they have completed their training as radiation protection inspectors and as soon as the statutory texts governing the appointment of radiation protection inspectors have been finalized.

Regulation

The ASN has decided to update and simplify the Public Health Code regulations on licensing and declaration systems without waiting for the Euratom directive transposition work to be completed. This simplification is expected by the end of 2005. The last 3 years' experience indicate that the existing statutory framework will be made less burdensome by transferring the onus of responsibility to the users. This development seems feasible and desirable once supervision and correction of any deviations can be ensured by the inspection system set up.

Outline of the 2005 programme

Radiation protection inspection targets a high number of facilities or activities that incur the risk of human exposure to radiation. The current numbers of radiation protection inspectors is bound to increase, but will remain limited in 2005. What is more, the annual non-BNI nuclear activity inspection programme cannot cover all the activities. Thus the ASN accepts the need to determine criteria that will enable action priorities to be set and cover the inspection of all the activities. Accordingly a programme of about 400 inspections has been drawn up. The emphasis will be placed on industrial radiography activities (gamma radiography, X-ray generators), suppliers of sources and nuclear medicine units.

4 Radiation protection and monitoring of patients

The transposition of Euratom directive 97/43 into French legislation has led to a legislative and statutory framework geared to the radiation protection for patients, since in the past this issue used to be a confidential subject handled exclusively by the medical practitioner carrying out the procedure. The new statutory framework, instigated in March 2003 should be completed by 2005. At the same time medical practitioners have engaged major initiatives to ease implementation of this new device, promoting the establishment of good practices for procedures involving the use of ionising radiation.

Radiation protection for persons exposed for medical purposes is based on two regulatory principles: justification of the procedures and optimisation of exposure, which are under the responsibility of both the prescribing practitioners and the practitioners carrying out these procedures. They cover all the diagnostic and therapeutic applications of ionising radiation, including radiological examinations requested for screening, occupational health, sports medicine and in a medico-legal setting.

Procedures justification

A written exchange of information between the prescribing physician and the physician carrying out the irradiating procedure on the patient must justify the usefulness of the exposure on a case by case basis. This "individual" justification is required for each procedure. However it will be based on a general justification of medical procedures using ionising radiation, set out in good practices guides currently finalised by the various learned societies.

By way of illustration the use of radioscopy appliances that do not use image intensification was proscribed in 2003 in application of the principle of justification; statutory arrangements were stipulated for decommissioning this apparatus. Establishments operating a total number of 35 installations of this type have confirmed that their equipment is no longer in use and has been scrapped.

Exposure optimisation

Optimisation in medical imaging (radiology and nuclear medicine) consists in delivering the lowest possible dose compatible with obtaining a quality image that provides the diagnostic information sought for. Optimisation in therapy (external radiotherapy, brachytherapy and nuclear medicine) consists of delivering the prescribed dose to the tumor to destroy cancerous cells while limiting the dose to healthy tissues to the strict minimum. The optimisation approach is thus a pledge of the quality of the procedures conducted. Standardised guides for conducting procedures using ionising radiation have or are being written by health professionals to make optimisation easier in practice.

New statutory concepts specific to radiation protecting for patients have been introduced for this very purpose. Accordingly, diagnostic reference levels were published in February 2004 that are laid down for the most frequent or most irradiating examinations. In radiology they consist in dose levels and in nuclear medicine in the activity administered. These reference levels will be updated by conducting regular measurements or readings in line with the type of examination in each radiology and nuclear medicine department and centralizing them at the IRSN. Hence since June 2004 it has been compulsory for any newly installed radiological apparatus to be fitted with a device that estimates the dose delivered during an examination.

In another area such as biomedical research where exposure to ionising radiation offers no direct benefit to the people exposed, the physician must establish the dose constraints intended to govern the doses delivered; an order currently being prepared will stipulate the arrangements for validating these dose constraints.

Medical radiological physics

Special medical physics skills are called for in optimising the dose delivered to patients. The employment of a specialized medical radiological physicist, formerly called a "radiophysicist", has been extended to radiology having already been compulsory in radiotherapy and nuclear medicine. Qualification of such specialists involves obtaining a master's degree (the ASN published the list in January 2005), followed by training including clinical work placements.

Their missions have been defined and extended. Thus medical radiological physics specialists must ensure the appropriateness of the equipment, data and computing processes for determining and delivering the doses and activity levels administered to the patient in any procedure involving ionising radiation. In the field of radiotherapy they guarantee that the radiation dose received by the tissues due to be irradiated matches that prescribed by the prescribing physician.

Furthermore, they estimate the dose received by the patient during diagnostic procedures and play a part in quality assurance including inspecting the quality of the medical devices. Finally they contribute to teaching and training the medical and paramedical personnel in medical radiological physics.

As part of the new measures, heads of establishments will have to draw up plans for medical radiological physics as of the year 2005, defining the resources allocated, primarily in terms of staffing, in the light of the medical practices carried out in the establishment, the actual or probable patient numbers, existing dosimetry skills and resources allocated to quality assurance and control.

Maintenance and quality control of medical devices

Since March 2003 internal and external maintenance and quality control of medical appliances using ionising radiation has been compulsory. External quality control is entrusted to organisations accredited by the Director General of the French Health Products Safety Agency (AFSSAPS) responsible for defining, by decision, the acceptability criteria, follow-up parameters and frequency of inspections carried out on the particular medical appliances.

Furthermore greater knowledge of the radiology appliance base in use will be needed to further external quality control and assess how effective it is. Therefore a new ownership declaration procedure was set up in 2004 for radiological equipment.

Training and information

Additional major factors in the optimisation approach are the training of health professionals and informing patients. Work is continuing on finalizing the mechanism introduced in March 2003, through statutory channels.

Thus the objectives and content of training programmes for practitioners conducting procedures using ionising radiation, or who assist in these procedures, were defined in May 2004. This patients radiation protection training is already part of initial medical training programmes and extends to other medical professions involved in these procedures; on-the-job training, currently being devised by learned societies and professional bodies, will also be offered to working practitioners.

As regards the traceability of the data on the application of justification and optimisation, the report on the procedure, written by the medical practitioner carrying out the examination, must provide the information justifying the need for the exposure, the operations carried out and the data used to estimate the dose received by the patient. An order is awaited that will specify the nature of this data in detail.

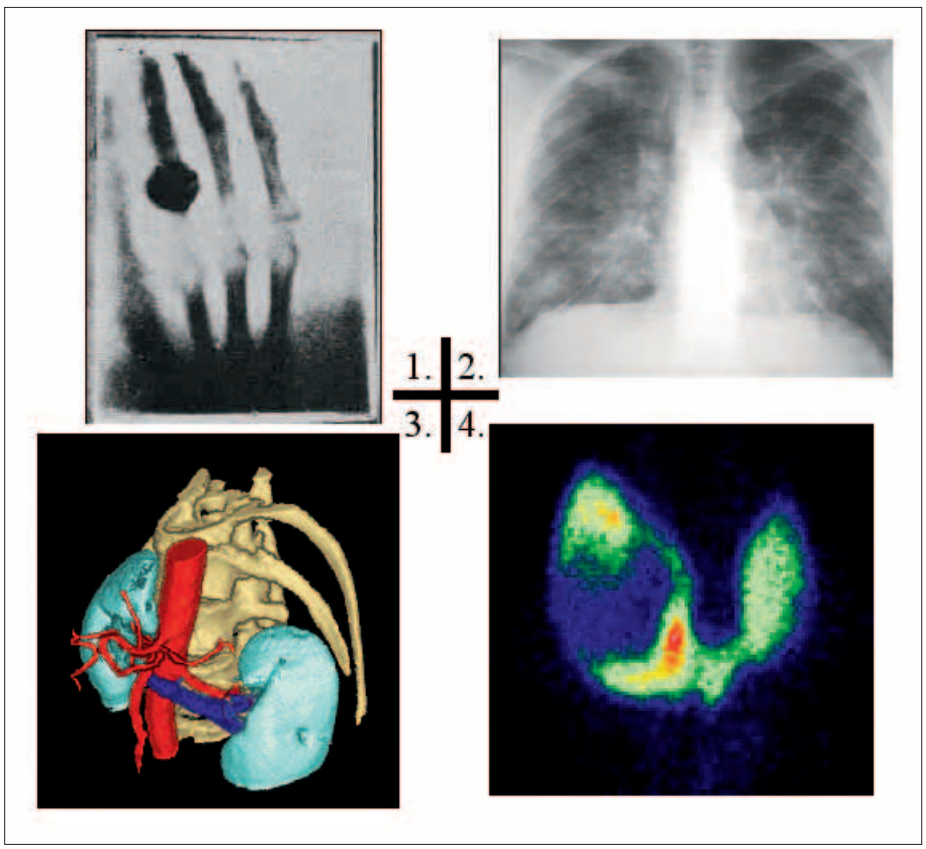
Finally, before carrying out a diagnostic or therapeutic procedure using radionuclides, the physician must give the patient oral and written guidelines on radiation protection that are of use to him/herself, his/her relations, the public and the environment. In the event of a therapeutically-oriented nuclear medicine procedure, this information, issued in a written document, provides lifestyle hints to enable potential contamination to be minimised and states, for example, for how many days contacts with the spouse and children should be reduced. Recommendations (the French High Council on Public Health, or learned societies) are awaited to harmonise the content of information already given out.

Radiation protection supervision of patients as viewed by the ASN

Since the publication of the new statutory framework in 2003, radiation protection supervision of patients is a new concern for the ASN. This issue is also mentioned in the Vrousos commission report (March 2004) that recommends that “assessment and supervision methods for implementing justification and optimisation should be rapidly developed, with the professionals on the basis of the baselines and guides drawn up by the learned societies”.

Already in 2004 the ASN deliberated internally to establish the practical arrangements for these inspections, primarily drawing on the first conclusions of inspections already carried out supplemented by the feedback acquired in other European countries. Without waiting for the

deliberation to end, the 2005 medical facilities inspection programme already incorporates verifications on the effective installation of tools or procedures arising from the new legislation, excluding any medical confidentiality issues. A transitional period will be needed in view of the time needed to implement provisions that require time for preparation (such as drawing up individual establishment medical radiological physics plans) or require additional resources (recruiting medical radiological physics specialists).



1. First radiography realized in 1895 by Wilhelm Conrad Röntgen, reproducing his spouse left hand.
2. Lung radiography.
3. Kidneys 3D reconstitution.
4. Thyroid gland scintigraphy.

5 The safety of the EPR reactor project

Safety goals

Safety of the reactors currently operated in France is satisfactory. However, any project for a new generation of nuclear power plants must lead to a higher level of safety.

Thus in 1993, the French and German nuclear safety authorities jointly set strenghthened safety goals for the planned EPR (European Pressurized water Reactor), as part of an evolutionary concept drawing on feedback from the reactors in service:

• the number of incidents must fall, in particular by improvement of systems reliability and reinforcement of the human factor management;

• the risk of core meltdown must be reduced still further, compared to other generations;

• any radioactive discharge resulting from any conceivable accident must be minimised:

– for accidents without core meltdown, measures to protect the population living around the plant should not be necessary (no evacuation nor sheltering),

– for accidents with low-pressure core meltdown, measures to protect the population must be highly limited in terms of scale and duration (no permanent rehousing, no emergency evacuation outside the immediate vicinity of the facility, limited sheltering requirements, no long-term restrictions on consumption of foodstuffs),

– accidents liable to lead to significant radioactive releases, in particular accidents with high-pressure core meltdown, must be "practically eliminated".

Finally, according to operating experience acquired from reactors in service, the ASN also asked operating constraints and human factor to be taken into account from the design stage onwards, especially in order to improve worker radiation protection, limit radioactive discharges and the quantity and activity level of the waste produced.

Examples of improvements resulting from the EPR project

These safety goals led the reactor designers to propose safety improvements, including the following examples:

– significant strengthening of the nuclear island building engineering to offer greater protection against external threats, including earthquakes, industrial explosions and aircraft crashes (on this point, studies are currently under way to improve reactor protection against events such as those that occurred in the United States on September 11 2001);

– positioning under the reactor of a device specially designed to recover, contain and cool the molten core;

– designing the reactor in order to leave the operators more time before their intervention becomes necessary.

The EPR reactor project: an opportunity for harmonising safety approaches among European countries

From the outset of the project, the French and German nuclear safety authorities and their technical support bodies and advisory committees, worked in close collaboration to determine the project's safety requirements and examine the proposed design options.

Although scaled down since the German Government's 1998 decision to abandon nuclear power, this collaboration was maintained and German experts continue to take part in technical evaluation of the project.

Furthermore in 2004 the Finnish electricity production utility TVO filed an application for planning permission to construct an EPR reactor with the aim of starting construction work early in 2005. Against this background the Finnish (STUK) and French nuclear safety authorities decided to strengthen their collaboration on this issue: over and above sending all the EPR project assessment reports already drawn up in France, several joint technical meetings were held. The ASN also appointed a Finnish expert to the permanent Advisory Committee for nuclear reactors in 2004. Lastly, on behalf of STUK, the ASN inspected the start of the manufacture of the major components for the Finnish reactor, such as the containment vessel and steam generators.

ASN's position

On 28 September 2004, the Director General for Nuclear Safety and Radiation Protection

addressed a letter to the Chairman of Electricité de France presenting the position of the public authorities on behalf of the Ministers responsible for nuclear safety on the EPR reactor project safety options.

On the basis of the examination carried out by the ASN and the permanent Advisory Committee for nuclear reactors, the Public authorities consider that the safety options adopted meet the aim of safety improvement compared with current reactors and ask Electricité de France to comply with the two technical regulation codes attached to the letter. Furthermore, this appraisal, brought to the safety options phase, must be confirmed by examining a few detailed design studies.

This technical stance by the public authorities doe not constitute planning permission for an EPR reactor. The granting of such a licence depends on the procedures for nuclear facilities instituted by the decree of 11 December 1963.

Preparation for a future application for creation

The procedure relating to issuing a licence to create a nuclear facility is defined by the decree of 11 December 1963 on basic nuclear installations.

This decree specifies that in support of the application for creation sent to the ministers responsible for nuclear safety the future operator must:

- send the ASN for analysis a Preliminary Safety Report (PSR) including the description of the installation and the operation carried out there, the inventory of risks of all origins, an analysis of the steps taken to prevent these risks and the specific measures to reduce the probability of accidents and their consequences;

- present a dossier for use in a public enquiry, comprising various drawings of the facility and a danger and impact study based on the contents of the PSR. This dossier must also specify the measures designed to manage future decommissioning.

Early in 2004 Electricité de France sent the ASN a first draft of the PSR, said to be generic, as it contained no specific element related to the site choice. The ability to examine this draft report will make it easier for the ASN to deliberate on granting any future application.

The choice of the Flamanville site

On 21 October 2004, Electricité de France announced that its first EPR reactor would be built on the Flamanville site. In line with the statutory instruments that stipulate that a national public debate must be conducted on the choice of the siting of all major works and infrastructures, EDF then referred to the National Commission for Public Debate (CNDP).

Once the debate is over, EDF will file an application for permission to build an EPR reactor as appropriate. The ASN will then examine the safety issues related to the particular site of the EPR reactor, primarily to ensure that the site-specific constraints (risk of flooding, earthquakes, climatic vagaries, etc.) have been taken into account and that the facility is adequately dimensioned to ensure its safety.



Aerial photo of the Flamanville site

6 The national plan for radioactive waste management

Context

Further to a request from the Parliamentary Office for the Assessment of Scientific and Technological Options, on the basis of the report produced in 2000 by the Drôme deputy, Michèle Rivasi, the Nuclear Safety Authority (ASN) offered to draw up a national plan for radioactive waste management. During a presentation to the Council of Ministers on 4 June 2003, the Minister for Ecology and Sustainable Development stated her intention to produce such a plan. On behalf of the public authorities, the ASN was tasked with overseeing its production.

For radioactive waste, a more global framework appeared necessary. As a matter of fact, it will allow consistent management of all radioactive waste, guaranteeing safe management and the corresponding financing, in particular for its disposal, and determining the relevant priorities.

The following were invited to take part to the work for the national plan for radioactive waste management: representatives of waste producers and of disposal facilities, the National Agency for Radioactive Waste Management, environmental protection associations, elected representatives and the directorates of the ministries concerned.

Goals of the national plan for radioactive waste management (NPRWM)

The national plan for radioactive waste management is based on knowledge of the various types of waste primarily sourced from the "national inventory of radioactive waste and recoverable material", produced and published by ANDRA (October 2004). This inventory surveys radioactive waste regardless its origin. The NPRWM includes :

- clear definition of the waste to be considered as radioactive, taking account of the existence of natural radioactivity of variable levels and of radioactive materials for which reuse has not been envisaged;
- search for long-term management solutions for each category of radioactive waste produced;
- taking charge of older radioactive waste which has been "forgotten";
- consideration of the concerns of the public, who rightly or wrongly are worried about the fate of radioactive waste;
- consistency of the entire radioactive waste management structure, whatever the level of radioactivity or the chemical or infectious toxicity, in particular for waste with a "mixed" risk;



Low activity and long term waste before processing (CEA/Saclay)

- without prejudice to the primary responsibility of the waste producer, optimisation of waste management by the waste producers: nuclear industry, more conventional industries (in particular those using naturally radioactive substances but for their other properties), activities using radionuclide sources, medical sector, earth taken from old polluted sites, mining industry (uranium mines in particular);
- consistency of practices to deal with polluted sites and reclamation methods;
- analysis of long-term management solutions implemented in the past and examination of any justification for intervention if improvements prove necessary;

leading to open, exhaustive and safe management.

The national plan for radioactive waste management does not aim to duplicate the inventory work done by ANDRA. It will therefore be more particularly based on the information already available in this framework. It is not however impossible that this plan could bring to light certain waste that does not appear in the inventory, in particular through a more detailed definition of radioactive waste.

Interface with research into high-level long-lived waste

For high-level long-lived waste, research into disposal channels is governed by law (article L.542 of the Environment Code, resulting from the law of 30 December 1991), which requires that a report on the progress of research on disposal of high-level long-lived waste be presented to Parliament before the end of 2006. A debate will be held on the follow-up to be given to this research, which has intensified and diversified since the 1991 law.

Producing a national plan for radioactive waste management does not interfere with this process, which concerns high-level long-lived waste. The national plan for radioactive waste management above all meets the need to provide channels for managing and disposing of waste which does not fall into this category, such as sealed sources, waste containing radium, graphite waste, dismantling waste, and so on. However, producing it at the same time as the Government's report requested in article L.542 of the Environment Code will give the political decision-making bodies an overview of radioactive waste problems and will place the special case of high-level long-lived waste within a more general context. The draft bill on high-level long-lived waste management could validate principles decreed in the plan that could be attached to the draft bill.

Lessons learned

A first version of the national plan for radioactive waste management was written and presented to the members of the working group on 27 September 2004. Management solutions are available for most types of radioactive waste or are being researched into primarily by ANDRA. Long-term management solutions for certain types of waste, such as used sources, require further investigation. Many sources (fire detectors, radioactive lightning conductors) could effectively have to be recalled when the justification principle of the Public Health Code for radiation protection is applied and these would require appropriate management. The future of dismantling waste from first-generation natural uranium reactors and radium-bearing waste must also be specified, particularly in relation to the possible inventory of a specific disposal facility for this waste. A public service mission of ANDRA should eventually be recognized so that all radioactive waste can go to a dedicated management channel, even if its owner does not have the financial means to have it treated.

Outlook

The initiative consisting in producing the national plan for radioactive waste management (PNGDR) was on the whole warmly received by the various parties involved, including the representatives of activities which are not among those the public authorities normally find themselves faced with in this field. Furthermore, this approach was seen as a good practice internationally, in particular within the framework of the meeting to review the national reports drafted under the terms of the joint convention on the safety of spent fuel management and the safety of radioactive waste management, which took place in Vienna on 3 to 14 November 2003. Production of a PNGDR in each country was recommended in the final report issued by the review meeting.

The ASN considers that developing the PNGDR is a priority and that it will eventually lead to more open, more exhaustive and safer management of radioactive waste in France.

7 The future of high-level long-lived waste

Context

The provisions of the law of 30 December 1991 concerning high-level long-lived waste were codified in article L.542 of the Environment Code. It sets the broad outlines for research into the field of radioactive waste management:

– high-level long-lived radioactive waste must be managed in such a way as to protect nature, the environment and human health, taking into consideration the rights of future generations;

– work is being conducted into:

a) searching for solutions allowing the separation and transmutation of long-lived radioactive elements present in this waste. The aim is to reduce the period during which these elements are radiologically toxic by using a neutron reaction to transform them into non-radioactive elements or short-lived radionuclides. This research direction comprises two steps which require the use of different technical processes,

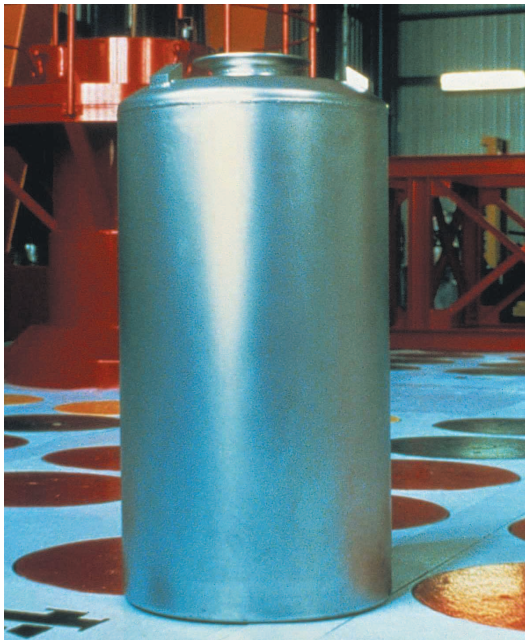
b) studying the possibility of reversible or irreversible disposal in deep geological formations, in particular by building underground laboratories,

c) studying packaging and long-term surface storage solutions for this waste, pending development of a management solution liable to reduce its long-term toxicity.

Article L.542 stipulates that this research should be conducted under the supervision of the National Evaluation Commission, which produces a yearly report on the progress of the research. At the end of a 15-year period starting on 31 December 1991, the Government must submit a report reviewing the research done, accompanied by a bill which may authorise the creation of a high-level long-lived radioactive waste disposal centre, specifying the constraints and restrictions applying to the centre.

Progress of research

This research work is primarily conducted by the French Atomic Energy Commission (CEA) and the National Agency for Radioactive Waste Management (ANDRA), which receive contributions from other stakeholders both in France and abroad.



High-level long-lived waste package stored by COGEMA-La Hague plant

a) Separation/transmutation

Reprocessing of part of the spent fuel taken from EDF and CEA reactors led to initial de-facto separation of radionuclides contained in these fuels. The minor actinides and fission products are thus encapsulated in a glass matrix.

Research into minor actinides separation has demonstrated the feasibility of further separation of americium and curium, following a series of tests conducted on solutions of dissolved fuels, in the Atalante installation in Marcoule. The feasibility of separating most fission products such as caesium was also demonstrated. Work is continuing with the aim of carrying out an economic assessment of advanced separation on an industrial basis.

The theoretical feasibility of transmuting minor actinides has been demonstrated, in particular thanks to the extensive knowledge of transmutation efficiency resulting from the development of reactor physics. These same theoretical studies show that transmutation of long-lived fission products, some of which could be highly mobile in a deep geological disposal site, offers lesser efficiency or implies technical implementation problems. Work is continuing to demonstrate the technological feasibility of transmutation. This work is

being done in France in the CEA's Phenix reactor in Marcoule.

Going beyond this examination of the theoretical possibilities, transition to an industrial phase of advanced separation of minor actinides and certain fission products, plus their transmutation, would require:

– a significant research effort;

– decisions concerning energy policy, in particular the choice of electricity production technologies compatible with the transmutation of certain radionuclides;

– considerable investment in the construction of installations employing the separation and transmutation processes.

The ASN believes that transition to the industrial phase for these processes could not reasonably be envisaged in the immediate future.

b) Disposal in deep geological formations

Research into the geological disposal of high-level long-lived waste is being carried out by ANDRA. ANDRA was authorised in 1999 to create an underground laboratory at a site on the boundary between the two *départements* of Haute-Marne and Meuse, and designed to study the Callovo-Oxfordian argilite formation and its environment. Soundings made on the site helped characterise the geological environment. Sinking of shafts for access to the drifts in which various experiments are to be conducted is continuing. However, it was impossible to create an underground laboratory in a granite geological formation, which could also constitute an environment likely to be used for this type of disposal.

In 2001, ANDRA presented a dossier on the findings obtained from the argilite research project, constituting a methodological test of the safety assessment approach it will have to present in 2005 to justify the feasibility of a disposal centre. This dossier was sent to the ASN, which submitted it to the advisory committee on waste. This dossier was examined by other organisations, in particular by a team of experts from the NEA/OECD during the peer review ordered by the French Government. This review concluded that the research work done by ANDRA was of high quality and mentioned areas for improvement which would seem to be necessary in the light of the dossier to be submitted in 2005.

By the end of 2005 ANDRA should have gathered sufficient information and research on the Bure site to make a judgement on the possibility of constructing a disposal facility within callovo-oxfordian formation.

c) Long-term storage

Finally, the work concerning the third area covered by the law, that is long-term storage of LLHLW is continuing in two directions.

The first direction concerns radioactive waste packaging. The packaging processes for radioactive materials are being examined, as are the characterisation and long-term performance of the packages.

The second direction concerns the definition and qualification of concepts for long-term storage on or near the surface. The CEA is to submit the storage safety option dossiers for generic sites shortly.

Preparation for the deadlines mentioned in the law

The three areas of research into the future of high-level long-lived waste mentioned in article L.542 of the Environment Code are complementary. They should allow the development of appropriate waste management strategies. A significant amount of scientific and technical data has been obtained in all three areas. It is important for Parliament in 2006 to state what is to happen to the process initiated in 1991, drawing on the results already obtained. The need to continue or diversify the areas of research beyond 2006 will have to be examined. Similarly, the legal conditions for licensing the creation of a deep geological disposal centre for high-level long-lived waste will have to be clarified.

Preparations for this deadline should involve all of the stakeholders.

8 Harmonising nuclear safety in Europe



Context

From the very start nuclear energy has essentially been developed on a national basis and thus been subject to national safety standards. It soon emerged that two countries could provide different technical solutions to a single safety problem. The explanation for this might be that a nuclear installation considered satisfactory in one country would not be viewed as compliant with the practices or regulations of the other.

Leaving aside the potential cross-border nature of nuisances and accident risks, the development of the economic context also dictates that nuclear safety and radiation protection approaches should be harmonised. The liberalisation of the electricity market and internationalisation of the economy (the recent choice of the Finnish electricity utility TVO of a Franco-German-designed EPR reactor is a good example) are just two reasons that argue in favour of this harmonisation. The stance adopted by the safety authorities of the various countries is that the increased competition should not push safety levels to a common lower level, but on the contrary take protection levels to new heights.

Thus it is important to develop a common approach to nuclear safety without making the slightest concession on the key issue: nuclear safety must be the top priority.

ASN's position

As far as the ASN is concerned, the aims of harmonising safety in Europe must not create the pretext for drawing up detailed European safety standards that parallel the global standards produced under the stewardship of the IAEA: what legitimacy would those standards have if they were not recognised beyond Europe and were not more widely accepted?

Harmonisation of methods cannot be carried out independently from the existing safety approaches nor without links to the bodies that currently perform the supervisions in practice. Nuclear safety expertise is currently a matter for individual countries, which is why the national safety authorities are in the best position to effectively carry out this process.

In practical terms harmonisation work sights must be set on a level of detail appropriate to the aim: the safety requirements must be sufficiently similar to offer the same protection level, with comparable industrial constraints, which implies that an adequate level of precision must be reached without seeking to harmonise points of detail that would not give any added value.

The resources used

The International Atomic Energy Agency (IAEA), a United Nations organisation, is charged

with drawing up documents describing safety principles and practices that the Member States (they number 137) may use as the basis for their national regulations. Preparing these texts, a lengthy process based on consensus between the States, is supervised by a commission, of which the ASN is a member, that co-ordinates the work of the technical committees.

Early in 2003, the European Commission put forward a set of two draft directives commonly known as the "nuclear package" - one defining the general principles of the safety of nuclear facilities, the other the management of radioactive waste, to meet the demand for harmonisation between the European Union's relatively similar (from a political, scientific, technical and economic point of view) countries.

The WENRA association members (set up on the ASN's initiative in 1999), that comprises the 17 safety authorities of the "nuclear" countries of the European Union and Switzerland, for their part, were quicker to start work on a technical rules harmonisation project in these two areas.

The future of the European Commission's "nuclear package"

It has been impossible to adopt these drafts so far because of opposition by several European Union member states that prefer non legally binding texts such as resolutions or recommendations.

The ASN, which considers that progress towards the harmonisation of nuclear safety principles and standards is necessary, has played an active part in the debate to define the French position in favour of these projects. It has effectively supported the "package", that all in all meets its expectation in that the European Commission accepts national competences. Legally binding documents would have given more stability to the European legislative and regulatory framework for nuclear safety.

In June 2004 the European Council adopted conclusions acknowledging the lack of consensus on the matter and recommended that work to take nuclear safety harmonisation forward, such as that of WENRA, should be continued. During its meeting of 27 October 2004, the European Commission's Group on atomic issues suggested that an action plan should be implemented to that effect.

Work of the WENRA association

According to the definition used for the work carried out by WENRA, harmonisation will be achieved when there are no substantial differences between the countries in national safety requirements or their application to facilities. Thus the task consists firstly of defining a minimum regulatory or para-regulatory framework for all the countries involved in the harmonisation process, and secondly ensuring that the defined requirements are effectively implemented by the operators in those countries.

WENRA members contend that harmonisation must not lead to a reduction in safety. When desirable it should allow safety to be increased. Therefore there is no question in seeking to align safety on the lowest common denominator of various countries. However if the various regulations were to be stacked up purely and simply, that would lead to inapplicable if not to say conflicting demands: it is impossible to define common requirements that are in every case more binding that those already in force. Furthermore the WENRA association is aiming at the safety level represented by the "upper quartile" in its harmonisation work. Furthermore, if a country insists on stricter requirements than those used as the reference for comparison, it would be considered as being harmonised and would not be asked to relax its requirements.

This WENRA harmonisation programme is being developed by two working groups, one for nuclear power reactors, the other (set up after promising results had been achieved in the field of reactors) for the management of radioactive waste and decommissioning operations.

The ASN plays an active role in the work of these two groups and one of its representatives chaired the management of radioactive waste and decommissioning operations working group (until January 2005).

WENRA is kept abreast of the progress of work in the groups and deliberates on the future directions of the work during its two annual plenary sessions. Thus during the last meeting held in Stockholm (23 November 2004) WENRA members were cheered by the promising progress and confirmed the following commitments that had been made at the previous meeting (Munich, 17-18 March 2004):

- the working groups will submit their final conclusions, presenting the results of the national practices assessment process, to the WENRA plenary meeting planned for December 2005,
- before the end of 2006, each member will present an action plan, that aims to bring its national practices into compliance with the defined

reference levels for any technical area in which there are identified differences,

– national practices must be harmonised by 2010.

Outlook

The various approaches mentioned above are complementary and all lead to the harmonisation of safety across Europe by different means. In particular the European Commission's "top down" initiative (the "nuclear package") and WENRA association's "bottom up" approach (the work on harmonisation) are bound to converge in time.

Without waiting, the ASN intends to make the most of the results of ongoing work to enhance its regulations and use other countries' "good ideas" to take safety in France further forward. Where power reactors are concerned, three ministerial draft orders on fuel, general operating rules and reactor safety are being drawn up and already take on board the discussions held within the WENRA "reactors" working group.

9 ASN International involvement



IAEA Beijing conference in October 2004

The ASN's international missions were enshrined in decree no. 2002-255 of 22 February 2002 that created the DGSNR, which specifically states: "In collaboration with the services of the Foreign Ministry, the Directorate General of Nuclear Safety and Radiation Protection prepares and puts forward the French positions in its areas of competence, with a view to international and community discussions".

ASN's aims in the international arena

The following key aims are being pursued by the ASN in its international relations:

- to develop information exchanges with foreign counterparts on regulatory systems and practices, on problems encountered in nuclear safety and radiation protection and on the steps taken to enhance its approach and:
  - improve its knowledge of how these Authorities really operate and draw conclusions for its own operation,
  - strengthen its technical lines of argument through practical knowledge of the reality abroad;
- to make known and explain the French approach and practices in the nuclear safety and radiation protection fields and provide information on the measures taken to deal with the problems encountered. This approach has several objectives:
  - helping to make known French positions on certain issues such as very low level waste, the creation of a radiation protection incident and accident classification scale, the French policy of lowering the authorised limits for BNI releases;
  - providing assistance to countries that wish to create or modify their nuclear safety authority, such as states from the former USSR and a number of emerging countries;
  - when requested, help foreign nuclear safety authorities required to issue permits for nuclear equipment of French origin or design.
- to play an active role in nuclear safety and radiation protection principles and standards harmonisation work, primarily within frameworks such as WENRA (the Association of European Union and Swiss nuclear regulators)

and European Community directive drafting work;

- to inform the French public on what is happening abroad;
- to inform the outside world of events that have occurred in France, and provide the relevant countries with all useful information on nuclear installations sited near their borders;
- to implement the nuclear safety commitments to which the French State is a signatory, primarily in the context of international agreements.

Means

The ASN currently uses the following means in pursuit of these objectives:

- it entertains ongoing bilateral relations with counterparts in over twenty countries;
- it takes part in work co-ordinated by international bodies (IAEA, UNSCEAR, WHO, OECD/NEA, G7/G8, EBRD, European Union);
- it takes part in Nuclear Safety Authority associations (INRA, WENRA), primarily in the work undertaken by WENRA with a view to harmonising the principles and rules applicable in the European context;
- it prepares French reports that must be written in application of international conventions and takes part in the national report review meetings;
- it takes part in international conferences;
- last but not least, it exchanges staff with some of its foreign counterparts. These exchanges are either very short (lasting 1-2 days) for crossover inspections or joint emergency drills, short (lasting 3 weeks to 3 months) when specific technical issues need to be researched, or long (3 years) for detailed study of how other nuclear safety or radiation protection authorities operate.

Outlook

International relations are an effective way of taking nuclear safety and radiation protection forward both in France and abroad. They are one of the Nuclear Safety Authority's major activities, that sustain the work both in technical fields and also as regards methods and organisation.

They effectively enable the ASN and its counterparts to become more familiar with each other and gain better understanding of their reciprocal operation and the problems that beset them. They also enable assistance to be given to countries that wish to develop or improve their safety authority.

They are also the driving force for the harmonisation of safety and radiation protection principles and standards that is needed.

There are only a few bilateral frameworks dealing with radiation protection, while "multi-bilateral" frameworks (associations of radiation protection regulatory authorities) have yet to be set up. This will prompt ASN to widen the scope of existing arrangements or sign new arrangements, depending on the organisation of the countries with which it wishes to develop co-operation, as radiation protection problems do not only occur in States that have nuclear installations; they exist in all States that have modern medical, scientific or industrial activities.

NUCLEAR ACTIVITIES, IONISING RADIATIONS AND HEALTH RISKS

CHAPTER 1

1 DANGERS AND RISKS OF IONISING RADIATIONS

1 | 1 Biological and health effects

1 | 2 Evaluation of risks linked to ionising radiations

1 | 3 Scientific uncertainty and vigilance

2 FIELDS OF ACTIVITY INVOLVING RADIOLOGICAL RISKS

2 | 1 Basic nuclear installations

2 | 1 | 1 Definition

2 | 1 | 2 The safety of basic nuclear installations

2 | 1 | 3 Radiations protection in the basic nuclear installations

2 | 1 | 4 The environmental impact of basic nuclear installations

2 | 2 Transport of radioactive and fissile material for civilian use

2 | 3 Production and use of ionising radiation

2 | 4 Radioactive waste

2 | 5 Contamined sites

2 | 6 Technologically enhanced naturally occuring radioactive materials (TENORM)

3 EXPOSURE TO IONISING RADIATION

3 | 1 Population exposure to natural radiation

3 | 2 Doses received by workers

3 | 3 Doses received by the population as a result of nuclear activities

3 | 4 The doses received by patients

4 OUTLOOK

Nuclear activities are defined by the Public Health Code as "activities entailing a risk of human exposure to ionising radiation, emanating either from an artificial source, whether a substance or a device, or from a natural source when natural radioelements are or have been processed owing to their fissile or fertile radioactive properties, as well as interventions to prevent or reduce a radiological risk following an accident or contamination of the environment". These nuclear activities include those conducted in basic nuclear installations (BNI), as well as in all industrial and research installations and hospital installations in which ionising radiation is used.

The common goal of nuclear safety and radiation protection is to protect people and property against hazards, detrimental effects or troubles of whatsoever nature, arising from the operation of nuclear or radiological facilities, the transportation, utilisation and transformation of radioactive or fissile substances, and exposure to natural radiation.

Nuclear safety is defined as encompassing all technical and organisational provisions relating to the design, construction, operation, shutdown and dismantling of facilities comprising a source of ionising radiation, as well as those relating to the transportation of radioactive materials, and intended to prevent accidents and mitigate any consequences thereof.

Radiation protection is defined as the set of prevention and surveillance rules, procedures and means aimed at preventing or minimising the harmful effects of ionising radiation on persons directly or indirectly exposed, including through environmental contamination.

Responsibility for supervising the safety of nuclear installations and radioactive substance transports lies with the Ministers for the Environment and Industry, while responsibility for supervising radiation protection lies with the Minister for Health and the Minister for Labour.

Decree n° 2002-255 of 22 February instituting the Directorate General for Nuclear Safety and Radiation Protection entrusts this body, under the authority of the Ministers for Health, Industry and the Environment, with responsibility for defining and implementing nuclear safety and radiation protection policy. The DGSNR together with the decentralised departments for which it organises and supervises activities in its area of competence, is referred to as the "Nuclear Safety Authority" (ASN).

1 DANGERS AND RISKS OF IONISING RADIATION

1 | 1

Biological and health effects

Whether it consists of charged particles, for example an electron (beta radiation) or a helium nucleus (alpha radiation), or of electromagnetic radiation photons (X rays or gamma rays), ionising radiation interacts with the atoms and molecules making up the cells of living matter and alters them chemically. Of the resulting lesions, the most important concern the DNA of the cells and are not fundamentally different from those caused by certain toxic chemical substances.

When not repaired by the cells themselves, these lesions can lead to cell death and the appearance of health effects once tissues are no longer able to carry out their functions. These effects, called "deterministic effects", have been known for a long time, as the first effects were observed with the discovery of X rays by Roentgen. They become apparent once the quantity of radiation absorbed

exceeds a certain dose level, depending on the type of tissue exposed; the effects increase proportionally to the dose of radiation received by the tissue.

Cells can also repair the lesions thus caused, although imperfectly or incorrectly. Of the damage that persists, that to the DNA is of a particular type, because residual genetic anomalies can be transmitted by successive cellular division to new cells. A genetic mutation is still far removed from transformation into a cancerous cell, but the lesion due to ionising radiation may be a first step towards cancerisation.

The suspicion of a causal link between the occurrence of cancer and exposure to ionising radiation dates from the beginning of the 20th century (observation of skin cancer on radiodermatitis). Since then, several types of cancers have been observed in a professional environment, including leukaemia, primitive bronchopulmonary cancers through inhalation of radon and bone sarcomas. Outside the professional sphere, monitoring of a group of about 85,000 people irradiated in Hiroshima and Nagasaki provided detailed data on induction and mortality from cancer after exposure to ionising radiation. Other epidemiological work, in particular in radiotherapy, highlighted a statistically significant rise in secondary cancers among patients treated using radiotherapy and attributable to ionising radiation. We should also mention the Chernobyl accident which, as a result of the radioactive iodines released, caused a peak in the incidence of thyroid cancers in children in the areas near the accident.

The occurrence of carcinogenic effects is not linked to a dose threshold and only a probability of occurrence can be stated for any given individual. This is the case with occurrence of radiation-induced cancers. We then talk of probabilistic, stochastic or random effects.

• *The internationally established health goals of radiation protection aim to avoid the appearance of deterministic effects, but also to reduce the probability of radiation-induced cancers appearing.*

1 | 2

Evaluation of risks linked to ionising radiation

Cancer monitoring in France is organised around 13 general registers covering about 13% of the general mainland population and 2 national child cancer registers. As with any monitoring system, the aim is to identify trends in the rise or fall of the incidence of this illness over a period of time, or to identify clusters of cases in a particular region. This intentionally descriptive monitoring method cannot identify radiation-induced cancers, as their form is not specific to ionising radiation.

Epidemiological investigation supplements monitoring. The purpose of epidemiological surveys is to highlight an association between a risk factor and the occurrence of a disease, between a possible cause and an effect, or at least to enable such a causal relation to be posited with a very high degree of probability. However, one should not ignore the difficulty in conducting these surveys or arriving at convincing conclusions when the latency of the disease is long or when the number of expected cases is small, which are both characteristics of exposure to ionising radiation of less than 100 mSv. The epidemiological surveys were thus only able to link pathologies to ionising radiation for relatively high radiation doses at high dose rates (for example: monitoring of the populations exposed to the Hiroshima and Nagasaki bombings).

With a view to risk management, use is then made of the risk evaluation technique which uses calculations to extrapolate the risks observed at higher doses in order to estimate the risks incurred during exposure to low doses of ionising radiation. Internationally, this estimate uses the prudent scenario of a linear relationship without threshold between exposure and the number of deaths through cancer. Thus an estimate of the number of cancers attributable to exposure to ionising radi-

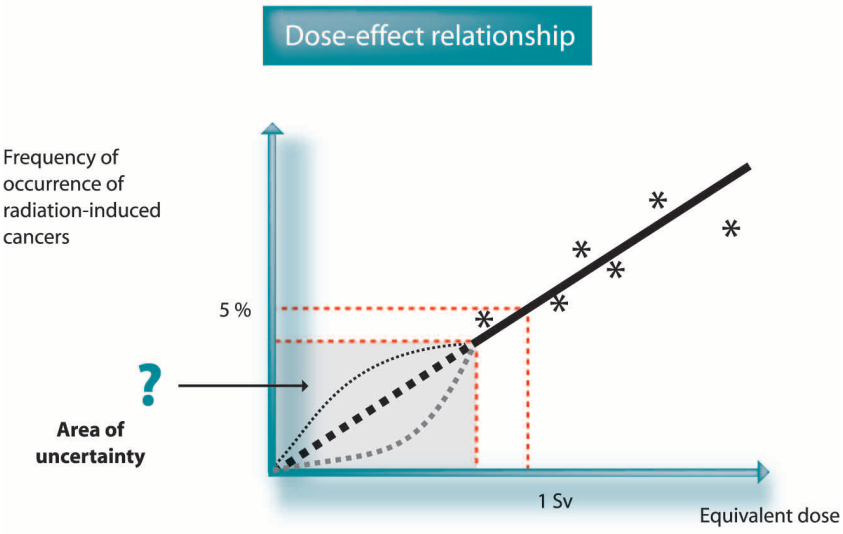


Diagram of the linear relationship without threshold

ation can be calculated, using a linear extrapolation without threshold of the relationship observed at high doses. The legitimacy of these estimates however remains open to debate within the scientific community.

In this context, and on the basis of the scientific work performed by UNSCEAR (see box), ICRP 60 (International Commission on Radiological Protection) published risk coefficients for death through cancer due to ionising radiation, showing a 4% excess risk per sievert for workers and 5% per sievert for the general population. Use of this model, for example, would lead to an estimate of about 7000 deaths in France every year, as a result of cancer due to natural radiation.

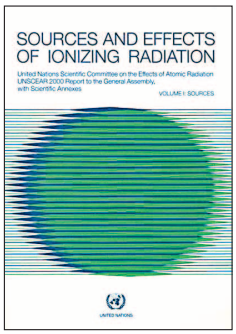
UNSCEAR

The United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) was established in 1955 during the 10th session of the General Assembly of the United Nations. It comprises scientists from 21 countries and reports to the General Assembly of the United Nations. It is a scientific body which validates and underpins the results of national and international studies into the effects of ionising radiation on man.*

Its vocation is not to produce recommendations, as is for example the case with the ICRP. The WHO, ICRP and IAEA enjoy observer status within UNSCEAR.

Every 5 years, UNSCEAR publishes a summary of international work conducted in 2 areas: radiation sources (metrology) and the effects of radiation on man (radiobiology, radiotoxicology, etc.). The next publication is scheduled for 2006.

** Argentina, Australia, Belgium, Brazil, Canada, China, Egypt, France, Germany, India, Indonesia, Japan, Mexico, Peru, Poland, Russia (Federation), Slovakia, Sudan, Sweden, UK, USA. The chair cannot be held by a nuclear-weapon State. The current chairman is Y. Sasaki, from Japan.*



UNSCEAR 2000 report

Evaluation of the risk of lung cancer owing to radon is the subject of a specific model, based on observation of epidemiological data concerning mine workers. Assuming a linear relationship without threshold for low-dose exposure, the relative risk linked to radon exposure, for a radon concentration of 230 Bq/m^3, would be about the same as passive smoking (USA Academy of Science, 1999).

• *The health goal of reducing the risk of cancer linked to ionising radiation cannot be directly observed through epidemiology; the risk can be calculated if we assume the existence of a linear relationship without threshold between exposure and the risk of death from cancer.*

1 | 3

Scientific uncertainly and vigilance

The action taken in the fields of nuclear safety and radiation protection in order to prevent accidents and limit detrimental effects has led to a reduction in risks but has not reached either zero risk nor zero impact, whether in terms of the doses received by medical or industrial workers, or those associated with releases from BNIs. However, many uncertainties and unknown factors persist and require the ASN to remain attentive to the results of the scientific work in progress, for example in radiobiology and radiopathology, with possible spin-offs for radiation protection, particularly with regard to management of risks at low doses.

One can in particular mention six areas of uncertainty:

• *The linear relationship without threshold* - This assumption, adopted to model the effects of low doses on health (see § 1|2), albeit practical from the regulatory standpoint, and albeit prudent from the health standpoint, is not as scientifically well-grounded as might be hoped for: there are those who feel that the effects of low doses could be higher, while others believe that these doses could have no effect below a certain threshold, with some even postulating that low doses could have a beneficial effect! Research into molecular and cellular biology is leading to progress, as are epidemiological surveys of large groups. But faced with the complexity of the DNA repair and mutation phenomena, and faced with the limitations of the methods used in epidemiology, the uncertainties remain and precaution is essential for the authorities.

• *Acceptable risk* - Radiation protection does not claim to be able to achieve zero risk for the effects of ionising radiation but simply to keep them below a level felt to be acceptable. The choice of this level is not the result of technical considerations only, but also involves a significant degree of subjectivity: everyone is entitled to have his own view of the acceptable level of risk, and this level can even differ according to the industrial or medical application of the ionising radiation or its natural or artificial origin. The authorities must take account of this social perception when defining public health policy; but to what extent can they differentiate between a dose received by a nuclear worker, and that received by a patient undergoing radiography or a person subject in the home to radon emissions from granite bedrock?

• *Hypersensitivity to ionising radiation* - The effects of ionising radiation on personal health varies from one individual to the next. We have for example known for a long time that the same dose does not have the same effect on a growing child as on an adult, and this has been incorporated into the regulations. However, in addition to these well-known disparities, certain individuals could be hyper-sensitive to radiation owing to deficiencies in their cellular repair mechanisms controlled by the genetic machinery: in any case this is what is indicated by the in-vivo observations made by radiotherapists and the in-vitro observations made by biologists. Delicate ethical questions then legitimately arise, clearly going beyond the framework of radiation protection: for example should one

search for the possible hyper-sensitivity of a worker likely to be exposed to ionising radiation? Should the general regulations, for example, provide for specific protection for those concerned by hyper-sensitivity to ionising radiation?

• *Hereditary effect* - The appearance of possible hereditary effects from ionising radiation in man remains uncertain. Such effects have not been observed among the survivors of the Hiroshima and Nagasaki[1] bombings. However, hereditary effects are well documented in experimental work on animals: the mutations induced by ionising radiation in germ cells can be transmitted to the descendants. The recessive mutation of an allele will remain invisible as long as the allele carried by the other chromosome is not affected.

• *Dose, dose rate and chronic contamination* – The epidemiological surveys performed on persons exposed to the Hiroshima and Nagasaki bombings, have given a clearer picture of the effects of radiation on health, for high-dose and high dose rate external exposure. The studies begun in the countries most affected by the Chernobyl accident, Byelorussia, Ukraine and Russia, could also advance current knowledge of the effects of radiation on human health, for lower dose and lower dose rate internal exposure levels as well as of the consequences of chronic exposure to ionising radiation (by external exposure and contamination through food) owing to the long-term contamination of the environment.

• *Environment* - The purpose of radiation protection is to prevent or reduce the direct or indirect harmful effects of ionising radiation on humans, including through damage to the environment: human protection entails protection of the environment, as illustrated by the impact assessments submitted to the public inquiries prior to granting of BNI release licences. But quite apart from this environmental protection aimed at protecting present and future generations of mankind, one could also envisage the protection of nature, in the specific interests of animal species or the rights of nature. On this subject, even more so than those mentioned earlier, defining an acceptable level will be a delicate business. The ASN will therefore closely monitor the work being done on this subject by the ICRP, the results of which could have important repercussions in the regulatory field.

2 FIELDS OF ACTIVITY INVOLVING RADIOLOGICAL RISKS

The activities involving a risk of exposure to ionising radiation can be grouped into the following categories:
- basic nuclear installations;
- transport of radioactive and fissile materials for civilian use;
- production and use of ionising radiation;
- radioactive waste and contaminated sites;
- activities enhancing naturally-occurring ionising radiation.

2 | 1

Basic nuclear installations

2 | 1 | 1

Definition

The regulations classify nuclear facilities in various categories corresponding to procedures of various stringency, depending on the scale of the potential hazards. The main permanent nuclear instal-

1. Sources and effects of ionising radiations UNSCEAR 2000.

lations, called "Basic Nuclear Installations" (BNI) are defined by decree 63-1228 of 11 December 1963 which sets the categories:
- nuclear reactors, with the exception of those equipping a means of transport;
- particle accelerators;
- plants for the separation, manufacture or transformation of radioactive substances, in particular nuclear fuel manufacturing plants, spent fuel reprocessing plants or radioactive waste packaging plants;
- facilities designed for the disposal, storage or use of radioactive substances, including waste.

The last three types of facilities are however only covered by BNI regulations when the total quantity or activity level of the radioactive substances exceeds a threshold set, according to the type of facility and the radionuclide concerned, by joint order of the ministers for the Environment, Industry and Health.

Nuclear facilities which are not considered to be BNIs may be subject to the requirements of the law of 19 July 1976 as installations classified on environmental protection grounds (ICPE).

The BNI status as at 31 December 2003 is given in appendix B.

2 | 1 | 2

The safety of basic nuclear installations

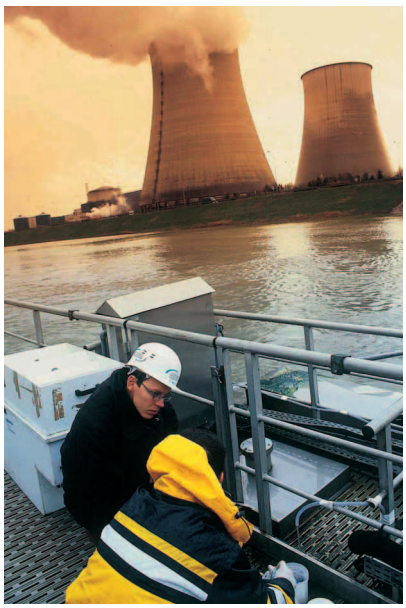
The fundamental principle underpinning the organisational system and the specific regulations applicable to nuclear safety is the prime responsibility of the operator. The public authorities verify that this responsibility is fully assumed, in compliance with the regulatory requirements.
The respective roles of the public authorities and the operator can be summarised as follows:
- the public authorities define the general safety objectives;
- the operator proposes technical procedures for attaining them, and justifies them;
- the public authorities ensure that these procedures are consistent with the goals set;
- the operator implements the approved measures;
- during inspections, the public authorities check correct implementation of these measures and draw the corresponding conclusions.

2 | 1 | 3

Radiation protection in the basic nuclear installations

BNIs are "nuclear activities", as defined by the Public Health Code, but are subject to specific regulation and supervision, owing to the significant risks of exposure to ionising radiation.

The operator is required to take all necessary steps to protect the workers against the hazards of ionising radiation, and more particularly to follow the same general rules as those applicable to all workers exposed to ionising radiation (annual dose limits, categories of exposed workers, definition of supervised areas and controlled areas, etc.), along with the technical and administrative requirements specific to BNIs (organisation of work, prevention of accidents, keeping of registers, workers from sub-contractors, etc.). The operator must also take the steps necessary to



Radiological monitoring of the environmental around a BNI

attain and maintain an optimum level of protection of the population, in particular by checking the effectiveness of the technical systems implemented for this purpose.

2 | 1 | 4

The environmental impact of basic nuclear installations

Under normal operating conditions, nuclear facilities release liquid and gaseous effluents, which may or may not be radioactive. The environmental and health impact of these discharges must be strictly limited.

The facilities must therefore be designed, operated and maintained in such a way as to limit the production of such effluents. These effluents must be treated so that the corresponding releases are kept to a level as low as reasonably achievable. These discharges may not exceed the limit values set on a case by case basis by the public authorities, using the best technologies available at an economically acceptable cost, and taking into account the particular characteristics of the site. Finally, these discharges must be permanently measured and their actual impact regularly assessed, in particular with regard to radioactive discharges, which are the truly specific factor in nuclear facilities.

2 | 2

Transport of radioactive and fissile material for civilian use

When transporting radioactive or fissile materials, the main risks are those of internal or external exposure, criticality, or chemical hazard. Safe transport of radioactive materials relies on an approach called defence in depth:
- the package, consisting of the container and its content, is the first line of defence. It plays a vital role and must be able to withstand all foreseeable transport conditions;
- the transport medium and its reliability constitute the second line of defence;
- finally, the third line of defence consists of the response resources implemented to deal with an incident or accident.



Transport of radioactive materials

The prime responsibility for implementing these lines of defence lies with the shipper.

2 | 3

Production and use of ionising radiation

Ionising radiation, whether generated by radionuclides or by electrical equipment (X-rays), is used in very many areas of medicine (radiology, radiotherapy, nuclear medicine), human biology, research, industry, but also for veterinary and medico-legal applications as well as for conservation of foodstuffs.

In terms of radiation protection, most of these activities - also considered to be nuclear activities - are the subject of a general system of authorisations or, as applicable, a special system of authorisa-



Radiation protection of patients

tions (case of BNIs, ICPEs and installations subject to the Mining Code) in which, on the basis of information forwarded by the licensee, the various radiation protection related aspects are examined, with regard to protection of both the workers and the population at large. Environmental protection is also taken into account through requirements applied to discharges of liquid and gaseous effluents. In the case of use for medical purposes, patient protection issues are also examined.

For activities other than those subject to the special systems mentioned above, the authorisations are issued to the persons responsible for utilisation of the ionising radiation. The fact that the responsibility is targeted on the user in no way means that the head of the company is relieved of his duty to provide the person in possession of the sources with all resources necessary for radiation protection, be they human (person competent in radiation protection, medical physics expert), technical (premises and equipment conforming to current standards) organisational, or measurements (dosimetry).

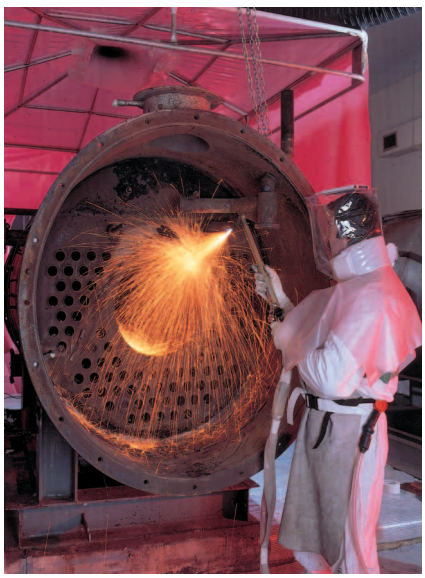
2 | 4

Radioactive waste

Like all industrial activities, nuclear activities generate waste. Some of this waste is radioactive. The three fundamental principles on which strict management of radioactive waste is based, are the responsibility of the waste producer, traceability of the waste and information of the public.

For very low level waste, application of a management system based on these principles, if it is to be completely efficient, rules out setting a universal threshold below which regulatory supervision can be dispensed with.

The technical management provisions to be implemented must be tailored to the hazard presented by the radioactive waste. This hazard can be mainly assessed through two parameters: the activity level, which contributes to the toxicity of the waste, and the lifetime defined by the half-life, the time after which the activity level is halved.



Dismantling of a nuclear installation

Finally, management of radioactive waste must be determined prior to any creation of new activities or modification of existing activities in order to:

- optimise the waste management channels;

- ensure mastery of the processing channels for the various categories of waste likely to be produced, from the front-end phase (production of waste and packaging) to the back-end phase (interim storage, transport, disposal).

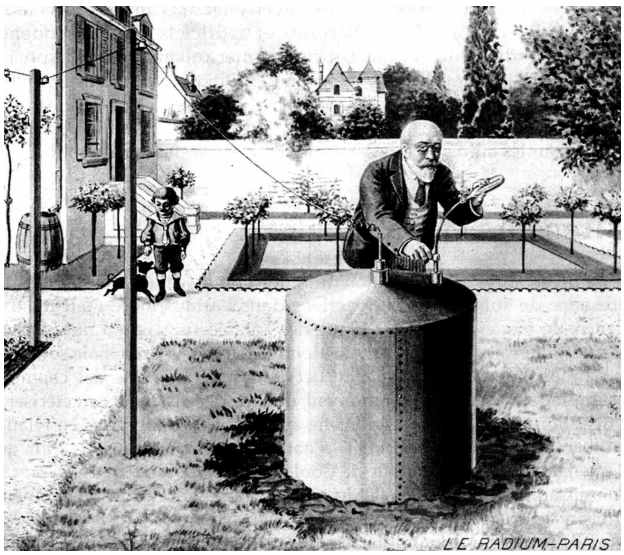
2 | 5

Contaminated sites

Management of sites contaminated by residual radioactivity resulting either from a past nuclear activity, or an activity which generated deposits of natural radioelements, warrants specific radiation protection actions, in particular if rehabilitation is envisaged. In the light of the current or future uses of the site, decontamination targets must be set and disposal of the waste produced during clean-up of the premises and the contaminated soils must be controlled, from the site up to the storage or disposal location.

2 | 6

Technologically enhanced naturally occuring radioactive materials (TENORM)



Ancestor of radon flux measurement in the soil using an accumulation chamber

Exposure to naturally-occurring ionising radiation, when enhanced by human activities, justifies supervision, and even risk evaluation and management, if it is likely to generate a risk for exposed workers and, as applicable, the population in general.

• Some professional activities which cannot be defined as "nuclear activities" can indeed lead to significant exposure to ionising radiation of the workers and, to a lesser extent, of the populations in the vicinity of the places where these activities are carried out. This is in particular the case with activities which use materials (raw materials, construction materials, industrial residues) containing natural radioelements not used for their radioactive, fissile or fertile properties. The natural families of uranium and thorium are the main radioelements encountered.

Among the industries concerned, we could mention the phosphate mining and phosphated fertiliser manufacturing industries, the dyes industries, in particular those using titanium oxide and those using rare earth ores such as monazite.

The radiation protection actions required in this field are based on a precise identification of the activities, estimation of the impact of the exposure on the persons concerned, taking of corrective action to reduce this exposure if necessary, and monitoring.

• Targeted on the risk to the population as a whole, but also to workers, monitoring of human exposure to radon in premises open to the public is also a radiation protection priority in geographical areas with a high potential of radon exhalation owing to the geological properties of the site. A strategy to reduce this exposure is necessary if the measurements taken exceed the regulatory action levels defined on the basis of work done internationally.

• Teaching establishments, health and social care establishments, thermal establishments and penitentiary establishments are primarily concerned by the radon monitoring measures.

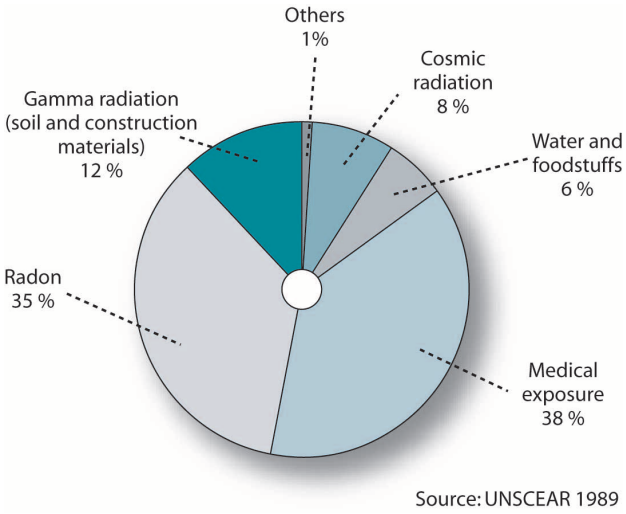
• Finally the exposure of aircrews to cosmic radiation, aggravated by prolonged periods at altitude, also warrants dosimetric monitoring.

3 EXPOSURE TO IONISING RADIATION

The pathology monitoring systems set up (cancer registers for example) do not enable those pathologies attributable to ionising radiation to be determined. Nor do we have reliable and easily measurable biological indicators which could be easily used to recreate the radiation dose to which the persons were exposed. In this context, "risk monitoring" is performed by measuring ambient radioactivity indicators, or at best by measuring the dose rates linked to external exposure to ionising radiation or internal contamination, or failing which, by measuring values (concentration of radionuclides in radioactive waste releases) which would then enable an estimate of the doses received by the exposed populations to be calculated.

The entire French population is potentially exposed, although to different extents throughout the country, to ionising radiation of natural origin and to radiation created by human activities. The average exposure of the French population is estimated, per inhabitant, at 4 mSv per year, but this exposure is subject to wide individual variability, in particular depending on the place of residence and the number of radiological examinations received (source: National health and environment plan, report by the National Orientation Committee - February 2004). The following diagram represents an estimate of the respective contributions of the various sources of French population exposure to ionising radiation.

These data are mainly extracted from international literature and are too imprecise to allow identification - in each category of exposure sources - of the categories or groups of persons most exposed.



Dose distribution
(Source : UNSCEAR, 1993)

3 | 1

Population exposure to natural radiation

Exposure of the population to ionising radiation is the result of the presence of radionuclides of terrestrial origin in the environment, radon emanations from the ground and exposure to cosmic radiation.

Terrestrial radiation (excluding radon)

Natural radionuclides of terrestrial origin are present at various levels in all aspects of our environment, including inside the human organism. They lead to external exposure of the population owing to gamma radiation emissions produced by the uranium 238 and thorium 232 chains and by the potassium 40 present in the soil, but also to internal exposure by inhalation of radon or particles in suspension, and by ingestion of foodstuffs or drinking water.

• The levels of natural radionuclides in the ground are however extremely variable. The highest external exposure dose rates in the open air range in France, depending on the regions, between a few nGy h^{-1} and 300 nGy h^{-1}. The average highest values are observed in the Limousin region (120 nGy h^{-1}), with the lowest in the sedimentary basins (20 nGy h^{-1} in the Bouches-du-Rhône area).

The dose rate values inside residential premises are generally higher owing to the contribution of construction materials (an average of about an extra 20%).

Based on scenarios covering the time individuals spend inside and outside residential premises (80 and 20% respectively), the average annual effective dose due to external exposure to gamma radiation of terrestrial origin is estimated at about 500 µSv (UNSCEAR 1993).

• The internal exposure through inhalation, owing to air suspension of particles of soil, is estimated at 2 µSv per year, while that due to the long-lived descendents of radon is estimated at about 10 µSv per year.

The doses due to internal exposure of natural origin vary according to the quantities of radionuclides of the uranium and thorium families incorporated through the food chain, which depend on each individual's eating habits. According to UNSCEAR (1993), the average dose per individual is about 50 µSv per year. The average concentration of potassium 40 in the organism is about 55 Bq per kg, resulting in an average effective annual dose of about 17 µSv.

Water intended for human consumption, in particular groundwater and mineral waters, become charged in natural radionuclides owing to the nature of the geological strata in which they spend time. The concentration of descendants of uranium and thorium, but also of potassium 40, varies according to the department given the geological nature of the ground. The waters with a high level of radioactivity, the annual effective dose resulting from daily consumption (2 litres/inhabitant/day) can reach several tens or several hundreds of µSv, and could even exceed the value of 1 mSv per year.

ASN Action - New radiological inspection programs for public mains water and non-mineral bottled water (see chapter 3) will eventually produce a complete balance of the radiological quality of the water intended for human consumption, in particular on the basis of total alpha and beta radioactivity measurements. The corresponding information will be incorporated into the health/environment information system of the DDASS (SISE-Eau). It will give a picture of the natural radioactivity of the water distributed.

Exposure to radon

Exposure to "domestic" radon (radon in the home) was estimated by measurement campaigns, followed by statistical interpretations (see IRSN atlas). The average radon activity value measured in France is 63 Bq/m^3, with about half the results being below 50 Bq/m^3, 9% above 200 Bq/m^3 and 2.3% above 400 Bq/m^3. These measurements led to a classification of the departments according to the radon exhalation potential of the land (see chapter 3). For methodological reasons, the results of this supervision are still however too imprecise for an accurate assessment of the doses linked to the

2. IPSN, 1985

actual exposure of the individuals. If we assume a home occupancy ratio of 90%, these values give an average annual dose of 1.5 mSv.

In premises open to the public, and in particular in teaching establishments and health and social care establishments, measurements have been taken since 1999. The summary of these measurements, published by the DGSNR in 2003, show that of about 13,000 establishments checked between 1999 and 2001, 12% showed concentrations of more than 400 Bq/m³ and 4% more than 1000 Bq/m³. Given the diversity of the length of time for which the premises are occupied, no conclusions could be drawn in terms of exposure.

ASN Actions – The ASN is taking part in constructing the new information system designed to collect data about the main domestic pollutants (SISE-Habitat project coordinated by the Directorate General for Health). This project should centralise the radon measurement results for premises open to the public and the information system should come on stream in around 2007.

In June 2004, the decision was taken to study the feasibility of incorporating radon measurements into the domestic health dossier required whenever a property is sold or rented, in order to improve the information available to the future buyer or tenant (see national heath and environment plan - PNSE); this action, which is to be coordinated by the DGSNR with the Ministry for Housing, should contribute to obtaining a clearer understanding of the radon exposure doses for the population as a whole.

External exposure due to cosmic radiation

Cosmic radiation is of two types, an ionic component and a neutronic component. At sea level, the ionic component is estimated at 32 nSv per hour and the neutronic component at 3.6 nSv per hour.

If we assume the average time spent inside the home (which itself attenuates the ionic component of the cosmic radiation), the individual effective dose in a locality at sea level in France is 267 µSv per year, whereas it could exceed 1100 µSv per year in a mountain locality such as Cervières at 2836 m altitude. The average annual effective dose per individual in France is 331 µSv per year.

3 | 2

Doses received by workers

Exposure of nuclear workers

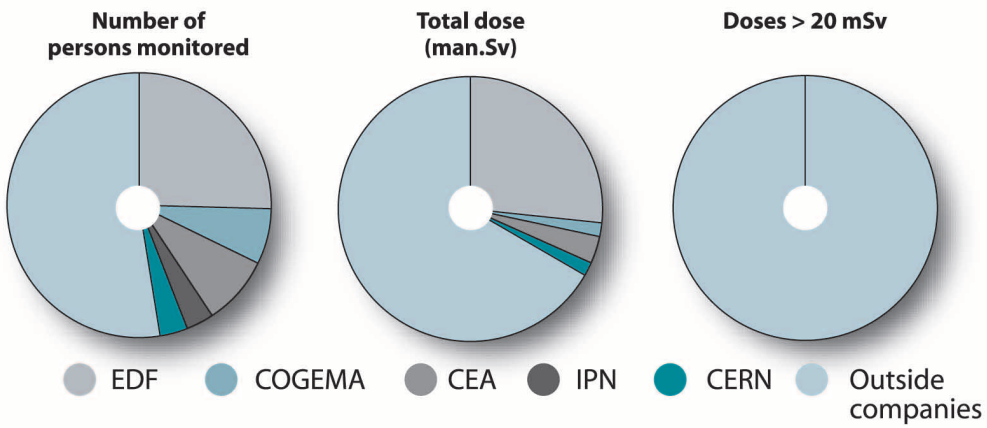
The exposure monitoring system for persons working in installations employing ionising radiation has been in place for a number of decades. It is based on the mandatory wearing of personal dosimeters by workers likely to be exposed and is used to check compliance with the regulatory limits applicable to workers. The data recorded give the cumulative exposure dose over a given period (monthly or quarterly). They are fed into the SISERI system managed by the IRSN and are published annually. In the future, the SISERI system will be able to collate the data supplied by "operational dosimetry", in other words, real-time measurement of exposure doses.

These results show a general drop in the workforce monitored since 2001 (-3.2%), which is particularly marked in the outside contractors (-30%) and the conventional industries (-9%); however, among veterinarians, the workforce monitored is significantly up (+75%). In terms of exposure, a slight increase in collective dose is observed between 2002 and 2003 but also a significant rise in the number of times the 20 mSv/year limit was exceeded (+39%); this latter increase was observed among the monitored workers of outside contractors, conventional industries and medical departments.

BNI dose distribution (year 2003)

	Number of persons monitored	Total dose (man.Sv)	Doses > 20 mSv
EDF	19 987	9,866	0
COGEMA + MELOX	6 048	1,15	0
CEA	6 702	1,48	0
IPN Orsay	3 497	0,021	0
CERN	2 091	0,341	0
Outside contractors	30 280	24,377	13
Total	68 605	37,235	13

Statistical results of worker dosimetry (year 2003 – Source IRSN)

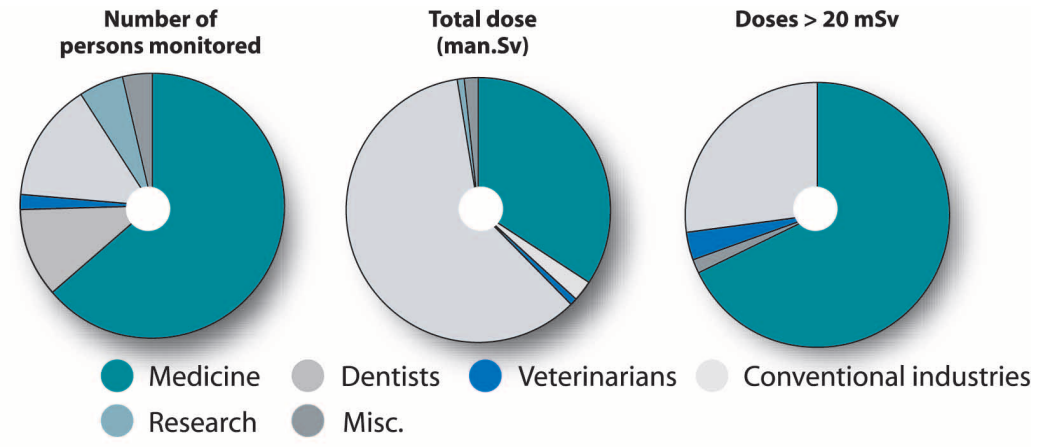


Statistical results of worker dosimetry (year 2003 – source IRSN)

Non-BNI dose distribution (year 2003)

	Number of persons monitored	Total dose (man.Sv)	Doses > 20 mSv
Medicine	112 458	9,254	44
Dentists	22 805	0,432	2
Veterinarians	6 915	0,56	4
Conventional industries	26 160	22,758	40
Research	8 805	0,071	0
Miscellaneous	5 005	0,24	0
Total	182 148	33,315	90

Statistical results of worker dosimetry (year 2003 – source IRSN)



Statistical results of worker dosimetry (year 2003 – source IRSN)

The following table shows the overall variations in the workforce monitored, the collective dose and the number of times the 20 mSv limit was exceeded.

Year	Workforce monitored	Collective dose (man.sievert)	Number of times the 20 mSv/year limit was exceeded
2001	259 163	74	111
2002	253 001	67	74
2003	250 753	71	103

As soon as it became aware of this rise in the number of persons receiving exposure above 20 mSv, the ASN asked the IRSN for clarification concerning the reasons for this increase. An enquiry is currently in progress. The generalised use of operational dosimetry, with improved dosimetric monitoring, and the implementation of the IRSN's SISERI centralised dosimetry data collection and analysis system should enable these results to be examined more closely and identify the origin of these regulatory exposure limit overshoots.

The ASN is particularly attentive to the correct working of SISERI in that the statistics provided by the IRSN constitute national indicators of choice concerning the evolution of worker exposure and assessment of the effectiveness of the steps taken by the operator to apply the principle of optimisation. The SISERI access procedures for radiation protection inspectors should also be examined as of 2005.

Worker exposure to enhanced natural radiation

On the other hand, there is no system for monitoring exposure of persons working in activities which enhance exposure to natural radiation. The studies so far published show that exposure can range from a few millisieverts to several tens of millisieverts per year. Worker exposure to enhanced natural radiation is the result either of the ingestion of dust containing large amounts of radionuclides (phosphates, metal ore), or of the inhalation of radon formed by uranium decay (poorly ventilated warehouses, thermal baths) or of external exposure due to process deposits (scale forming in piping for example). Thus, for example:

• industries handling raw materials that are naturally rich in radionuclides (phosphates, foundry ore, zirconium silicates, dye pigments, rare earths) can lead to annual worker exposure of several millisieverts;

• extraction of oil and natural gas can also lead to annual doses of several millisieverts through irradiation due to the particularly radioelement-rich scale that forms in the pipelines;

• in spas, the high radon content of the water and the poor ventilation indicate that there would be significant doses, both for the personnel and the public coming to take the waters (a bibliographical study by the IRSN of foreign spas shows that annual doses of 10 to 100 mSv are common for the personnel and from 1 to 4 mSv for the members of the public).

Flight crew exposure to cosmic radiation

Airline flight crews and certain frequent travellers are exposed to significant doses owing to the altitude and the intensity of cosmic radiation at high altitude. These doses can exceed 1 mSv/year. We therefore estimate that the mean annual dose for "short-haul" crews would be from 1 to 2 mSv, from 3 to 5 mSv for "long-haul" crews and up to 10 mSv for certain air mail flight crews.

In order to collect information on this annual exposure, an observation system named SIEVERT was set up by the Directorate General for Civil Aviation (DGAC), the IRSN, the Paris Observatory and the Paul-Émile Victor French institute for polar research (www.sievert-system.com).

3 | 3

Doses received by the population as a result of nuclear activities

The automatic monitoring networks managed nationwide by the IRSN (Téléray, Hydrotéléray and Téléhydro networks) 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.

However, for methodological reasons, there is no overall monitoring system able to provide an exhaustive picture of the doses received by the population as a result of nuclear activities. Consequently, it is impossible directly to check compliance with the exposure limit for the population (see chapter 3). 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 dosimetric 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. Prior methodological studies are required in order to obtain a clear knowledge of these facilities, in particular the impact of releases containing small quantities of artificial radionuclides originating from the use of unsealed radioactive sources in research or biological laboratories, or in nuclear medicine departments. These are in progress within the IRSN at the request of the ASN.

3 | 4

The doses received by patients

We have no system for monitoring patient exposure, in particular because this exposure is not subject to any strict limitation, owing to its medical benefits. It is hard to accurately identify the overall exposure of medical origin, as we do not know the numbers of each type of examination practiced and the doses delivered for the same examination can vary widely. However, global statistics (UNSCEAR 2000 report, volume 1, p. 401) drawn up for 1.53 billion inhabitants of the developed countries (1991-1996 data) indicate an annual effective dose rate per inhabitant of 1.2 mSv for radiology, 0.01 mSv for dentistry and 0.08 mSv for nuclear medicine. In western Europe, for diagnostic radiological imaging, the annual effective dose per inhabitant in France was assessed at 1 mSv, whereas it is 0.33 mSv for the United Kingdom and 1.9 mSv for Germany.

ASN Action – Based on the recommendations published in 2002 by the InVS, the DGSNR draw up a plan of action at the end of 2003 designed to set up and develop supervision of patient exposure to ionising radiation of medical origin (PASEPRI). This plan was drawn up in close collaboration with the concerned departments of the IRSN and the InVS, then submitted to the various institutional partners involved for approval. Multi-year implementation began in 2004. It is regularly monitored by a committee chaired by the DGSNR. The actions included in this plan meet the following two objectives:
– to obtain a better understanding of patient exposure to ionising radiation, to allow greater optimisation of practices and to determine the reference dose levels for medical radiology and nuclear medicine;
– to pool the knowledge needed for subsequent development of epidemiological monitoring of the effects of ionising radiation.

The action plan defined in this way, involving a multi-year commitment by the IRSN and the InVS in their respective areas of competence, is the first step in a long-term process to set up a system in France for centralising information concerning patient exposure, in the same way as the system that already exists for workers.

4 Outlook

In addition to its regulatory and supervisory actions, the ASN closely monitors changes in research and knowledge in the field of health and ionising radiation, and international radiation protection doctrine. More precisely:

a) At the end of 2004, the ASN asked the IRSN and the InVS to start to give thought to the subject of a scientific watch and to research priorities. The need to set up the processes required for a regular summary of published research had already been underlined in the 2003 report, on the basis of the conclusions of the Vrousos commission into radiation protection priorities. This need was subsequently confirmed by the national health and environment plan, the priorities of which included coordinating a scientific watch network to support the policies of prevention and precaution. This scientific watch should allow analysis of progress made in the knowledge of the biological effects of ionising radiation and, as applicable, allow a reduction in the uncertainties regarding the associated health risk, in particular with respect to low doses.

b) Close attention must continue to be paid to the work of the ICRP, which is updating its recommendations published in 1990. The ASN is therefore closely monitoring the work presented as being likely

to simplify the internationally defined radiation protection system. Incorporating environmental protection into the next ICRP recommendation is still very much on the agenda.

c) Exposure monitoring requires a particular effort in order to better identify the population categories or groups which are most exposed. The interest of this is three-fold: this knowledge should lead to better targeting of risk reduction efforts (optimisation), provide reliable indicators for evaluating the effectiveness of public policy and develop epidemiological surveys for an improved approach to the risk. Monitoring patient exposure and domestic radon are two priority areas for the ASN:

• together with the IRSN and the InVS, the ASN in early 2004 published the PASEPRI, the first national action plan designed to identify the exposure to ionising radiation of medical origin. When taken as a whole, the knowledge gleaned from this action plan will enable the ASN to implement the regulations in a more efficient way, to modify them if necessary to ensure optimum patient protection and to encourage targeted epidemiological surveys, with the possibility of cross-referencing exposure data with the effects at an individual level;

• on the basis of the orientations defined in the national health and environment plan (PNSE), adopted by the Government in June 2004, the ASN is preparing the first action plan for managing the domestic radon risk. This should contribute to gaining a clearer picture of radon exposure in those departments most concerned by this radioactive gas.

THE ORGANISATION OF SUPERVISION OF NUCLEAR SAFETY AND RADIATION PROTECTION

CHAPTER 2

1 PRINCIPLES OF ACTION

1 | 1 Responsibility

1 | 2 Justification

1 | 3 Optimisation

1 | 4 Limitation

1 | 5 Precaution

1 | 6 Participation

2 ORGANISATION OF SUPERVISION

2 | 1 The Nuclear Safety Authority and its technical support organisations

2 | 1 | 1 The Directorate General for Nuclear Safety and Radiation Protection

2 | 1 | 2 The decentralised departments

2 | 1 | 3 The working of the Nuclear Safety Authority

2 | 1 | 4 Technical support organisations

2 | 1 | 5 The experts groups

2 | 2 The other players

2 | 2 | 1 The Parliamentary Office for Assessment of Scientific and Technological Options

2 | 2 | 2 Consultative bodies

2 | 2 | 3 The public health and safety agencies

2 | 2 | 4 Other consultative committees

3 OUTLOOK

On behalf of the state, the Nuclear Safety Authority (ASN) supervises nuclear safety and radiation protection, to ensure the safety of workers, patients, the public and the environment against risks linked to nuclear activities. It also contributes towards informing the citizens.

For the exercise of its activity, and in compliance with the fundamental action principles, the ASN has its own resources and can call on the competence of advisory committees, technical support and consultative bodies.

1 PRINCIPLES OF ACTION

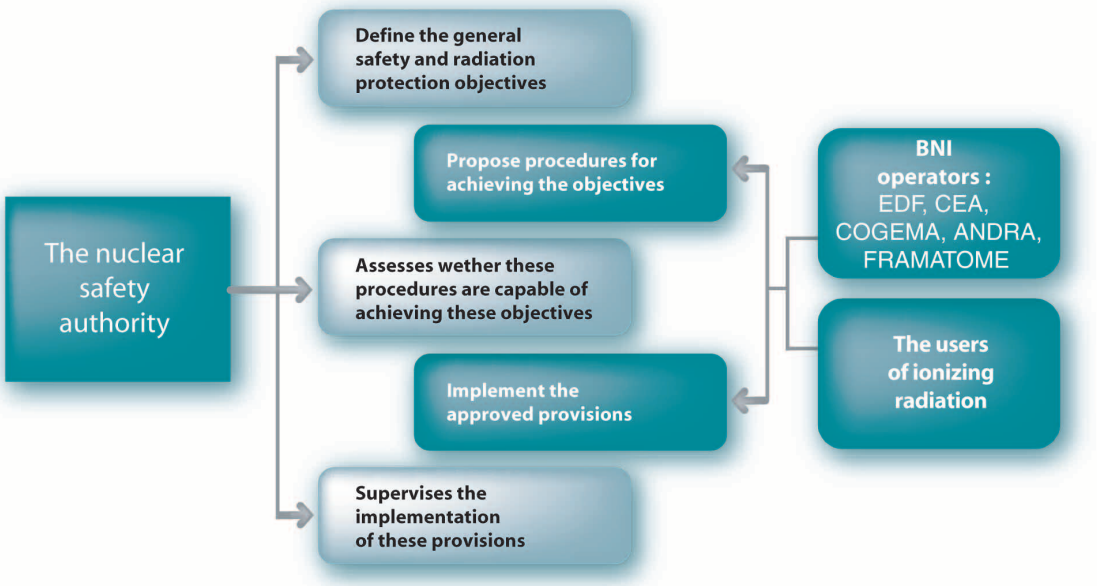
Nuclear activities must be carried out in compliance with principles, some of which are enshrined in legislation or regulations and which may be applicable differently according to the scope of activity.

1 | 1

Responsibility

The principle of responsibility states that the prime responsibility for activities entailing a risk lies with those who carry out these activities:

- responsibility of the operators for the safety of basic nuclear installations;
- responsibility of the consignor for the transport of radioactive materials;
- responsibility of the users for radiation protection of the public;
- responsibility of the suppliers for recovery of radioactive sources;
- responsibility of the employers for radiation protection of workers;
- responsibility of the prescribing doctor and the practitioner of the procedure for radiation protection of patients;
- responsibility of the polluters for harm to the environment;
- responsibility of the producers for disposal of waste.



Responsibility of the operators and responsibility of the Nuclear Safety Authority

The polluter-pays principle introduced into the environment code is an application of the principle of responsibility in that it ensures that the polluter responsible for environmental damage resulting from its activity is responsible for bearing the cost of pollution prevention and mitigation measures. This in particular leads to taxing of basic nuclear installations (BNI) and installations classified on environmental protection grounds (ICPE).

The environment charter bill states that "everyone must contribute to reparation of the damage he or she has caused to the environment".

1 | 2

Justification

The principle of justification is one of the three fundamental principles of radiation protection, enshrined in the Public Health Code. It states that a nuclear activity can only be undertaken if its health, social, economic or scientific benefits are justified, given the risks inherent in human exposure to ionising radiation which it is likely to entail.

Traditionally, this principle of justification was first of all applied to radiation protection of patients - any unjustified examination being prohibited - before being extended to all radiation protection.

It thus applies to most areas supervised by the ASN: the aim is to compare the advantages of a nuclear activity against its radiological risks, whether dealing with the risk of radiological accident or the risks induced by normal operation of the facilities, in particular through radiological exposure of the workers, effluent discharge and the production of radioactive waste.

1 | 3

Optimisation

The principle of optimisation, another fundamental principle of radiation protection enshrined in the CSP, states that 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.

Traditionally, this principle of optimisation was first of all applied to radiation protection of workers, before being extended to all radiation protection. It today has equivalents in the other fields of activity supervised by the Nuclear Safety Authority (ASN): nuclear safety, environmental protection, waste disposal.

The Environment Code thus introduces the principle of preventive and corrective action against environmental damage, primarily at the source, using the best techniques available at an economically acceptable cost.

The safety of nuclear facilities is to a large extent optimised by applying the principle of defence in depth. Whether in terms of design, manufacture or operation of BNIs, a whole series of material barriers and organisational measures are set up to prevent accidents and keep the risk as low as possible. Going further than this, the simultaneous failure of all these lines of defence and the occurrence of an accident are postulated, in order to plan the resources for minimising the consequences of these accidents: these resources are the last line of defence.

1 | 4

Limitation

The principle of limitation, also one of the fundamental principles of radiation protection enshrined in the Public Health Code (CSP), states that the exposure of a person 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 notion of limit clearly does not apply only to radiological exposure of the general public and workers, but also to other sorts of hazards and detrimental effects: for example to the non-radiological parameters of discharges from ICPEs subject to authorisation.

1 | 5

Precaution

The Environment Code introduces the principle of precaution whereby an absence of certainty, in the light of current scientific knowledge, should not delay the adoption of effective, proportionate measures to prevent a risk of serious and irreversible damage to the environment at an economically acceptable cost.

This principle of precaution is included in the constitutional bill concerning the environment charter, which has already passed its first reading in the National Assembly and the Senate.

With regard to the biological effects of ionising radiation at low doses and low dose rates, the principle of precaution adopts a linear dose-effect relationship without threshold.

1 | 6

Participation

The Environment Code introduces the principle of participation whereby there is unrestricted access to information about the environment, including hazardous activities and substances, and the public is involved in drafting projects with an important influence on the environment.

This principle is also included in the environment charter bill.

The law of 17 July 1978 on access to administrative documents supplemented by the law of 12 April 2000 on citizens' rights in their dealings with the administration, also provides for public access to information.

This right to information concerns all fields of ASN activity, and in particular:
- information of the public about events occurring in BNIs or during the transport of radioactive materials, about releases from BNIs, whether normal or accidental;
- workers information about their individual radiological exposure;
- patient information about the medical act, in particular its radiological aspect.

In accordance with the duties entrusted to it, the ASN contributes to public information about nuclear safety and radiation protection. It does so through various types of action (exhibitions, publications, press conferences, access to original documents issued by the ASN), with a three-fold goal of objectivity, instruction and transparency.

2 Organisation of supervision

The organisation of nuclear safety and radiation protection in France is based on the principle of the prime responsibility of those carrying out these activities involving risks (see § 1|1).

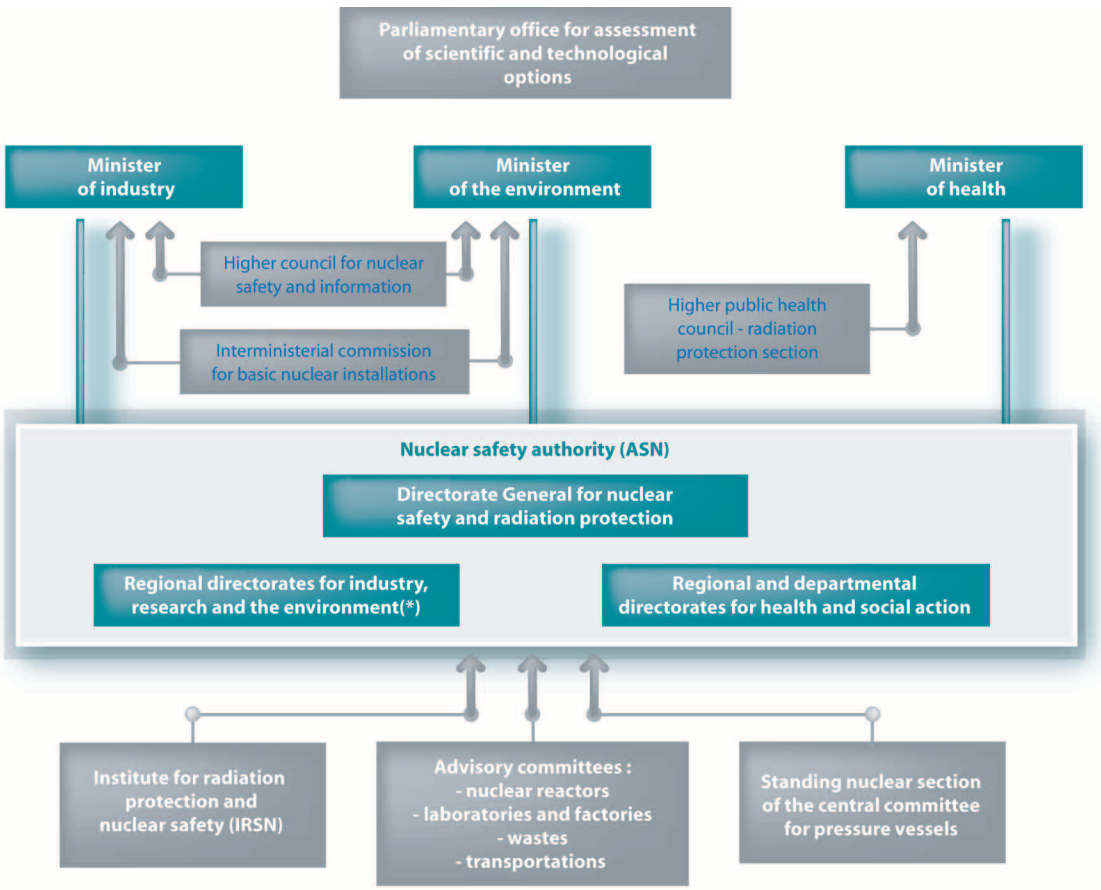
The role of the public authorities is to ensure that this responsibility is assumed in full, in compliance with the principles mentioned above and the regulatory requirements implementing them.

Within the public authorities, responsibility for supervision of the safety of nuclear installations and radioactive material transports lies with the Ministers for the Environment and Industry, while responsibility for supervision of radiation protection lies with the Minister for Health.

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

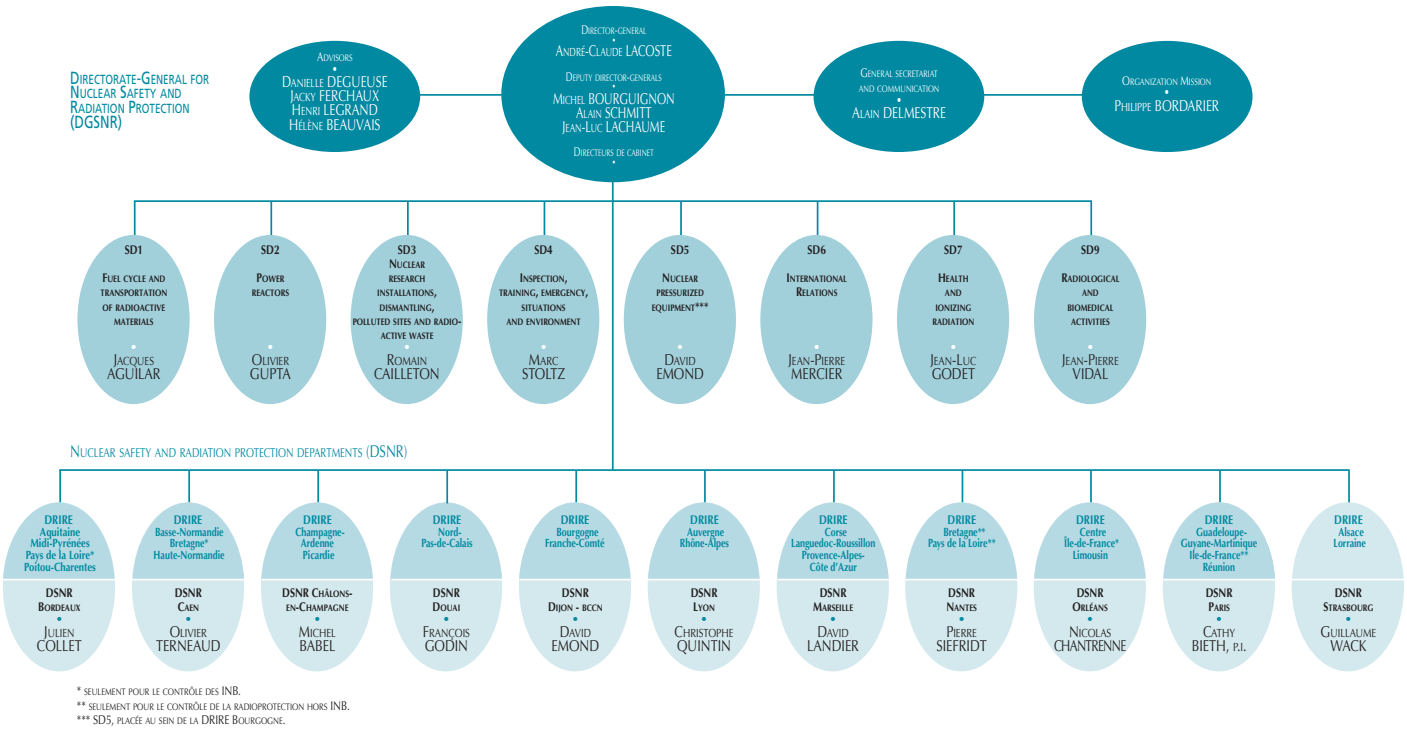
In order to carry out this duty, the DGSNR calls on the services of the decentralised governmental departments. The DGSNR together with the decentralised departments for which it organises and supervises activities in its area of competence, is referred to as the "Nuclear Safety Authority" (ASN).

In carrying out their duties the ASN, and the men and women in it, strive to respect four key values: competence, independence, stringency and transparency.



(*) For their nuclear safety and radiation protection control activities.

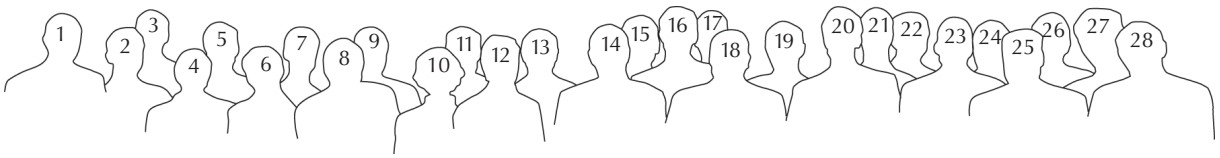
Supervision of nuclear safety and radiation protection in France



ASN organization chart as of December 31, 2004



Nuclear Safety Authority management committee



1 Pierre Siefridt (DSNR Nantes)
2 Guillaume Wack (DSNR Strasbourg)
3 Olivier Terneaud (DSNR Caen)
4 Cathy Bieth (DGNSR Paris)
5 Christophe Quintin (DSNR Lyon)
6 Hélène Beauvais (Advisor)
7 David Emond (BCCN/DSNR Dijon)
8 Jean-Pierre Mercier (SD6)
9 Julien Collet (DSNR Bordeaux)
10 Danielle Degueuse (Advisor)
11 Rémy Zmyslony (DSNR Orléans)
12 David Landier (DSNR Marseille)
13 Michel Babel (DSNR Châlons-en-Champagne)
14 Michel Bourguignon (Deputy director-general)
15 Philippe Bordarier (senior executive for organization)
16 Alain Schmitt (Deputy director-general)
17 François Godin (DSNR Douai)
18 André-Claude Lacoste (Director-general)
19 Henri Legrand (Advisor)
20 Jean-Luc Lachaume (Deputy director-general)
21 Marc Stolz (SD4)
22 Jacky Ferchaux (Advisor)
23 Olivier Gupta (SD2)
24 Romain Cailleton (SD3)
25 Jacques Aguilar (SD1)
26 Jean-Luc Godet (SD7)
27 Alain Delmestre (Secretary-general)
28 Jean-Pierre Vidal (SD9)

2 | 1

The Nuclear Safety Authority and its technical support organisations

The Nuclear Safety Authority comprises a directorate at central level, the Directorate General for Nuclear Safety and Radiation Protection (DGSNR), and decentralised departments.

In the performance of its duties, the ASN calls on the expertise of external technical support bodies, in particular the Institute for Radiation Protection and Nuclear Safety, and asks the various advisory committees for their opinions and recommendations.

2 | 1 | 1

The Directorate General for Nuclear Safety and Radiation Protection

The general role of the DGSNR is to propose and implement the government's nuclear safety policy, except with regard to facilities and activities related to defence, and its radiation protection policy.

Article 2 of its instituting decree specifies what its responsibilities are in its area of competence.

Decree n° 2002-255 of 22 February 2002 creating the Directorate General for Nuclear Safety and Radiation Protection
Article 2:
(…)

III – The Directorate General for Nuclear Safety and Radiation Protection is responsible, within its specified field:

l. For preparing and implementing all measures concerning the safety of basic nuclear installations, in particular by drafting the corresponding technical regulations and checking that they are applied;
2. For preparing and implementing all measures concerning the safe transport of radioactive and fissile materials for civil purposes, in particular by drafting the corresponding technical regulations, jointly with the Minister for Transports, and checking that they are applied;
3. For preparing and implementing - jointly with the other competent administrations - all measures such as to prevent or limit the health risks linked to exposure to ionising radiation, in particular by drafting technical regulations concerning radiation protection, except with respect to the protection of workers against ionising radiation, and checking that they are applied;
4. For organising safety inspections of basic nuclear installations and, together with the competent departments of the Minister for transport, of transports of radioactive and fissile material for civil purposes;
5. Notwithstanding the inspections stipulated by the labour code and the environment code, for organising the radiation protection inspections laid down in the public health code and in the above-mentioned law of 2 August 1961 and its implementing texts, and for coordinating all inspections involved in the supervision of industrial, medical and research radiation protection, including by monitoring sources of ionising radiation used in these fields;
6. For organising a permanent radiation protection watch, in particular through radiological monitoring of the environment nationwide;
7. For supervising releases of gaseous and liquid effluents and waste from basic nuclear installations;
8. For proposing, coordinating and implementing government policy concerning the regulation and supervision of radioactive waste management;
9. For collecting all information concerning R&D work done in the field of nuclear safety and radiation protection;

10. For participating - jointly with the other competent administrations, in particular the departments responsible for civil security - in defining and implementing a technical emergency response organisation to deal with an accident in a nuclear facility or a transport of radioactive materials, or more generally, an accident of any type likely to harm human health through exposure to ionising radiation, occurring in France or likely to affect French territory;
11. For collecting all information in the field of nuclear safety and radiation protection and about the steps taken in this field in France and abroad, and for distributing this information to the administrations concerned;
12. For contributing to informing the public about subjects concerning nuclear safety and radiation protection.

The functions mentioned in 3 and 5 above are, where necessary, carried out jointly with the works inspectorate personnel mentioned in articles L. 611-1, L. 611-4 and L. 611-6 of the labour code and the other competent inspection organisations and administrations.

Together with the departments of the Minister for Foreign Affairs, the Directorate General for Nuclear Safety and Radiation Protection will, within its areas of competence, prepare and propose France's positions with a view to international and community debates.

In the performance of its duties, it may conduct or have conducted any studies it feels useful.
(…)

V - Jointly with the other competent administrations and within its field of competence, the Directorate General for Nuclear Safety and Radiation Protection orients, organises and supervises the activities of the decentralised government departments concerned. It oversees and coordinates their actions and provides them with the resources they need.

2 | 1 | 2

The decentralised departments

The DGSNR coordinates and supervises the activities of the Nuclear Safety and Radiation Protection divisions (DSNR) of the Regional Directorates for Industry, Research and the Environment (DRIRE), and also relies on the Regional and Departmental Health and Social Action Directorates (DRASS and DDASS) for supervision of radiation protection, in accordance with the provisions of article 2-V of decree n° 2002-255 of 22 February 2002.

In 2004, the DGSNR implemented the conclusions of the working groups which were set up in 2003 to look at the ASN's regional organisation:
- the DRASS-DDASS-DRIRE working group on the radiation protection functions of the DRASS and DDASS;
- the DGSNR-DRIRE working group on the organisation of the DRIREs concerning supervision and radiation protection.

2 | 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) operate under the authority of the DRIREs in a geographical area consisting of one or more administrative regions, as shown in the breakdown below.

The DSNRs take part in examining the authorisation requests submitted by the operators of the BNIs in their geographical area:
- creation, modification or shutdown of BNIs;
- water intake and effluent discharge 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 ministers.

The DSNRs also take part in supervising basic nuclear installations and shipments of radioactive materials through:
- inspections (see chapter 4);
- 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 discharges, installations classified on environmental protection grounds (ICPE) and pressure-vessels (ESP).

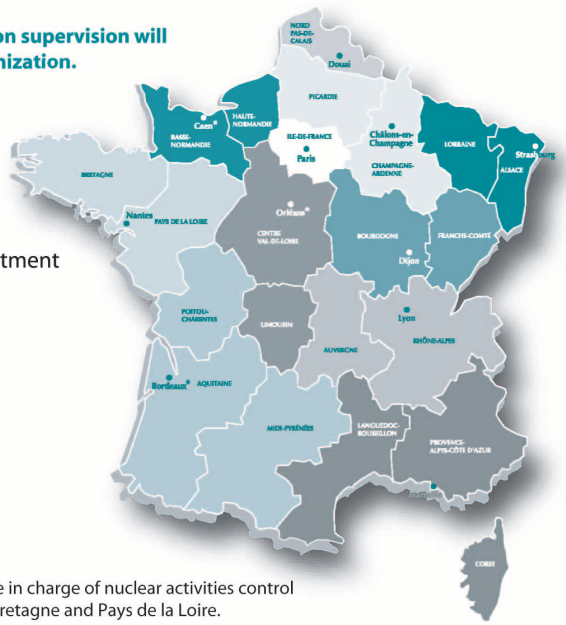
In emergency situations, the DSNRs have a twofold role to support the department Prefect, who is responsible for protection of the populations, and to monitor the site. To ensure preparedness for these situations, they take part in drawing up the emergency plans drafted by the prefects and in periodic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

The reinforcement of radiation protection supervision will lead the ASN to review its regional organization.

Regions covered by the french Nuclear safety and radiation protection departments :

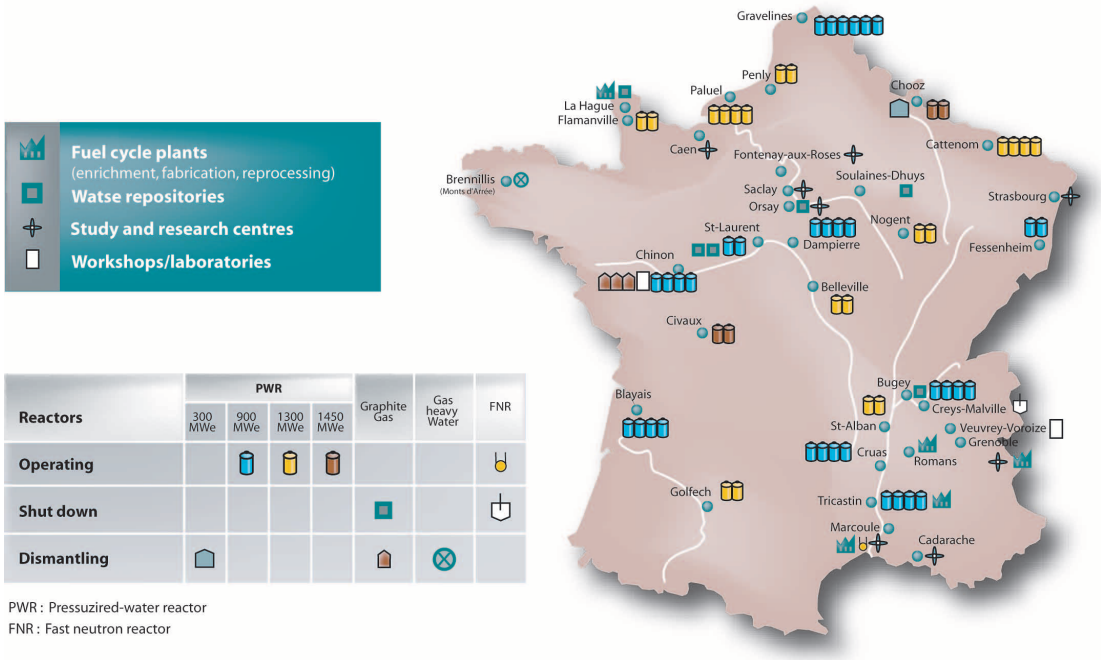
- BORDEAUX department (1)
- CAEN department (1)
- CHÂLONS-EN-CHAMPAGNE department
- DIJON department
- DOUAI department
- LYON department
- MARSEILLE department
- NANTES department
- ORLÉANS department (1)
- PARIS department
- STRASBOURG department



(1) Orléans, Caen and Bordeaux departments are in charge of nuclear activities control for the only BNIs, respectively in Ile-de-France, Bretagne and Pays de la Loire.

The Nuclear Safety Authority regional organization

In 2004, the ASN's actions were extended to cover the whole of France, with the creation of two DSNRs:
- the Paris DSNR, for monitoring local nuclear activities in the Île-de-France, Réunion and Guyane-Guadeloupe-Martinique regions;
- the Nantes DSNR, for supervising local nuclear activities in the Loire and Brittany regions.



Reactors	PWR				Graphite Gas	Gas heavy Water	FNR
	300 MWe	900 MWe	1300 MWe	1450 MWe			
Operating		■	■	■			■
Shut down					■		■
Dismantling	■				■	■	

PWR : Pressuzired-water reactor
FNR : Fast neutron reactor

The main nuclear sites

2|1|2|2

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

The DRASS and DDASS operate in a given geographical area, either a department or administrative region.

In 2004, starting from the conclusions of the DDASS-DRASS-DRIRE working group mentioned earlier, a circular sent out to the prefects specified those functions that the DDASS and DRASS were to continue to carry out in the field of radiation protection supervision and those that they could relinquish.

The DRASS and DDASS take part in supervising radiation protection in both the natural and man-made environments:
- radiological monitoring of drinking water;
- radon monitoring in institutions open to the public and in the home.

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.

However, the DRASS and DDASS will on longer be required to take part in radiation protection authorisation or declaration procedures for medical nuclear activities, nor to take environmental samples. Their role in supervising the radiation protection of patients has yet to be clarified.

2 | 1 | 3

The working of the Nuclear Safety Authority

1. Human resources

Workforce

On 31 December 2004, the ASN's total workforce stood at 332 people, split between the DGSNR and the DSNR.

This workforce can be broken down as follows:
- 216 civil servants assigned to the ASN;
- 4 staff on assignment from the Minister of Public Works or the Assistance publique - Hôpitaux de Paris (national health);
- 21 contractual staff;
- 91 staff on assignment from the CEA and the IRSN.

75% of the ASN's workforce are executive, with 21% of these managers being women. Most of these managers come from State technical school (mining school engineers, State engineering school graduates, engineers from industry and mining, State public works engineers, inspector-doctors from the public health service, health engineering specialists) who often have prior experience of supervisory activities (in the nuclear or other fields). This also concerns management staff made available by the CEA or the IRSN, who have experience of nuclear or radiological activities, as well as contractual engineers specialising in radiation protection.

As part of the system of inspector exchanges with the nuclear safety authorities of other foreign countries, an ASN engineer has been on assignment to the Nuclear Installation Inspectorate (NII) of Health and Safety Executive (HSE) in Great Britain since September 2002.

Furthermore, an NII engineer has been available to the ASN since January 2003.

Effectifs on 31 December 2004	Management		Non-management		TOTAL
	DGSNR	DSNR	DGSNR	DSNR	
Civil servants	70	92	30	28	220
Non-civil servants	55	31	24	2	112
TOTAL	125	123	54	30	332

Sites

DGSNR Paris	DGSNR Fontenay-aux-Roses	BCCN/SD5 Dijon	DSNR	TOTAL
81	98	23	130	332





Paris-Bourgoin Site, 6 place du Colonel Bourgoin, Paris

Personnel training

Competence is one of the four key values of the ASN. Initial and continuing training are a fundamental element of professionalism. The system adopted involves complementary training in nuclear technologies, general training and communication training.

• Training in nuclear technologies

A formalised technical training scheme is one of the key elements in managing the qualification levels within the ASN.

This training scheme comprises four training categories, depending on the functions occupied within the ASN:

- inspector training: this is a course needed to make the transition from trainee inspector to qualified inspector. The BNI inspector's card can only be issued to someone holding this inspector qualification;
- 1st year basic training: this type of training is not necessarily a prerequisite to making the transition from trainee inspector to qualified inspector, but it is advisable to take the various courses as soon as a session become available;
- senior inspector training: this is a course necessary for making the transition from qualified inspector to senior inspector. "Senior inspector training" requires that the person has first taken the "inspector training" and "basic 1st year training" courses;
- advanced training: this type of training is not necessarily a prerequisite to making the transition to senior inspector. It comprises training courses which can be taken by staff members, at their request or that of their superiors, according to the specific subject which they have to deal with.

In 2004, 2734 days of technical training were given to the ASN personnel. The financial cost of the courses provided by organisations other than the ASN and its technical support organisation (IRSN), amounted to 500,000 €.

• General training

General training is open to all ASN personnel, both administrative and technical, whatever their status. In the case of engineers and technicians, it supplements the training programmes described above.

The main objectives of general training are to develop professionalism and a sense of responsibility and self-reliance, through:
- proficiency in IT skills;
- mastery of foreign languages, in particular English;
- acquisition of a professional culture and adaptation to various occupations (project management, public procurement, public finances, data communications, secretarial skills, etc.);
- help with preparation for State competitions and exams.

• Communication training

The communication training programme aims to offer all personnel training tailored to their various responsibilities, in the fields of spoken and written communication and emergency response tactics.

Inspector qualifications

Since 1997, the Nuclear Safety Authority has followed a program of qualification of its inspectors, based on recognition of their technical competence. This was paralleled by the 25 April 1997 creation of a Safety Authority Accreditation Committee. This is a consultative committee whose role is to rule on the entire qualification system. It examines the training courses and the qualification reference systems applicable to the various units within the Nuclear Safety Authority. These reference systems in particular comprise a definition of the levels of qualification (inspector and senior inspector), a description of the corresponding tasks and the rules for attaining these levels.

In the light of these reference systems, the Accreditation Committee interviews the inspectors presented by their superiors. It proposes nominations to the grade of senior inspector to the DGSNR, which is then responsible for making the decision.

Chaired by Mr Yves Lecointe, the Accreditation Committee is made up half of confirmed inspectors belonging to the DGSNR and the DSNRs and half of persons with competence in the field of nuclear safety supervision, appraisal and teaching, and supervision of classified installations and who are not members of the Nuclear Safety Authority.

The Accreditation Committee met three times in 2004 and confirmed seven BNI inspectors.

On 31 December 2004 the number of senior inspectors active within the Nuclear Safety authority stood at 37.

2. 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 contribution to the constitutional bylaw on budget acts (LOLF), which will take effect on 1 January 2006, was to define the structure of the State's budget according to its missions, programmes and actions.

Its activities were thus integrated into the "Economic development and regulation" mission, within the "Supervision and prevention of technological risks and industrial development" programme. Its organisational scope, consisting of the DGSNR and the 11 DSNRs is defined in the "Supervision of nuclear safety and radiation protection" action.

The ASN's 2004 budget amounted to 34.1 M€. This comprises the payroll (15.2 M€), operating expenses (6.9 M€), as well as the safety work and analyses and appraisals entrusted to outside experts (1.3 M€). To this should be added the sum of 53.78 M€ corresponding to the appraisal work carried out by the IRSN for the ASN (see § 2|1|4).

On behalf of the State, the ASN is also responsible for issuing the annual tax collection forms to the BNI operators.

These taxes were created by article 43 of the 2000 budget act and are paid into the general budget of the State. The revenue from them, which amounted to 213 M€ in 2003, came to 346 M€ in 2004. The breakdown of contributions is shown in the following table:

OPERATOR	BNI TAX for 2004 (k€)
EDF	307 667
COGEMA	18 586
CEA	8 530
ANDRA	6 403
EURODIF	1 830
FBFC	1 220
OTHERS	1 635
TOTAL	**345 871**

3. The "ASN Information System" (ASN IS)

Deployment of the "ASN Information System" (ASN IS) was completed in 2004. The different applications for sharing knowledge between the ASN staff, in particular "press review", "inspections", "incidents", "reactor outages", "project monitoring", "mail" are now accessible from the Oasis intranet. Extension of the ASN IS to the ASN's new functions, in particular those specific to the medical field, is in progress.

4. Internal communication

2004 saw a significant rise in the number of users of the ASN's intranet, Oasis. With more than 120 connections daily by the end of 2004, Oasis became the ASN's main source of internal information.
The internal actions put in place in recent years were also continued:
- presentation of each dossier to be published in *Contrôle* to the DGSNR personnel, prior to the meetings for their presentation to the specialist and general press;
- organisation of a reception to welcome newcomers to the ASN in May and November;
- regular visits by DGSNR head office to each of its component entities (general secretariat, sub-directorates, DSNR).

5. Quality Management

To guarantee and improve the quality and effectiveness of its actions, the ASN defined and implemented a quality management system inspired by the ISO and IAEA international standards and based on:
- listening to the needs of all parties involved (the public, elected representatives, associations, media, trade unions, industry) within the context of procedures stipulated by the regulations (public enquiry) or less formal frameworks (opinion polls, hearings, etc,
- action plans setting ASN targets and annual priorities, adjusted on a daily basis by exchanges between entities (discussions, periodic meetings, internal memos, etc....);
- organisation notes and procedures, gradually structured and compiled to form an organisation manual, defining the ASN's internal rules for the correct performance of each of its duties and roles;
- internal audits and inspections by the General Mining Council and context, activity and performance indicators, for checking and improving the quality and effectiveness of the actions taken by the ASN.

2 | 1 | 4

Technical support organisations

The ASN relies on the expertise of 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 partner diversification, both nationally and internationally.

The Institute for Radiation Protection and Nuclear Safety

This industrial and commercial public establishment was created by decree n° 2002-254 of 22 February 2002. On behalf of the ASN, the IRSN carries out nuclear safety and radiation protection work and analysis funded by amount and nature under the terms of an annual agreement.

In 2004, the work done by the IRSN for the Nuclear Safety Authority was valued at 54.08 M. It appears in Part IV, subsidies, chapter 44-40 article 20 of the budget of the Ministry for Ecology and Sustainable Development.

The other technical support organisations

In 2004, the ASN entrusted expert work to CETEN-APAVE in the field of fire prevention and fire fighting in nuclear installations, as well as to the Galson company with regard to certain aspects of nuclear waste interim storage.

2 | 1 | 5

The experts 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 (see § 3|2|2) plays a similar role in the field of radiation protection.. § 3|2|2).

a. The Advisory Committees

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

The Advisory Committees are consulted by the Director General for Nuclear Safety and Radiation Protection regarding the safety of the facilities and activities within their sphere of competence.

In this capacity, they examine the preliminary, intermediate and final safety analysis reports for each of the BNIs. They are provided with a report presenting the results of the assessment conducted by the IRSN, and issue an opinion with a number of recommendations.

Each Advisory Committee can call on the services of any person recognised for his or her particular competence. It may also organise a hearing of representatives of the operator.

Participation by foreign experts results in a wider range of different approaches to the problems with opportunities to benefit from international experience.

The Advisory Committee for nuclear reactors

In 2004, the Advisory Committee for nuclear reactors (GP reactors) held fourteen meetings, during which the following subjects were examined:
- the safety of the Cabri experimental reactor and of its water loop;
- the dismantling strategy for the first generation of EDF reactors;
- the EDF methodology for taking account of human factors in the design of modifications;
- the detailed studies for the EPR reactor project;
- experience feedback from fuel operation in the PWRs during the period 1996 to 2002;
- experience feedback from PWR operation in France and abroad during the period 2000 to 2002;
- Superphénix dismantling conditions;
- the modifications to be made to the NPPs during the third ten-yearly outages of the 900 MWe reactors;
- the clogging risk affecting the sumps of the safety injection and spray systems in the containment.

The Advisory Committee for reactors also held a joint meeting with its German counterpart, the RSK.

The dismantling strategy for the first generation of reactors and the conditions for dismantling Superphénix were jointly examined with the Advisory Committees for laboratories and plants and for waste.

Chaired by Mr Pierre Govaerts, the Advisory Committee for nuclear reactors comprises representatives of the Administration, experts nominated on proposals from the IRSN, EDF and Framatome, and experts chosen for their particular competence.

The Advisory Committee for laboratories and plants

In 2004, the Advisory Committee for laboratories and plants (GP laboratories and plants) held three meetings during which the following subjects were examined:
- dismantling strategy for the first generation of EDF reactors;
- Superphénix dismantling conditions;
- planned extension of the spent fuel test laboratory (LECI) on the Saclay site.

The first two of these subjects were jointly examined with the Advisory Committees for reactors and for waste. The Advisory Committee for laboratories and plants also held an information meeting intended for new members and a meeting to raise awareness of seismic risks.

Chaired by Mr Pierre Chevalier, the Advisory Committee for laboratories and plants comprises representatives of the Administration, experts nominated on proposals from the IRSN, EDF, CEA, COGEMA and ANDRA, as well as experts chosen for their particular competence.

The Advisory Committee for radioactive waste

In 2004, the Advisory Committee for waste (GP waste) held three meetings devoted to the subjects presented by the ANDRA and concerning the following subjects:
- assessment of the mechanical behaviour of a possible deep geological disposal facility on the Bure site;
- the geochemical phenomena governing the release and transport of radionuclides in the envisaged Bure repository;
- summary of knowledge concerning disposal in a granite formation.

An information meeting was also held on 9 November 2004 concerning evolution of the safety doctrine concerning deep geological disposal.

Chaired by Mr Pierre Bérest, the Advisory Committee for waste comprises representatives of the Administration, experts nominated on proposals from the IRSN, CEA and ANDRA, as well as experts representing the producers of radioactive waste and experts chosen for their particular competence in the nuclear, geological and mining fields.

The Advisory Committee for transport

The Advisory Committee for transport (GP transport) did not meet in 2004.

Chaired by Mr François Barthélemy, the Advisory Committee for transport comprises representatives of the Administration and the French committee for accreditation of companies training and supervising personnel working with ionising radiation, experts nominated on proposals from the IRSN, CEA, EDF and COGEMA, as well as experts chosen for their particular competence.

b. The Standing Nuclear Section of the Central Committee for Pressure Vessels

Instituted by article 26 of the 13 December 1999 decree concerning pressurized equipment, the Central Committee for Pressure Vessels (CCAP) is a consultative body placed at the disposal of the Minister for Industry.

It was set up by the order of 4 March 2003 and comprises members of the various administrations concerned, persons chosen for their particular competence and representatives of the manufacturers and users of pressure vessels and of the technical and professional organisations concerned. It was chaired by Mr Jean Scherrer until 3 August 2004, after which time he was replaced by Mr Rémi Guillet.

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 and pressurised equipment in nuclear facilities, the CCAP set up a Standing Nuclear Section (SPN).

Its role is essentially to issue recommendations with regard to application of pressure vessel regulations to the main nuclear steam supply systems (NSSS).

In 2004, the Standing Nuclear Section met three times.

During its 25 June session, it examined the dossier presented by EDF to support its request for a waiver to the order of 10 November 1999 concerning qualification of non-destructive test processes (see chapter 11, § 3|2|3). It also discussed national and international experience feedback into stress corrosion of “Inconel 600” nickel-based alloy.

During its 23 November session, it examined application of the absence of significant leakage during post-maintenance qualification test rule to steam generator tube bundles. It also examined experience feedback from the steam line accident that occurred in the Mihama plant in Japan.

During the 17 December session, it examined EDF’s demonstration of the possibility of keeping the steam shut-off valves in service on the reactors of the 900 MWe plant series, despite the presence of manufacturing defects. It also gave its opinion on the design choices for the pressuriser intended for the future EPR reactors, based on an examination of the changes with respect to the pressurisers of the existing N4 series. Finally, it examined a supplement to the waiver request dossier presented at its 25 June session.

In a context of harmonisation of conventional and nuclear pressurised equipment regulations, reforms are planned for the expert bodies placed at the disposal of the Ministry for Industry. These reforms would include the creation of an Advisory Committee for nuclear pressurised equipment, which would issue technical recommendations on questions concerning this equipment. The CCAP would continue to deal with questions concerning the regulations.

2 | 2

The other players

2 | 2 | 1

The Parliamentary Office for Assessment of Scientific and Technological Options

Created by law 83-609 of 8 July 1983, the Parliamentary Office for Assessment of Scientific and Technological Options, a parliamentary delegation comprising 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 comprising 24 members, with the composition of the Council reflecting 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 thus concerns the efficacy of administrative structures as well as technical issues, such as the future of nuclear waste or the transportation of radioactive materials, or again, socio-political questions, like the circulation and perception of nuclear news item.

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.

On 4 June 2003, the office of the National Assembly commissioned a study from the Parliamentary office into “the progress and prospects for radioactive waste management research”. Messrs Claude Birraux and Christian Bataille, deputies, were appointed rapporteurs on 10 June 2003.

Since then, and in order to assess foreign achievements and experiences, delegations were sent to the main nuclear countries, meeting more than 150 radioactive waste directors and visiting 9 underground facilities.

On 9 June 2004, the Parliamentary Office also organised a hearing of the National Committee for assessment of radioactive waste management research.

On this occasion, Mr Claude Birraux noted that there had been a clear acceleration, not only in research, but also in the results of current work in the field of radioactive waste management. He also observed that increasing interest was being shown in Sweden, Belgium and above all the United

States, in the French radioactive waste management model, based on reprocessing and minimisation of waste volumes and radio toxicity through recycling of the minor actinides and the incineration of ultimate waste.

For his part, Mr Christian Bataille considered that the work of the Assessment Committee fully meets the goal of interlinking scientific research with political decision-making, a goal that was incorporated into the 1991 law on radioactive waste management research. He felt that the conclusions of the 10th report from the National Assessment Committee are encouraging and he ruled in favour of the continuation beyond 2005 of research into separation and transmutation and expressed his desire to see results concerning the life of concretes beyond 100 years.

The rapporteurs visited the Meuse and Haute-Marne in November, to listen to the Bure dossier stakeholders.

The Parliamentary Office has scheduled a number of public hearings dealing with the subject of nuclear waste for the beginning of 2005.

2 | 2 | 2

Consultative bodies

a. 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.

The mandate of the CSSIN's members expired at the end of 2003. The renewal procedure was not completed by the end of 2004, so the CSSIN remained inactive during the course of 2004.

b. 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.

In 2004, the Commission, which is required to meet regularly and at least once a year, held five sessions under the chairmanship of Mr Yves Galmot, chairman of the honorary section of the Council of State. These sessions discussed the following subjects:

- on 27 January:
  - a draft decree concerning supervision of waste treatment technologies;
  - a draft decree authorising Électricité de France to modify the scope of basic nuclear installations n° 96 and 97 in the Gravelines nuclear power plant and to take charge of packaging radioactive waste received from the Société de Maintenance Nucléaire;
- on 5 May, a draft decree modifying decree n° 99-213 of 19 March 1999 concerning the creation of basic nuclear installation n° 163, known as CNA-D, an equipment storage facility in the Ardennes nuclear power plant;
- on 21 June, a draft decree modifying the decree of 21 May 1990, as amended, authorising the Compagnie générale des matières nucléaires (COGEMA) to operate the "Melox" basic nuclear installation located in Chusclan (Gard department);
- on 6 July, two draft decrees authorising the Commissariat à l'énergie atomique to proceed with final shutdown and dismantling of BNI n° 20, known as the Siloé reactor, and BNI n° 21, known as the Siloette research reactor, located in Grenoble (ISÈRE);
- on 14 December:
  - a draft decree authorising the Commissariat à l'énergie atomique to modify BNI n° 24, known as Cabri;
  - a draft decree modifying the decree of 27 August 1996 concerning the modification to allow continued surveillance - at an intermediate dismantling stage - of basic nuclear installation n° 161, called Chinon A3 (reactor decommissioned) on the Chinon site in Avoine (Indre-et-Loire).

Chaired by Mr Yves Galmot, the CIINB comprises representatives of the Administration, the CEA, CNRS, EDF, INSERM, IRSN, INRA, and personalities chosen for their competence in the nuclear field.

Secretarial services are provided by the DGSNR.

c. 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 predicting, evaluating and managing health hazards.

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 *Bulletin officiel* of the Ministry for Health.

Although the CSHPF is a long-standing institution, the Radiation Protection Section was only created in 1997 (decree 97-293 of 27 March 1997). Its composition was renewed by an order of 20 September 2002.

The section's activity reports for the years 1997 to 2002 are available on the ASN's web site.

In 2004, the section continued its regulatory activities and issued a number of recommendations concerning the intake of iodine tables, industrial gammagraphy and the person specialised in medical radiation physics (published in the *Bulletin officiel* of the Ministry for Health and Social Protection).

A standing committee ("Ionising radiation sources" committee) reporting to the Radiation Protection Section, was also created by ministerial order at the beginning of 2004. Its main role is to propose opinions or recommendations on all subjects dealing with radiation protection and linked to the use of ionising radiation sources, with the exception of questions concerning the protection of persons exposed for medical purposes, and to take part in drafting regulations and technical instructions on this subject. In 2004, it focused its work on a number of orders concerning worker protection, including that dealing with marking out of controlled and supervised areas and that dealing with certification of technical inspections.

Chaired by Mr André Aurengo, the Radiation Protection Section comprises members nominated on proposals from the national academy of medicine, the national academy of pharmaceuticals, the academy of sciences, the national medical council, the national pharmacists council, the national veterinarian council, the CEA and the INSERM, as well as personalities chosen for their particular competence.

Its secretarial services are provided by the DGSNR.

2 | 2 | 3

The public health and safety agencies

a. The French Health Monitoring Institute (InVS)

The French Health Monitoring Institute is a state institution under the authority of the Minister for Health. It is responsible for permanently monitoring and observing the health of the population, and for collating, analysing and updating knowledge of health risks, their causes and trends, and for detecting any event modifying or likely to alter the health of the population. Finally, it is responsible for taking all steps necessary to identify the causes of a change in the state of health of the population, particularly in an emergency situation.

More particularly with respect to monitoring of cancers likely to be linked to ionising radiation, The InVS proposes and implements appropriate monitoring systems, for example the system for monitoring thyroid cancers, and particularly the national registers (leukaemia register, child cancers register, etc.). The InVS is also competent in assessment of epidemiological risks and surveys. The InVS/IPSN report on the assessment of risks in France linked to fallout from the Chernobyl accident and the ongoing survey on risk factors involved in the increased risk of thyroid cancers are two examples.

In 2004, the InVS took part in a number of actions as part of the PASEPRI, in conjunction with the IRSN, and initiated preparatory work prior to an epidemiological survey on thyroid cancers.

b. The French Health Product Safety Agency (AFSSAPS)

The French Health Product Safety Agency is a state institution under the authority of the Minister for Health. It takes part in implementing laws and regulations concerning all activities affecting health products intended for use by man, as well as cosmetic products, and in particular drugs, biomaterials and medical devices, in-vitro diagnostic medical devices, including those using ionising radiation.

With regard to health products generating radiation, the AFSSAPS issues radiation protection authorisations for distribution of radio-pharmaceuticals and medical devices emitting ionising radiation

(radioactive sources, electric equipment generating X-rays, and so on). It is also responsible for organising supervision of medical devices and in particular issues certification for the organisations in charge of this supervision and defines the corresponding reference frameworks for each equipment category.

In 2004, the AFSSAPS published the quality control reference frameworks for external radiotherapy installations, electron accelerators and tele-cobalt therapy devices.

c. The French Food Product Safety Agency (AFSSA)

The French Food Product Safety Agency is a state institution under the authority of the ministers for Agriculture, Consumer affairs and Health. Its role is to help to guarantee health safety in the field of food products, from production of raw materials up to distribution to the end-user. It evaluates the possible health and nutritional risks of the food products intended for humans and animals, including those which could come from water intended for human consumption. In the field of ionising radiation, the AFSSA's role is to issue opinions concerning the radiological quality of foodstuffs and water intended for human consumption, in particular in an accident or post-accident situation.

d. The French Environmental Safety Agency (AFSSE)

The French Environmental Safety Agency is a state institution under the authority of the ministers for the Environment and Health. Its role, with the aim of protecting human health, is to help guarantee public health safety in the environmental field and to evaluate health risks linked to the environment.

The public state institutions, as listed in a decree from the Council of State, provide the agency with permanent assistance.

The AFSSE's contribution to appraisal work in the field of ionising radiation, as well as the links to be created with the IRSN and the InVS, has yet to be clarified.

In 2004, the AFSSE took part in coordinating the preparation work for the national health and environment plan, published by the government in June 2004.

2 | 2 | 4

Other consultative committees

Under application of the regulations, the DGSNR has set up a number of consultative committees:
- the national Committee responsible for examining certification applications by organisations carrying out radon measurements in premises open to the public;
- the national Committee responsible for examining certification applications by organisations measuring radioactivity in the environment;
- the national consultative committee for radiological monitoring of the environment.

3 OUTLOOK

Since 2002, the Nuclear Safety Authority has striven to develop supervision of radiation protection in France, although never at the expense of nuclear safety. The nuclear safety/radiation protection synergy achieved has already led to significant improvements in the two fields.

These continued efforts are directed at:
- strengthening the ASN's human resources in accordance with the government's decision to create 225 jobs in radiation protection supervision, including 150 inspector positions;
- increasing cooperation with the various administrations, in particular the departments of the Ministry for Labour, in order to improve assimilation of all aspects of radiation protection supervision;
- developing and ensuring its long-term territorial organization and reinforcing its organisation in general, in particular with respect to international practices, in the lead-up to the 2007 international audit.

CHAPTER 2

THE ORGANISATION OF SUPERVISION OF NUCLEAR SAFETY AND RADIATION PROTECTION

REGULATIONS

CHAPTER 3

1 THE REGULATION OF RADIATION PROTECTION

1 | 1 The legislative bases of radiation protection
1 | 1 | 1 The Public Health Code
1 | 1 | 2 The Labour Code

1 | 2 Protection of individuals against the dangers of ionising radiation from nuclear activities
1 | 2 | 1 General protection of workers
1 | 2 | 2 General protection of the population
1 | 2 | 3 The licensing and declaration procedures for sources of ionising radiation
1 | 2 | 4 Radioactive source management rules
1 | 2 | 5 Protection of persons in a radiological emergency situation
1 | 2 | 6 Protection of the population in a long-term exposure situation

1 | 3 Protection of persons exposed for medical and medico-legal purposes
1 | 3 | 1 Justification and optimisation
1 | 3 | 2 Maintenance and quality control of medical devices
1 | 3 | 3 Biomedical research

1 | 4 Protection of persons exposed to “enhanced” natural radiation
1 | 4 | 1 Protection of persons exposed to radon
1 | 4 | 2 Other sources of exposure to “enhanced” natural radiation

1 | 5 Radiological quality of water intended for human consumption and foodstuffs

2 BNI REGULATIONS

2 | 1 Licensing
2 | 1 | 1 Site selection
2 | 1 | 2 Safety options
2 | 1 | 3 Plant authorisation decrees
2 | 1 | 4 Operating licences
2 | 1 | 5 Final shutdown and dismantling licences
2 | 1 | 6 Liquid and gaseous effluent release and water intake licences

2 | 2 Technical rules
2 | 2 | 1 General technical regulations
2 | 2 | 2 Basic safety rules
2 | 2 | 3 French nuclear industry codes and standards

2 | 3 Installations classified on environmental protection grounds

3 OUTLOOK

APPENDIX 1 – VALUES AND UNITS USED IN RADIATION PROTECTION

APPENDIX 2 – LIMITS AND DOSE LEVELS

Like all regulations applicable to nuclear activities, the regulations covering the fields of radiation protection and nuclear safety were not the result of a general framework law. These regulations were created by gradual changes and additions as the nuclear activities themselves evolved. The legislative provisions applicable in these areas can be found on the one hand in Ordinance 2001-270 of 2 March 2001 on the transposition of Community directives in the field of protection against ionising radiation, and on the other in law 61-842 of 2 August 1961, as modified, on the abatement of atmospheric pollution and offensive odours.

Of the texts governing these activities, many are based on laws of a more general scope, such as nature protection legislation, the law on water, the law on air and the rational use of energy, the Public Health Code and the Labour Code.

It must also be pointed out that radiation protection and nuclear safety regulations are increasingly derived from rules adopted internationally, whether community regulations or directives, such as Council directive 96/29/Euratom of 13 May 1996 laying down basic safety standards for the protection of the health of workers and the general public against the dangers arising from ionizing radiation or international conventions such as the Convention on Nuclear Safety signed in Vienna on 20 September 1994 or the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management signed in Vienna on 5 September 1997.

Finally, the legal framework for nuclear activities also originates from a variety of international recommendations and standards. These include:
- the recommendations of the ICRP (International Commission on Radiological Protection), in particular the ICRP 60 currently under revision;
- the standards of the International Atomic Energy Agency (IAEA) for the nuclear safety and radiation protection field;
- the work of the Western European Nuclear Regulators' Association (WENRA).

Parts 1 and 2 of this chapter in turn present the current regulatory picture in the fields of radiation protection and nuclear safety and the work in progress.

1 THE REGULATION OF RADIATION PROTECTION

Since the publication of Directives 96/29/Euratom[1] and 97/43/Euratom[2], 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 completed by publication of ordinance 2001-270 of 2 March 2001 on the transposition of Community directives in the field of protection against ionising radiation and the law of 7 August 2004 concerning public health policy, with the introduction of new articles concerning the inspection of radiation protection.

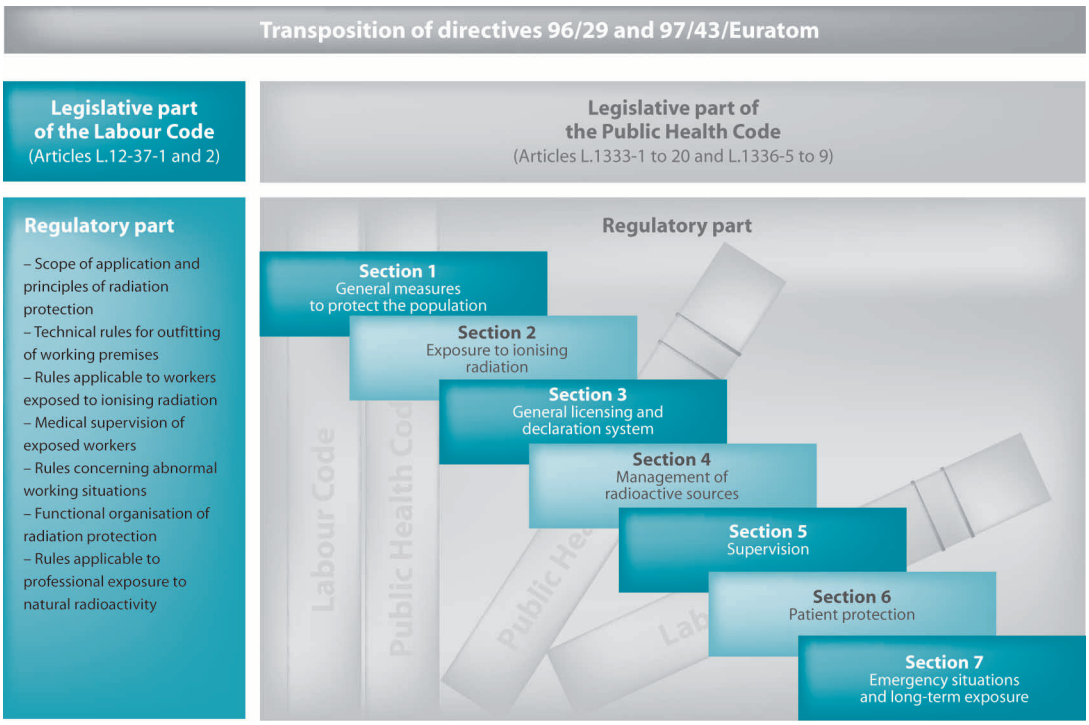
The regulatory part is being completed and the following in turn were published:
• decree n° 2001-1154 of 5 December 2001 concerning mandatory maintenance and quality control of medical devices;
• decree 2002-460 of 4 April 2002 concerning the protection of individuals against the dangers arising from ionising radiation;
• decree 2003-270 of 24 March 2003 concerning the protection of persons exposed to ionising radiation for medical and medico-legal purposes;

1. Council directive 96/29/Euratom of 13 May 1996 laying down basic safety standards for the protection of the health of workers and the general public against the dangers arising from ionizing radiation.
2. Council directive 97/43/Euratom of 30 June 1997 on health protection of individuals against the dangers of ionizing radiation in relation to medical exposure.

• decree 2003-295 of 31 March 2003 concerning intervention in a radiological emergency and in the event of long-term exposure;
• decree 2003-296 of 31 March 2003 concerning worker protection against the hazards of ionising radiation.

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

The following overall architecture was adopted for updating of this legislative and regulatory framework:



Structure of the legislative and regulatory radiation protection framework

Effective application of the new regulatory requirements remains dependent on the publication of a large number of ministerial orders: 20 were published between July 2003 and December 2004 and others will be published in 2005.

The new regulatory framework will however need to be completed in order to transpose the new directive 2003/122 Euratom of 22 December 2003 on the control of high-activity sealed radioactive sources and orphan sources[3] and to complete transposition of directive 89/618 Euratom of 27 November 1989 on health protection measures to be applied and steps to be taken in the event of a radiological emergency[4].

3. Directive 2003/122/Euratom of 22 December 2003 on the control of high-activity sealed radioactive sources and orphan sources.
4. Directive 89/618/Euratom of 27 November 1989 on health protection measures to be applied and steps to be taken in the event of a radiological emergency.

1 | 1

The legislative bases of radiation protection

1 | 1 | 1

The Public Health Code

The principles of radiation protection

The new chapter 3 "Ionising radiation" of part L of the Public Health Code, 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 radioelements are or have been processed owing to their fissile or fertile radioactive properties (section III, book III, part 1). 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 included in directive 96/29/Euratom, are enshrined in the Public Health Code (art. L.1333-1) and guide the regulatory action for which ASN is responsible.

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, decision-making power with regard to justification lies with different levels of authority: it lies with the government for issues of general interest, such as whether or not to resort to nuclear energy, it is delegated by the Minister for Health to DGSNR in the case of sources used for medical, industrial and research purposes, it is the competence of AFSSAPS when authorising use of a new irradiating medical device and is the responsibility of the doctors when prescribing and carrying out diagnostic or therapeutic procedures.

Assessment of the expected benefit of a nuclear activity and the corresponding health drawbacks may lead to prohibition of an activity for which the benefit would not seem to outweigh the risk. This prohibition is either generic (for example: ban on the intentional addition of radioactive substances in consumer goods), or the authorisation required with regard to radiation protection will be refused or will not be renewed. For existing activities, justification may be reassessed if current know-how and 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, referred to by the acronym ALARA (as low as reasonably achievable), for example leads to a reduction in the release licences of the quantities of radionuclides present in radioactive effluent from nuclear installations, to mandatory monitoring of exposure at the workstation in order to reduce it to the strict minimum necessary, or to supervision to ensure that medical exposure resulting from diagnostic procedures remains close to the predetermined 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 of the general population or of workers as a result of nuclear activities is subject to strict limits. These limits comprise significant safety margins to prevent the appearance of deterministic effects. They are also far below the doses at which probabilistic effects (cancers) have begun to

be observed (100 to 200 mSv). Exceeding these limits is considered to be unacceptable and in France, can lead to administrative or legal sanctions.

In the case of medical exposure, no strict dose limit is established in that this voluntary exposure is justified by the anticipated health benefits to the person exposed.

The declaration and authorisation system

The new legislative base introduced into the Public Health Code means that decrees passed after advice of the Council of State can be used 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 artificial or natural radionuclides management (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.

Exposure to enhanced natural radiation

Transposition of Directive 96/29 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).

Inspection of radiation protection

In 2004, new provisions were introduced, creating the new radiation protection inspectorate (art. L. 1333-17 to L. 1333-19) oversight of which is entrusted to the ASN. The radiation protection inspectors designated by DGSNR will mainly be chosen from among ASN personnel, including the IRSN staff on assignment to it, but also from among the inspectors of installations classified on environmental protection grounds active within the DRIREs. The administrative and judicial police powers of the radiation protection inspectors were also defined (art. L. 1336-1-1).

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

1 | 1 | 2

The Labour Code

The new provisions of the Labour Code (art. L. 230-7-1 and 2) introduce a legislative basis specific to the protection of workers, whether or not salaried, in order to transpose Directives 90/641/Euratom and 96/29/Euratom. They bring French legislation into line with Directive 90/641 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 are the subject of a specific decree (decree 2003-296).

1 | 2

Protection of individuals against the dangers of ionising radiation from nuclear activities

A table appended to this chapter gives the various levels and exposure limits set by the new regulations or the regulations currently under preparation.

1 | 2 | 1

General protection of workers

The new articles R. 231-71 to R. 231-116 of the Labour Code, introduced by decree 2003-296, create a single radiation protection system for all workers (whether or not salaried) likely to be exposed to ionising radiation during their professional activities. Of these requirements, the following should be mentioned:
- 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 facility, the employer, in particular when he or she is not the head of the facility, and the person with competence for radiation protection.
- the dose limits (art. R. 231-76) were reduced to 20 mSv for 12 consecutive months, barring waivers resulting from exceptional exposure levels justified in advance, or emergency occupational exposure levels;
- the dose limits for pregnant women (art. R. 231-77) or more accurately for the child to be born (1 mSv for the period from the declaration of pregnancy up until birth).

The publication in 2003 and 2004 of a number of implementing orders provides the clarifications necessary for setting up these new measures. Other orders are expected in 2005. For example:

Zoning

New requirements concerning controlled, monitored and specially regulated zones are currently under preparation (publication scheduled for 2005), in order to take into account the new dose limits. The monitored zone is to cover potential worker exposure of 1 mSv per year or more and the controlled zone exposure likely to exceed 6 mSv per year. In addition, this order should also allow definition of the signalling and health and safety rules applicable in these areas.

The person with competence for radiation protection (PCR)

The duties of the person with competence for radiation protection (PCR) were extended to marking out the areas in which radiation work is being carried out, to studying the exposed workstations and to taking measures such as to reduce exposure (optimisation). For the performance of these duties, the PCR will have access to passive dosimetry and operational dosimetry data (art. R. 231-106). PCR training was updated by the order of 29 December 2003.

The main innovations concern the duration of PCR training, which goes up from 7 to 10 days (2 modules of 5 days); instructor certification will be issued by organisations, themselves accredited by the COFRAC, with refresher courses to be held every 5 years.

Dosimetry

The new modalities for accreditation of organisations responsible for worker dosimetry have also been published (order of 6 December 2003); the new modalities for worker medical supervision and transmission of information on individual dosimetry were published in the order of 30 December 2004.

The approved supervision organisations

Technical supervision of sources and devices emitting ionising radiation, protection and alarm devices and measuring instruments, as well as ambient environment checks, can be entrusted to IRSN, to the department with competence for radiation protection or to organisations approved under application of article R. 1333-44 of the Public Health Code. However, once a year, these checks



Work in radiopharmacy laboratory

must be carried out either by IRSN or by approved organisations. The duties of the approved organisations will be published in an order (scheduled for 2005) (see table opposite).

1 | 2 | 2

General protection of the population

Apart from the special radiation protection measures included in individual nuclear activity authorisations for the benefit of the population as a whole and the workers, a number of general measures included in the Public Health Code help to protect the public against the dangers 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 receiving the opinion of 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 set at 15 mSv/year and 50 mSv/year respectively (average value for any 1cm² area of skin). The calculation method for the effective and equivalent dose rates and the methods used to estimate the dosimetric impact on a population are defined by ministerial order of 1 September 2003.

A national network for collection of environmental radioactivity measurements is currently being set up (art. R. 1333-11) and the data collected will help estimate 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 its 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 IRSN, with its guidelines defined by DGSNR (amended order of 17 October 2003).

So that the measurement results used are valid and comparable, the laboratories working in this network must meet the accreditation criteria defined by this ministerial order.

Management of waste and effluent from BNIs and installations classified on environmental protection grounds is subject to the requirements of the particular regulatory frameworks concerning these installations (see § 2 of this chapter). For management of waste and effluent from other facilities, including hospitals (art R. 1333-12), general rules will be specified by an interministerial order (not yet published). These waste and effluents must be eliminated 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 radioactive half-life of less than 100 days).

Although Directive 96/29/Euratom so allows, French regulations have not adopted the notion of release 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 installations classified on environmental protection grounds. 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 however in Directive 96/29/Euratom (10 µSv/year).

General protection of the population

Ministerial order of 15 July 2003 (Official Gazette of 15 august 2003) concerning approval of organisations responsible for measuring radon in premises open to the public

Ministerial order of 17 October 2003 (Official Gazette of 28 october 2003) regarding a national network implementation for collection of environmental radioactivity measurements

Ministerial order of 13 October 2003 (Official Gazette of 4 november 2003) defining intervention levels for protection of the population

Ministerial order of 12 May 2004 (Official Gazette of 18 may 2004) concerning radiological monitoring of water suitable for human consumption

Ministerial order of 22 July 2004 (Official Gazette of 11 august 2004) concerning procedures to management of radon in premises open to the public

Ministerial order of 20 August 2004 (Official Gazette of 28 august 2004) concerning accreditation of organisations authorised to carry out activity concentration measurements radon in premises open to the public

Protection of workers exposed to ionising radiation

Ministerial order of 1 september 2003 (Official Gazette of 13 november 2003) defining methods for calculating effective doses and dose coefficient values

Ministerial order of 2 december 2003 (Official Gazette of 8 january 2004) defining exemption thresholds for parameters other than those mentioned in article R. 1333-27 of the Public Health Code

Ministerial order of 6 december 2003 (Official Gazette of 7 january 2004) concerning the conditions for issue of the certificate and of approval for organisations responsible for individual surveillance of worker exposure to ionising radiation

Ministerial order of 8 december 2003 (Official Gazette of 7 february 2004) concerning radiation protection of flying personnel

Ministerial order of 29 december 2003 (Official Gazette of 22 january 2004) concerning the procedures for training the person with competence for radiation protection, and certification of the trainer

Ministerial order of 9 january 2004 (Official Gazette of 7 february 2004) concerning approval of supervision organisations for radiation protection

Ministerial order of 2 march 2004 (Official Gazette of 29 march 2004) defining conditions for the use of gammagraphy appliances

Ministerial order of 14 may 2004 (Official Gazette of 20 june 2004) concerning the declaration and authorisation general system

Protection of patient

Ministerial order of 3 Mars 2003 (Official Gazette of 19 March 2003) setting the maintenance and quality control lists of medical devices

Ministerial order of 3 March 2003 (Official Gazette of 19 March 2003) setting the composition of the licensing application file for organisations wishing to carry out external quality control of the medical appliances

Ministerial order of 17 July 2003 (Official Gazette of 21 August 2003) concerning procedures for decommissioning of radioscopy devices without image intensification

Ministerial order of 21 January 2004 (Official Gazette of 6 February 2004) defining the mandatory information to be transmitted by the practitioner to the patients after a nuclear medicine procedure

Ministerial order of 18 May 2004 (Official Gazette of 19 June 2004) concerning the training about patient radiation protection

Ministerial order of 19 November 2004 (Official Gazette of 28 November 2004) concerning duties and training and conditions of medical and radiological physics

List of ministerial orders publisched before 1 January 2005

1 | 2 | 3

The licensing and declaration procedures for sources of ionising radiation

The new system of licensing or declaration, which covers all sources of ionising radiation, is now described in full in section 3 of chapter III of the Public Health Code.

All medical, industrial and research applications are concerned by the new systems put in place by the decree of 4 April 2002. This more specifically concerns the manufacture, possession, distribution - including import and export, and utilisation of radionuclides or products and devices containing them. The use of X-ray equipment is subject to declaration for medical radio-diagnostic (except for very large systems) or to licensing in all other cases.

It should be noted that the licensing system applies irrespectively to companies or facilities which have radionuclides on-site, as well as to those which trade in them without directly possessing them. This arrangement, which already applies in France, appears to be in conformity with Directive 96/29, which explicitly mentions import and export. From the public health and safety viewpoint, this obligation is essential to close monitoring of source movements and to prevent accidents as a result of stray sources.

It should be recalled that in accordance with article L.1333-4 of the Public Health Code, the licences granted to industries covered by the Mining Code, basic nuclear installations and installations classified on environmental protection grounds also constitute radiation protection licences. However, this exception does not concern ionising radiation applications for medical purposes or for biomedical research.

The modalities for submitting licensing or registration applications were specified in the order of 14 May 2004.

1 | 2 | 3 | 1

The medical, biomedical research and medico-legal fields

For medical and biomedical research applications, the licensing system contains no exemptions:

• the licences required for the manufacture of radionuclides, or products and devices containing them, as well as for their distribution, import or export, are issued by the French Health Products Safety Agency (AFSSAPS);

• the licences required for the use of radionuclides, products or devices containing them, are issued at a national level by DGSNR;

• X-ray generators, which hitherto were subject to technical approval by OPRI, are now subject to declaration to the Prefect if they are of low-intensity (radiology or dental surgery), while a system of licences issued by DGSNR applies to sophisticated equipment (scanners).

X-ray installations used for medico-legal procedures are subject to a system of licensing or declaration applicable to medical installations, whenever their operation involves exposing persons to ionising radiation.

1 | 2 | 3 | 2

The industrial and non-medical research fields

DGSNR is also responsible for issuing licences for industrial and non-medical research applications, on behalf of the Minister for Health. In these fields, this concerns:

• the import, export and distribution of radionuclides and products or devices containing them;

• the manufacture of radionuclides and products or devices containing them, the use of devices emitting X-rays or the use of radioactive sources, the use of accelerators other than electron microscopes and the irradiation of products of whatsoever nature, including foodstuffs, with the exception of activities licensed under the Mining Code, the basic nuclear installations licensing system or that for installations classified on environmental protection grounds.

New criteria for licensing exemption incorporated in Directive 96/29/Euratom (Appendix 1, table A) have been introduced into and appended to the Public Health Code (table A, appendix 13-8). Values for additional radionuclides were introduced in the order of 2 December 2003. These criteria supersede those contained in decree 66-450 of 20 June 1966. Exemption will be possible if one of the following conditions is met:
- the total quantity of radionuclides possessed is less than the exemption values in Bq;
- the radionuclide concentrations are less than the exemption values in Bq/kg.

For this latter criterion, the decree introduces an additional mass restriction criterion (the mass of material used must be less than 1 tonne). This reference criterion was used when preparing the scenarios used to define the exemption values. The transposition into French law is thus stricter than Directive 96/29 which does not introduce this mass limit. Introduction of this restrictive criterion should avoid the risk of the radioactive material being diluted in order to fall below the exemption threshold.

The way in which this licensing system governed by the Public Health Code interfaces with the classified installations system, was specified in the DPPR circular of 19 January 2004.

1 | 2 | 3 | 3

Supervision organisations

Technical supervision of the radiation protection organisation, including supervision of the management of radioactive sources and any associated waste, is entrusted to approved organisations (R. 1333-44). The approval procedures for these organisations were defined in the order of 9 January 2004. ASN is now responsible for examining accreditation applications submitted by the organisations.

For the year 2004, the accreditation of those organisations already approved was extended for one year. A new list of approved organisations should be published in early 2005.

1 | 2 | 4

Radioactive source management rules

The general radioactive source management rules are contained in section 4 of chapter III of the Public Health Code. They were drafted on the basis of rules laid down by CIREA (Interministerial commission on artificial radioelements) and their supervision is now the responsibility of the ASN. However, CIREA's radioactive source inventory duties have been transferred to IRSN (article L.1333-9).

These general rules are as follows:
- sources may only be transferred to or acquired from someone in possession of a licence;
- prior registration with IRSN is mandatory for the acquisition, distribution, import and export of radionuclides in the form of sealed or unsealed sources, or products or devices containing them. This prior registration is necessary so that monitoring of the sources and control by the customs services can be organised;
- traceability of radionuclides in the form of sealed or unsealed sources, or products or devices containing them, is required in each institution, and a quarterly record of deliveries must be sent to IRSN by the suppliers;

- any loss or theft of radioactive sources must be declared;
- validity of the formalities required for the import and export of radioactive sources, products or devices, defined by CIREA and the customs services, is renewed.

The system for disposal and recovery of sealed sources which have either expired or reached the end of their operational life, is taken from CIREA's special licensing conditions (decision of the 150th CIREA meeting of 23 October 1989):
- all users of sealed sources are required to recover sources that have expired, are damaged, or have reached the end of their operational life, at their own expense (except when a waiver is granted for decay in-situ);
- simply at the request of the user, the supplier is required unconditionally to recover any source no longer needed or which has expired.

The conditions for the use of gammagraphy appliances were updated by the order of 2 March 2004, thereby abrogating the special conditions which had been stipulated by CIREA.

The question of financial guarantees will be dealt with in another decree implementing the new article L.1333-7 of the Public Health Code, which introduces the supplier's obligation to recover sources and the principle of financial guarantees. This new decree should also take account of the requirements of the new directive 2003/122/Euratom of 22 December 2003 concerning supervision of high-level sealed radioactive sources and orphan sources.

1 | 2 | 5

Protection of persons in a radiological emergency situation

The population is protected against the hazards of ionising radiation in case of an accident or of radiological emergency situations through the implementation of specific actions (or countermeasures) appropriate to the nature and scale of the exposure. In the particular case of nuclear accidents, these actions were defined in the interministerial circular of 10 March 2000, stipulating intervention trigger levels expressed in terms of doses. Exceeding these levels does not constitute a breach; such levels are simply a point of reference for the government authorities (Prefect), who are required on a case by case basis to decide on the feasibility of the action to be taken locally.

These actions are:
• sheltering, if the predicted effective dose exceeds 10 mSv;
• evacuation, if the predicted effective dose exceeds 50 mSv;
• administration of stable iodine, when the predicted dose in the thyroid is likely to exceed 100 mSv.

These intervention trigger levels were included in the order of 14 October 2003, implementing article R. 1333-80 of the Public Health Code. The reference exposure levels for persons intervening in a radiological emergency situation are also defined in the regulatory texts (art. R. 1333-86). Those involved are thus placed in two groups:

a) The first group comprises the personnel making up the special technical or medical response teams set up to deal with a radiological emergency. These personnel benefit from radiological surveillance, a medical aptitude check-up, special training and equipment appropriate to the nature of the radiological risk.

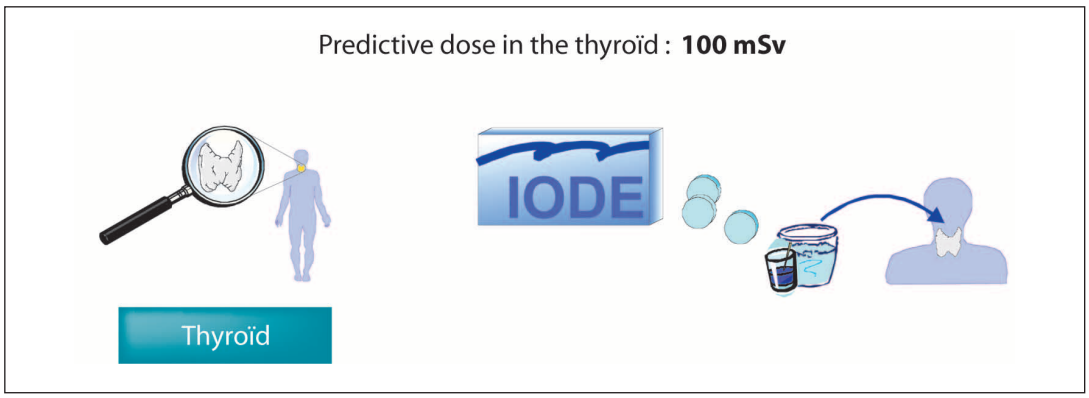
b) The second group comprises personnel who are not members of the special response teams but who are called in on the basis of their competence. They are given appropriate information.

The reference individual exposure levels for the participants, expressed in terms of effective dose, should be set as follows:

a) The effective dose which may be received by personnel in group 1 is 100 mSv. It is set at 300 millisieverts when the intervention measure is aimed at protecting other people.



Intervention trigger levels for protection of the population



Intervention trigger levels for protection of the population: administration of iodine

b) The effective dose which may be received by personnel in group 2 is 10 millisieverts. In exceptional circumstances, volunteers informed of the risks involved in their acts may exceed the reference levels, in order to save human life.

Information of the population in a radiological emergency

The procedures for informing the population of a radiological emergency are detailed in a specific directive (directive 89/618/Euratom of 27 November 1989 on informing the general public about health protection measures to be applied and steps to be taken in the event of a radiological emergency). This directive was transposed into French law by decree n° 2001-470 of 28 May 2001 amending decree n° 88-622 of 6 May 1988 concerning emergency plans, and by two implementing orders (order of 30 November 2001 concerning setting up of an alert system around a basic nuclear installation and the order of 21 February 2002 concerning information of the population).

To complete this process of transposition, a draft decree amending section 7 of chapter III of the Public Health Code should shortly be forwarded to the Council of State. These supplements will be accompanied by two implementing orders, one concerning the information to be transmitted to the public, the other concerning training and information of the participants in an emergency situation (publication scheduled for 2005).

1 | 2 | 6

Protection of the population in a long-term exposure situation

In recent years, and on a case by case basis, the General Directorate for Health set clean-up thresholds for sites contaminated by radioactive substances. These were sites which had been contaminated by a nuclear activity in the recent or more distant past (use of unsealed sources, radium industry, etc.) or an industrial activity using raw materials containing significant quantities of natural radioelements (uranium and thorium families). Most of these sites are listed in the inventory distributed and periodically updated by ANDRA.

This approach has today been abandoned in favour of a complete methodological approach defined in the IPSN guide (methodology guide for sites contaminated by radioactive substances, version 0, December 2000), produced at the request of the ministries for Health and Environment, and distributed to the prefects (DRIRE and DDASS/DRASS). Based on the current and future uses of the land and premises, this guide proposes a number of steps for local definition of rehabilitation targets expressed in terms of doses. The parties concerned (owners of the site, local elected representatives, local residents, associations) are involved in the process. Operational values for decontamination can then be fixed for each case.

This new approach now has a regulatory framework in article R. 1333-90 of the Public Health Code.

1 | 3

Protection of persons exposed for medical and medico-legal purposes

1 | 3 | 1

Justification and optimisation

The modalities for application of the principles of justification and optimisation concerning medical and medico-legal applications of ionising radiation are defined in the new section 6 of chapter III of the Public Health Code. The notions of diagnostic reference levels and dose constraints are also defined. These requirements cover all diagnostic and therapeutic applications, as well as screening, occupational medicine and medico-legal applications (insurance, customs, exposure during hiring of certain workers, prisons, etc.).

• Justification of acts (art. R. 1333-56 to R. 1333-58) - A written exchange of information between the prescribing physician and the doctor actually subjecting the patient to exposure, should make it possible to justify the benefits of the exposure in the precise case of the individual in question. This "individual" justification will be based on a general justification of medical acts using ionising radiation incorporated into a prescription guide published by the health authority. The two doctors will be jointly responsible for the exposure and the doctor performing the act must refuse to do so if it does not appear to be justified.

As there is no further justification for using them, radioscopy devices without image intensification are prohibited (art. R. 1333-58). The procedures for decommissioning these devices are specified in the order of 17 July 2003.

• Optimisation (art. R. 1333-59 to R. 1333-66) - The complex process of optimisation is a guarantee of the quality of operations. Exposure must be as low as possible while achieving the intended goal (diagnosis or therapy, screening, monitoring of specific populations, etc.) A standardised procedure guide for performance of examinations using ionising radiation is currently under preparation. Each user will have to adapt these procedures to his own personal equipment. The aim is not to restrict the scope of options offered by the various techniques but to allow transparency, based on knowledge of the exposure levels they generate. Both practitioners and patients alike will be the primary beneficiaries.

• Reference dose levels - Publication of reference dose levels for diagnosis contributes to optimisation. They were defined by the order of 12 February 2004. This order specified periodic measurements, depending on the type of examination, in each radiology department. Centralisation of these measurements by IRSN will enable these reference levels to be updated. If all doctors are aware of the dosimetry levels attributable to each act, this will lead to a gradual reduction in the doses received for each examination, until the "optimum" value is reached, corresponding to that which is needed to obtain the information looked for. Since June 2004 (decree of 15 June 2004), the new radiology appliances installed must be equipped with a device able to estimate the dose emitted during an examination.

• Medical radio-physics specialist (art. R. 1333-60) - Calling in a person specialising in medical radio-physics should lead to an improvement in quality assurance and to the practitioners becoming more aware of the radiation doses received by the patients, eventually resulting in a reduction in these doses. The order of 19 November 2004 specified the duties and training of these specialists. This order also requires that the head of the establishment draw up a medical radio-physics plan defining the resources to be deployed, notably in terms of manpower, given the medical procedures carried out in the establishment, the number of patients dealt with or likely to be dealt with, the constraints - particularly in terms of working time - arising from particular or complex techniques, existing dosimetry skills and the resources employed for maintenance and internal and external quality control.



X-ray of the chest

• Dose constraints - For exposure with no direct individual benefit to the person exposed (whether someone close to a patient undergoing nuclear medicine for example, or someone exposed during research without direct benefit), practitioners will have to define a dose constraint, in other words the maximum dose target. This is not a dose limit, but an estimate of the dose needed to attain the objective.

• Training – The goals and content of the training programmes for the personnel carrying out procedures involving ionising radiation, or who take part in the performance of these procedures were, with respect to patient protection makers, defined in the order of 18 May 2004. On this occasion, the decision was taken to do away with approval of the training organisations as specified in article R. 1333-74 of the Public Health Code.

• Information – The mandatory information to be transmitted by the practitioner to the patients after a nuclear medicine procedure were published in the order of 21 January 2004. Recommendations in order to harmonise the content of this information are being prepared, under the auspices of the CSHPF, with the participation of practitioners from nuclear medicine departments.

• Guides for the prescription and performance of medical procedures entailing exposure to ionising radiation – Articles R. 1333-70 and R. 1333-71 of the Public Health Code refer respectively to the publication of guides for the "prescription of routine procedures and examinations" (also called "indication guides") and guides for "procedures entailing exposure to ionising radiation (called "procedure guides").

Under the impetus of the departments reporting to the Ministry for Health (DGSNR since 2002), the professionals represented by their learned societies, including the French radiotherapy and oncology society (SFRO), the French radiology society (SFR), the French biophysics and nuclear medicine society (SFBMN), the French medical radio-physics society (SFPM), have set up the necessary working frameworks for drafting these guides. As applicable, DGSNR coordinates or supports this work, or is simply kept informed. The progress of the various guides is presented in the following table.

Speciality	Medical radiology		Nuclear medicine	Radiotherapy	Dental radiology
Documents	**Procedures guide**	**Indications guide**	**Indications and procedures guide**	**Best practices reference framework**	**Guide of installations and procedures**
Initialisation	09.1999	06.2001	09.1999	04.2004	01.2004
Interim reports	07.2000	03.2004	06.2004	In progress	End 2004
Finalisation	10.2001 (JFR 2001)	10.2004 (JFR 2004)		Planned for 2005	Planned for 2005
Availability	Website SFR and IRSN	Website SFR	Website SFBMN	–	–

JFR = French radiology annual conference

Table showing the progress of the prescription and performance guides for medical procedures involving exposure to ionising radiation

• Medico-legal applications - In the medico-legal field, ionising radiation is used for a wide variety of applications, such as occupational medicine, sports medicine, or in the course of assessment and appraisal procedures required by legal proceedings or insurance companies. The principles of justification and optimisation apply both to the person requesting the examinations and to the person performing them.

• In the field of occupational medicine, ionising radiation is used for medical supervision of workers (whether or not professionally exposed to ionising radiation, for example workers exposed to asbestos). A working group set up by ASN is examining the justification and optimisation of various procedures currently carried out and some of which are required by the regulations.

For medical supervision of high-level athletes, radiographic examinations are required by the regulations (order of 11 February 2004). An advisory committee was set up jointly by the Minister for Sports, DGS and DGSNR to use the principle of justification to validate the examinations performed on this basis.

It should also be noted that a modification to the penal procedural code is in progress, with a view to harmonising it with the Public Health Code.

1 | 3 | 2

Maintenance and quality control of medical devices

Decree n° 2001-1154 of 5 December 2001 (art D.6515-5-1 to 12 of the Public Health Code) provides for the setting up of mandatory maintenance and quality control (internal and external) of certain medical devices, which should include medical devices used for medical exposure to ionising radiation (order of 3 March 2003).
For each medical device, a decision by the Director General of the French Health Products Safety Agency (AFSSAPS) must be issued to determine the acceptability criteria, monitoring parameters and frequency of the inspections conducted on the medical devices concerned. Three decisions were published:
- decision of 27 March 2003 concerning control of mammography installations;
- decision of 2 March 2004 concerning outside quality control of external radiotherapy installations;

- decision of 2 March 2004 concerning electron accelerators for medical uses and tele-cobalt therapy devices.

1 | 3 | 3

Biomedical research

To be able to carry out biomedical research, the "researcher" must obtain a premise licence (article L.1124-6 of the Public Health Code). The licence is issued by the Director General of AFSSAPS with regard to medical devices, drugs and cosmetics, or by the Minister for Health (General Directorate for Health) with regard to physiology, physiopathology, epidemiology and genetics research.

For research conducted in a health care institution, the research practitioner submits an application to the regional Prefect. The services of the DRASS and DDASS conduct an inspection to check the conformity of the premises and procedures with the various regulations. The inspection report is sent to the General Directorate for Health. At present, when ionising radiation is used in a research facility, the services of the DRASS and DDASS check the conformity of the installations with the regulatory provisions applicable to these sources. In the case of research with no direct benefit to the person exposed, the licence issued comprises a dose constraint, as defined in article R. 1333-65 of the Public Health Code.

1 | 4

Protection of persons exposed to "enhanced" natural radiation

1 | 4 | 1

Protection of persons exposed to radon

The regulatory framework applicable to the management of radon risk in premises open to the public (art R. 1333-15) introduces the following clarifications:

• the radon monitoring obligation applies in geographical areas in which radon of natural origin is likely to be measured in high concentrations and in premises in which the public is likely to stay for extended periods;

• the measurements will be made by organisations approved by the Minister for Health, these measurements being repeated every 10 years and whenever work is carried out to modify the ventilation or the radon tightness of the building.

Apart from introducing action trigger levels of 400 and 1000 Bq/m^3, the implementing order of 22 July 2004 defined the geographical areas and the premises open to the public for which radon measurements are made mandatory: the geographical zones corresponding to the 31 departments classified as high-priority for radon measurement (see map enclosed). The categories of premises open to the public concerned are educational establishments, health and social establishments, spas and penitentiaries.

The obligations of the owner of the establishment once the action trigger levels are exceeded are also specified (see diagram).

The conditions for accreditation of the organisations authorised to carry out activity concentration measurements were defined in the order of 15 July 2003 concerning the accreditation of organisations responsible for measuring radon. The list of accredited organisations was published in the order of 19 August 2004, on the opinion of the accreditation committee comprising representatives of the Ministries concerned, of technical bodies (Institute for radiation protection and nuclear safety, scientific and technical centre for the building trades, French high public health council), building professionals and professionals concerned by radon measurement.

The order of 22 July 2004 was accompanied by a notice defining the standards applicable to radon measurements and published in the *Official Gazette* of 11 August. Another notice concerning the definition of the actions and work required if the trigger levels of 400 and 1000 Bq/m³ are exceeded is currently being published.

In the residential field, the National health and environment plan has defined a number of priorities which include regulatory action to deal with the radon risk:

- setting up a radon diagnosis to improve information made available to future real estate buyers and tenants;
- definition of construction rules for newly built accommodation located in the priority areas.

Finally, in the working environment, the new article R. 231-115 of the Labour Code requires the head of the facility to take radon activity measurements and take the steps needed to reduce exposure when the measurement results reveal an average radon concentration of more than 400 Bq/m³. An implementing order is expected, in order to define the categories of facilities concerned by this new requirement.

1 | 4 | 2

Other sources of exposure to "enhanced" natural radiation

Professional activities which use materials which naturally contain radioelements not used for their intrinsic radioactive properties but which are likely to create exposure such as to harm the health of workers and the public ("enhanced" natural exposure) are subject to the provisions of the Labour Code (art. R. 231-114) and the Public Health Code (art. R. 1333-13). The list of these activities should be published in an order at the beginning of 2005.

Industrial activities entailing exposure to enhanced natural radiation (draft list):

Industrial facilities extracting oil and natural gas

Coal-fired thermal power plants

Industrial facilities processing tin, aluminium, copper, titanium, niobium, bismuth and thorium ores

Industrial facilities producing or using refractory ceramics

Industrial facilities producing or using compounds comprising thorium

Industrial facilities producing or using zircon and baddeleyite

Industrial facilities producing or using phosphates or manufacturing phosphoric acid

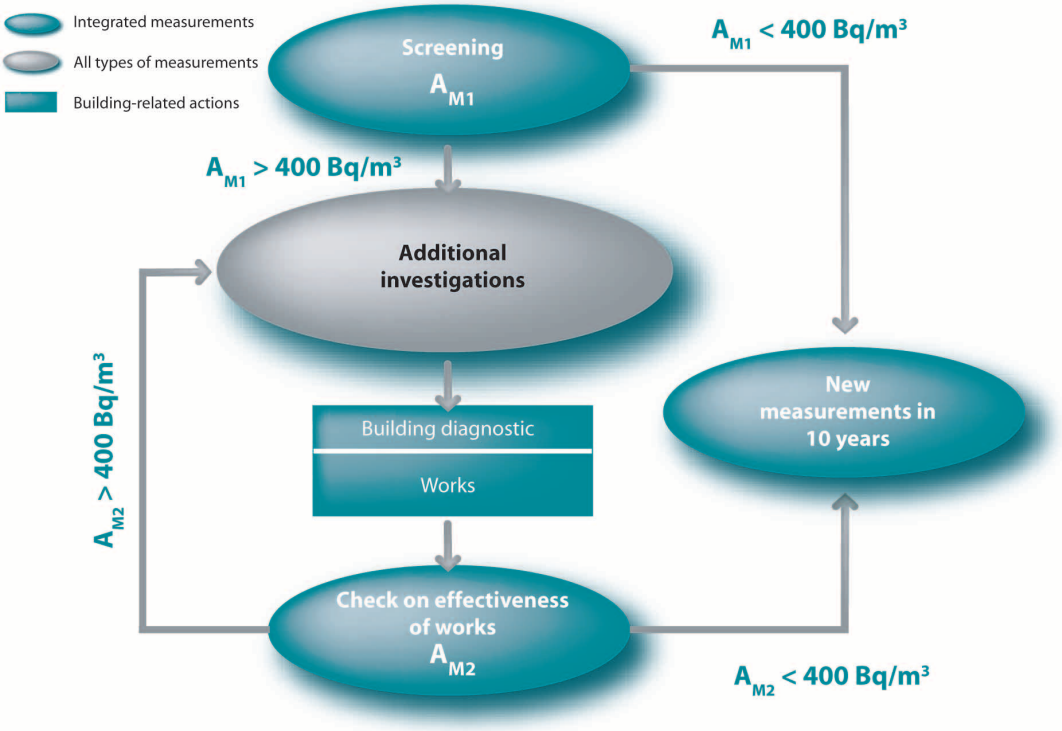
Industrial facilities processing titanium dioxide

Industrial facilities storing, processing or using rare earths

Groundwater treatment facilities using filtration to produce water intended for human consumption and mineral water.



Map of departments with radon priority



Method for radon risk management in buildings

For these activities, an obligation will be introduced to monitor exposure and estimate the doses to which the population is subjected. Furthermore, the Minister for Health may initiate protectivity measures against ionising radiation, should this prove necessary in the light of the estimates made. When these activities fall into the category of classified installations, these measures will be defined by the corresponding applicable regulations.

In addition, and if protection of the public so warrants, it will also be possible to set radioactivity limits for the construction materials and consumer goods produced by some of these industries (art. R.1333-14). This measure complements the ban on the intentional addition of radioactive substances to consumer goods.

For professional exposure resulting from these activities, a dose evaluation process, under the responsibility of the head of the facility, was introduced into the Labour Code. Should the dose limit of 1 mSv/year be exceeded, steps to reduce exposure should be taken. The planned order mentioned above will clarify the technical measures implemented for assessing the doses received by workers.

Finally, the Labour Code (art. R. 231-116) stipulates that for aircrews likely to be exposed to more than 1 mSv/year, the head of the facility must evaluate the exposure, take steps to reduce the exposure (particularly in the event of a declared pregnancy) and inform the personnel of the health risks. The order of 7 February 2004 defines the procedures for implementing these measures.

1 | 5

Radiological quality of water intended for human consumption and foodstuffs

• European Directive 98/83/EC, transposed into national regulation by the decree of 20 December 2001 on the quality of water intended for human consumption, set radiological quality criteria for water intended for human consumption. Two quality indicators concerning radioactivity were taken into account: tritium and the total indicative dose (TID). The reference level for tritium was set at 100 Bq/l, and that of the TID at 0.1 mSv/year. Tritium is considered to be an indicator capable of revealing the presence of other artificial radionuclides, while the TID covers both natural radioactivity and radioactivity due to the presence of artificial radionuclides.

Appendices 2 and 3 of Directive 98/83/EC should shortly be completed to clarify the radiological analyses strategy associated with TID. The document which should soon be adopted by the committee composed of representatives of the Member States created by Directive 98/83/EC recommends introducing the measurement of gross alpha and beta activity indicators and the corresponding values adopted by the World Health Organisation (0.1 Bq/l and 1 Bq/l respectively), and a search for specific natural and artificial radionuclides, when one or other of these gross activity values is not met.

On this basis, the order of 12 May 2004, implementing the decree of 20 December 2002, defined new radiological inspection programs for public mains water and non-mineral bottled water.

• Several European regulations (Regulation N° 3954/87/Euratom and following, regulation (EEC) N° 2219/89) were adopted after the Chernobyl accident to determine the maximum allowable radioactivity levels in contaminated foodstuffs. These levels, along with the values of the Codex alimentarius for international trade, are appended to this chapter.

2 BNI REGULATIONS

Apart from the general regulations, such as those concerning radiation protection described in the first part of this chapter, or those pertaining to labour law and environmental protection, basic nuclear installations (BNI) are subject to two particular types of regulations:

- licensing procedures;
- technical rules.

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

2 | 1

Licensing

The unlicensed operation of a nuclear installation is prohibited by French law and the relevant regulations. In this context, BNIs are currently regulated, pending a specific law, by decree 63-1228 of 11 December 1963, as modified, implementing law 61-842 of 2 August 1961, as modified, on the abatement of atmospheric pollution and offensive odours. 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, commissioning, final shutdown, dismantling. It also enables the ministers in charge of nuclear safety to request at any time the operator to conduct a periodic 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, as modified, on water (articles L.210-1 to L.217-1 of the Environment Code).This decree, modified in particular by article 3 of decree 2002-460 of 4 April 2002 concerning the general protection of individuals against the dangers arising from ionising radiation, sets the licensing 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 a manner contradictory to specified licence conditions lays himself 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 law of 3 January 1992 on water (articles L.216-1 to L.216-13 of the Environment Code), concerning effluent release and water intake.

Application of these various procedures starts with siting and plant design and ends with ultimate dismantling.

2 | 1 | 1

Site selection

Well before applying for an authorisation decree, the operator provides information to the concerned authorities on the site or sites selected for the BNI construction. The main site characteristics can therefore be analysed at a very early stage.

This analysis deals with socio-economic aspects and safety. If the planned BNI is intended for power generation, the General Directorate for Energy and Raw Materials of the Ministry for Industry will be directly involved. DGSNR will meanwhile analyse the safety-related characteristics of the site: seismicity, hydrogeology, industrial environment, cold water sources, etc.

In addition, under application of section IV of law 2002-276 of 27 February 2002 on local democracy (articles L.121-1 to L.121-15 of the Environment Code), provision is made in a decree of 22 October 2002 on the organisation of public debates and the National Public Debates Commission, whereby authorisation of a BNI may be subject to a public debate procedure:
- systematically, when dealing with a new electricity generating site or a new site not generating electricity and costing more than € 300 million;
- possibly, for a new nuclear electricity generating site costing more than € 150 million.

2 | 1 | 2

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 authorisation application.

DGSNR 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 simply facilitates them.

2 | 1 | 3

Plant authorisation decrees

Submission of the plant authorisation application

Applications for BNI authorisation decrees are sent to the Minister for Environment and the Minister for Industry, who forward them to other ministers concerned (Interior, Health, Agriculture, Town Planning, Transport, Labour, etc.). Each application file comprises a preliminary safety analysis report.

Processing of the application includes a public inquiry and a technical assessment..

• Consultation of the public and the local authorities

The public inquiry is opened by the Prefect of the department where 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, the nature and basic characteristics of the installation and comprise a plan of it, 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 communes completely or partially within a 5 km radius around the planned installation. If this radius encompasses the territory of several departments, a joint order of the Prefects concerned organises the inquiry in each department, with the Prefect of the main site of the operation co-ordinating the procedure.

In accordance with 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 elements necessary for its own information. So any interested person, 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 nominated by the President of the competent Administrative Court. He may receive any document, 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 observations of the public entered into the inquiry register or sent to him directly. Within the month following the end of the inquiry, he sends a report containing 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 opinion and the results of the competent authority consultations, to the ministers in charge of nuclear safety.

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.

· Consultation of technical organisations

The preliminary safety analysis report appended to the authorisation decree application is transmitted to DGSNR, which can submit it for examination to one of its Advisory Committees.

In view of the recommendations of the Advisory Committee, the results of the public inquiry and possibly the remarks of other ministers, the DGSNR eventually prepares a draft authorisation decree.

This draft decree is then sent to the Interministerial Commission for Basic Nuclear Installations (CIINB) by the ministers in charge of nuclear safety. The Commission is required to submit its opinion within two months.

The draft decree, if necessary amended, is then submitted to the assent of the Minister for Health who must state his position within three months.

· Authorisation decree

The authorisation decree, based on the proposals of the ministers for Environment and for Industry, defines the perimeter and the characteristics of the installation and the specific requirements which must be met by the operator. It also specifies the particular justifications the operator will have to present prior to:
- the various pre-commissioning stages;
- commissioning;
- and subsequently, the final shutdown and dismantling of its installation.

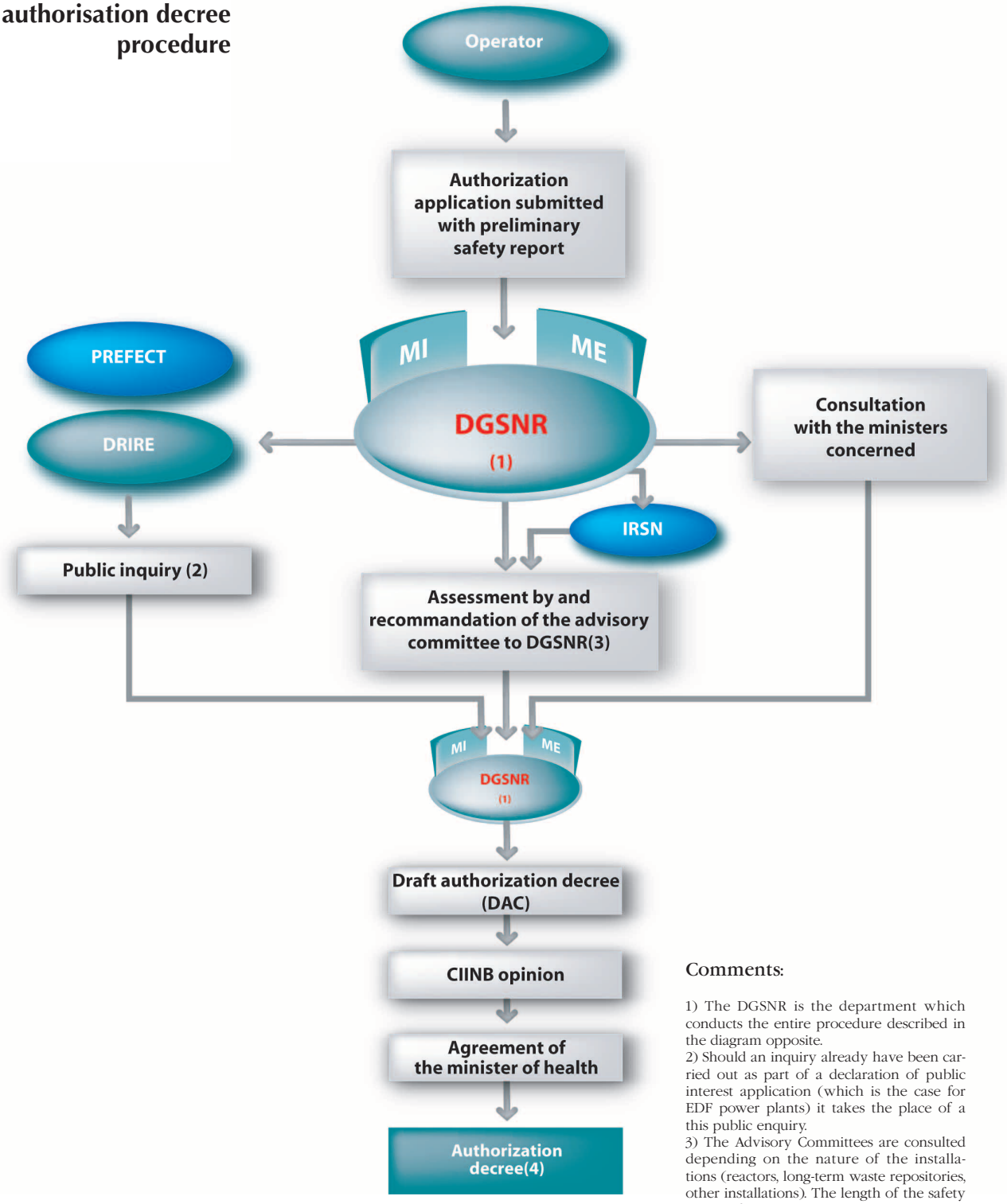
The authorisation decree requires the operator to submit the following to DGSNR, at least six months before the date scheduled for initial loading of facilities containing a reactor with nuclear fuel, or use of a particle beam or radioactive substance in other facilities:
- a provisional safety report in particular containing information guaranteeing the conformity of the installation with the technical construction requirements of the authorisation decree;
- the general operating rules to be followed during the period prior to commissioning, to guarantee safe operation;
- an onsite emergency plan specifying the response organisation and resources to be deployed on the site in the event of an accident in the installation.

The authorisation decree for the installation sets the time within which it is to be commissioned.

Before commissioning, the operator sends DGSNR a final safety report and the updated general operating rules and onsite emergency plan.

If the installation is not commissioned within the specified time or if it is not operated for a consecutive period of two years, a further authorisation, taking the same form, will be required.

Basic nuclear installations authorisation decree procedure



MI Minister for Industry
ME Minister for the Environment
DGSNR Directorate General for Nuclear Safety and Radiation Protection
DRIRE Regional Directorate for Industry, Research and the Environment
CIINB Interministerial Commission for Basic Nuclear Installations
IRSN Institute for Radiation Protection and Nuclear Safety

Comments:

1) The DGSNR is the department which conducts the entire procedure described in the diagram opposite.
2) Should an inquiry already have been carried out as part of a declaration of public interest application (which is the case for EDF power plants) it takes the place of a this public enquiry.
3) The Advisory Committees are consulted depending on the nature of the installations (reactors, long-term waste repositories, other installations). The length of the safety review for the planned installation varies widely according to the installation concerned: for large installations (electricity generating reactors, plants) it varies approximately between six months and two years, depending on the degree of innovation of the project with respect to projects already examined.
4) In addition to the authorisation decree, the MI and the ME may stipulate specific requirements.

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 in particular with regard to environmental protection or worker health and safety issues.

These requirements may in particular concern:
- the compliance with the provisions of the order of 10 August 1984 concerning the quality of the design, construction and operation of basic nuclear installations;
- operation of the installation, installation protection and security systems, emergency resources, ventilation and release systems, protection against earthquakes, radiological protection of the environment and workers, transport of radioactive products, installation modifications, shutdown and dismantling.

· Installation modifications

The operator notifies DGSNR of any modification to the installation demanding updating of the safety reports, the general operating rules or the onsite emergency plan.

A further authorisation must be obtained when a basic nuclear installation requires modifications likely to lead to non-compliance with the above-mentioned requirements.

In the case of modifications made to an existing or planned installation which has already undergone a public inquiry, if these modifications are not substantial and do not increase the risks of the installation, a public inquiry is not necessary.

Authorisation decrees issued or modified in 2004

Saclay radioactive liquid effluent management zone (Essonne)	8 January 2004	Decree authorising the CEA to modify BNI n° 35
EL4-D (Monts d'Arrée) (Finistère)	12 January 2004	Decree amending the authorisation decree of BNI n° 162
MELOX (Chusclan - Gard)	4 October 2004	Decree authorising COGEMA to modify BNI n° 151
CEDRA (Saint-Paul-lez-Durance - Bouches-du-Rhône)	4 October 2004	Decree authorising the CEA to create BNI n° 164
Ardennes nuclear power plant CNA-D (Chooz - Ardennes)	27 October 2004	Decree authorising EDF to modify BNI n° 163
Perimeter of the Cruas nuclear power plant (Ardèche)	29 November 2004	Decree authorising EDF to modify the perimeter of BNIs n° 111 and 112
Perimeter of the Belleville nuclear power plant (Cher)	29 November 2004	Decree authorising EDF to modify the perimeter of BNI n° 128
Perimeter of the Golfech nuclear power plant (Tarn-et-Garonne)	29 November 2004	Decree authorising EDF to modify the perimeter of BNI n° 135

Perimeter of the Gravelines nuclear power plant (Nord)	29 November 2004	Decree authorising EDF to modify the perimeter of BNIs n° 96 and 97 and take charge of the radioactive waste from the Société de Maintenance Nucléaire
Perimeter of the Tricastin nuclear power plant (Drôme)	29 November 2004	Decree authorising EDF to modify the perimeter BNI n° 88 and take charge of the liquid radioactive effluent and solid waste from the BCOT

2 | 1 | 4

Operating licences

· Power reactor commissioning

The first core load can only be delivered to the fresh fuel storage building after authorisation from the ministers for Environment and for Industry, granted after examination by DGSNR:
- of the storage provisions made by the operator, as presented at least three months beforehand;
- of the conclusions of an inspection carried out shortly before the date set for delivery of the fuel elements.

Moreover, six months before fuel loading, the operator must send the ministers for Environment and for Industry a provisional safety analysis report together with provisional general operating rules (RGE) and an onsite emergency plan (PUI) specifying the organisational provisions and measures to be implemented on the site in the event of an accident. 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.

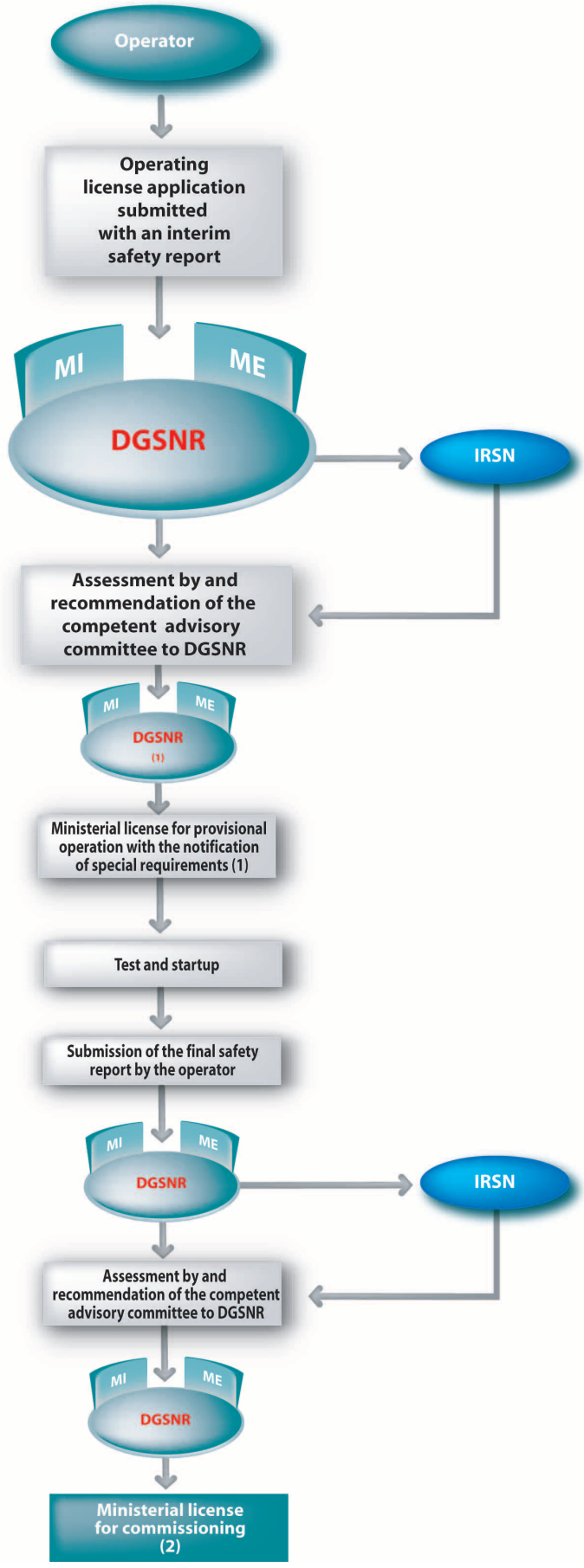
For PWRs, at least four successive licences are required in the startup stages:
- a fuel loading licence, authorising fissile fuel elements to be installed in the reactor vessel, enabling fuelled testing to start (pre-critical cold tests);
- a licence for pre-critical hot testing, prior to first criticality. 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 certificate by DRIRE Bourgogne, in application of the ministerial order of 26 February 1974 (see chapter 4 below);
- a licence for first criticality and power build-up to 90% of nominal power;
- a licence for power build-up to 100% of nominal power.

After the initial startup and within a time limit stipulated in the authorisation decree, the operator requests the issue of a commissioning licence by the ministers for Environment and for Industry. His request is substantiated by a final safety analysis report, final general operating rules and a revised version of the onsite emergency plan. These documents must reflect the experience acquired during the operating period since the initial startup.

· Commissioning of installations other than power reactors

The authorisation decrees for BNIs other than power reactors stipulate that their commissioning is subject to authorisation from the ministers for Environment and for Industry.

Operating licence procedure for basic nuclear installations



Comments:

1) For pressurised water reactors, commissioning of the pressure vessel is also dependent on issue of a hydrotest report for the primary circuit, as specified in the regulatory provisions applicable to pressure vessels.
2) As defined in article 4 of the decree of 11 December 1963. This approval must take place within a time set by the authorisation decree. It is given by the Ministers for the Environment and Industry

MI	Minister for Industry
ME	Minister for the Environment
DGSNR	Directorate General for Nuclear Safety and Radiation Protection
IRSN	Institute for Radiation Protection and Nuclear Safety

This pre-commissioning authorisation is accompanied by notification of technical requirements. It is granted after examination by DGSNR and its technical support organisations, especially the competent Advisory Committee, of the documents prepared by the operator, comprising the provisional safety analysis report, the general operating rules and the onsite emergency plan.

Furthermore, before an installation is definitely commissioned, which must take place within a time stipulated in the authorisation decree, the operator must submit a final safety analysis report to the ministers for Environment and for Industry. This commissioning is subject to ministerial authorisation, where necessary involving updating of technical requirements and general operating rules, according to a procedure similar to that adopted for power reactors.

Main licenses issued in 2004

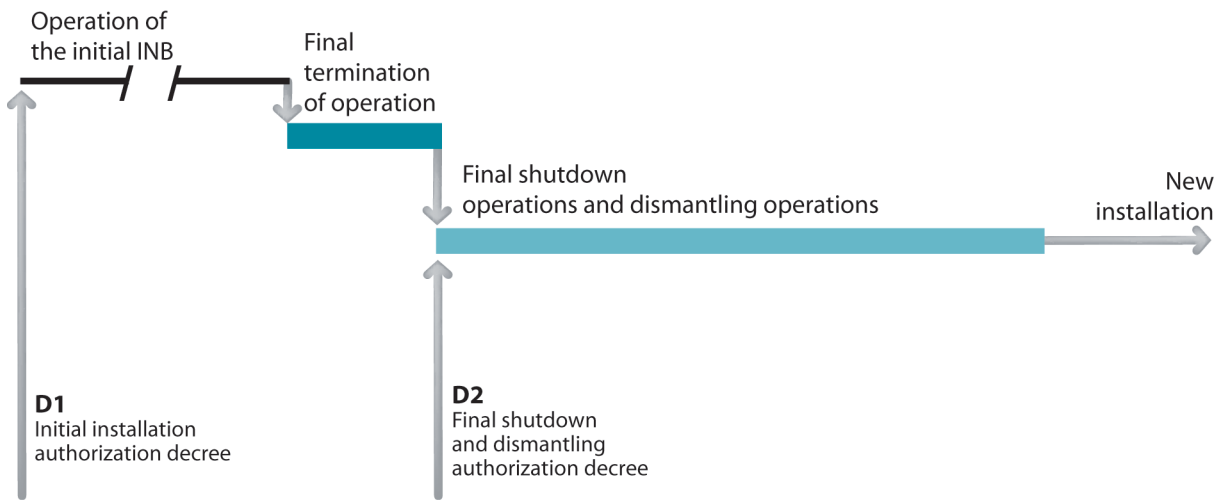
Chooz B nuclear power plant (reactor 2) (Ardennes)	30 January 2004	Commissioning authorisation for BNI n° 144 given to EDF
TU 5 Installation (Pierrelatte - Drôme)	17 September 2004	Commissioning authorisation for BNI n° 155 given to COGEMA

2 | 1 | 5

Final shutdown and dismantling licenses

As specified in article 6b of the above-mentioned decree of 11 December 1963, when an operator decides, for any reason, to close down its installation, it must inform the Director General for Nuclear Safety and Radiation Protection, by sending him:
- 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 to ensure that a satisfactory level of safety is maintained;
- 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 analysis pertaining to the proposed provisions.



Dismantling of basic nuclear installations

The implementation of these various provisions is subject to their approval by decree, countersigned by the ministers for 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. To do so, these operations must involve compliance with previously imposed requirements and with the safety analysis report and general operating rules currently in force. In all other cases, such operations come under the provisions of the final shutdown decree.

From the regulatory standpoint, after these end of operation tasks, two successive sets of operations 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 assessment 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 taking advantage of radioactive decay in certain activated or contaminated materials.

As soon as the installation, although still a BNI, is affected by the dismantling operations in such a way that they alter its nature, it is considered to be a new basic nuclear installation and consequently a new authorisation decree is required, involving the 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 the 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 for environmental protection grounds (Articles L.511-1 to L.517-2 of the Environment Code), in which case it would be subject to registering or licensing procedures.

On 17 February 2003, the DGSNR issued a doctrine note to the nuclear operators concerning final shutdown and dismantling of nuclear installations. Without calling into question the existing regulatory framework, this note makes it possible to simplify the procedures involved in the closure of the installations, by dealing with final shutdown and the successive phases of dismantling in a single decree. The purpose of this note is thus:
- to clearly define the main technical steps in decommissioning, to ensure that they are better adapted to the diversity of nuclear facilities;
- to encourage complete dismantling either immediately or after slight postponement;
- before the regulatory procedures are launched, to encourage presentation and justification by the operator of the chosen decommissioning scenario, from the cessation of production up to final dismantling of the facility;
- to clarify the administrative notion of declassifying of a basic nuclear installation and the related criteria.

Final shutdown and dismantling authorisation issued in 2004

MÉLUSINE (Grenoble)	8 January 2004	Decree authorising the CEA to modify BNI n° 19 with a view to its dismantling and declassifying
HARMONIE (Saint-Paul-lez-Durance)	8 January 2004	Decree authorising the CEA to carry out final shutdown and dismantling of BNI n° 41

SACLAY LINEAR ACCELERATOR	12 January 2004	Decree authorising the CEA to carry out final shutdown and dismantling of BNI n° 43
CADARACHE IRRADIATOR (IRCA)	12 January 2004	Decree authorising the CEA to carry out final shutdown and dismantling of BNI n° 121

2 | 1 | 6

Liquid and gaseous effluent release and water intake licences

The normal operation of nuclear plants produces radioactive effluents, for which release to the environment is subject to stringent conditions stipulated in an administrative licence devised for the protection of staff, the public and the environment. The licence concerns liquid and gaseous radioactive effluents, covering both their activity level and their chemical characteristics.

The operation of most nuclear installations also involves 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, as modified, on 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 release 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 in all cases examined by DGSNR.

The procedures stipulated in the above-mentioned decree also apply to the installations classified for environmental protection grounds located within the perimeter of a BNI. This decree thus also enables assessment of the overall environmental impact of an installation's effluent release and water intake.

· Submission of the plant authorisation

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 Environment. In addition to various drawings, maps and information, it comprises a description of the operations or activities envisaged and an assessment of their impact on human health and on the environment, comprising a list of proposed compensatory measures and the intended surveillance provisions.

· Recommendations of the ministers concerned

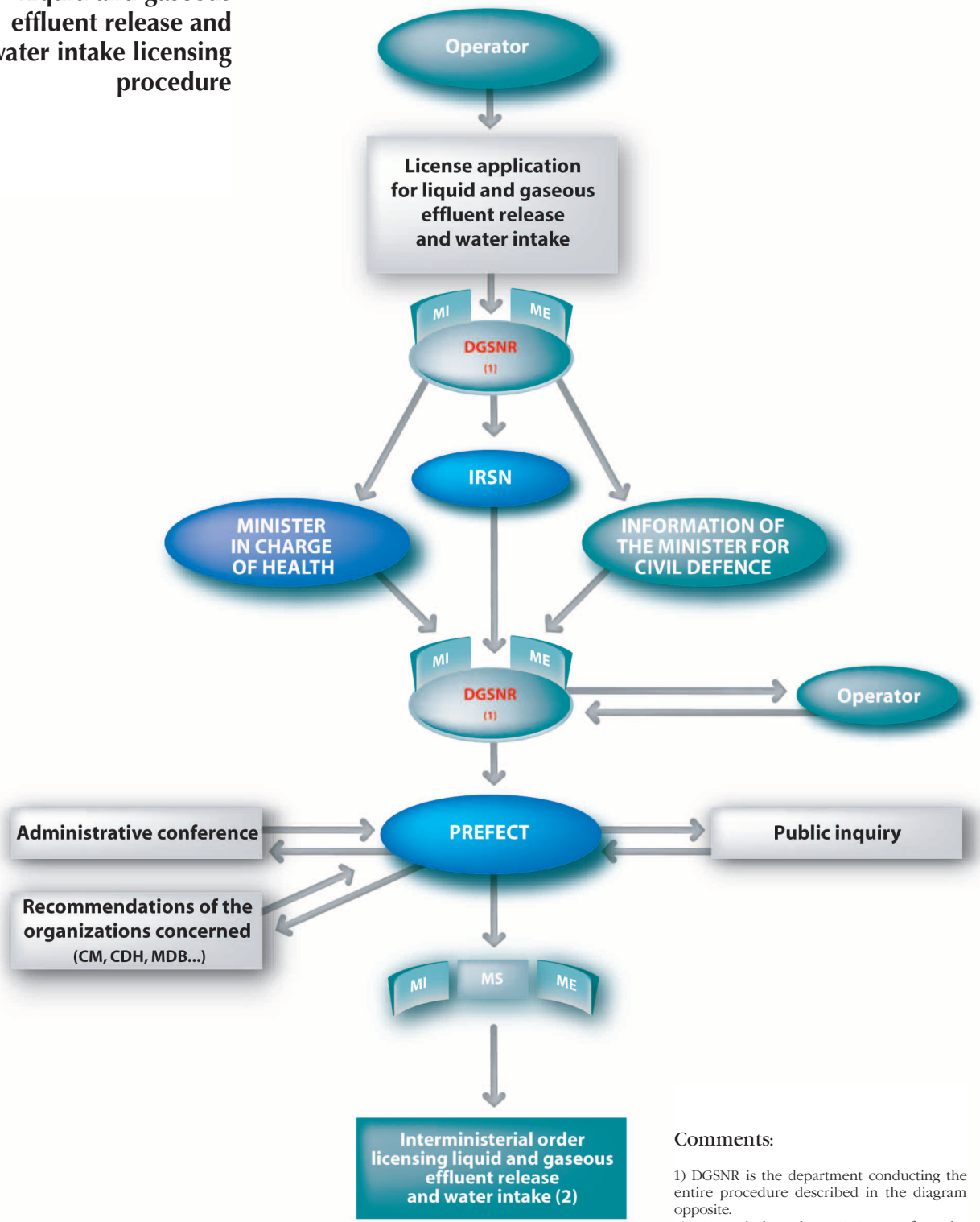
The application is forwarded for their opinion to the ministers for Health and for Civil Defence and to the Directorate for the Prevention of Pollution and Risks at the Ministry for Environment.

· Consultation of the public and local authorities and organisations

The ministers for Industry and for Environment, after having requested complementary data or modifications where necessary from the applicant, forward the application, together with the recommendations of the consulted ministers, to the Prefect of the department concerned.

The Prefect organises an administrative conference between various local State departments which he feels should be consulted and subjects the application to a public inquiry under conditions similar to those described in § 2|1|3 above for authorisation decrees.

Liquid and gaseous effluent release and water intake licensing procedure



Comments:

1) DGSNR is the department conducting the entire procedure described in the diagram opposite.
2) Signed by the Ministers for the Environment, Industry and Health.

MI	Minister for Industry
ME	Minister for the Environment
MS	Minister for Health
DGSNR	Directorate General for Nuclear Safety and Radiation Protection
IRSN	Institute for radiation protection and nuclear safety
CM	Town councils
CDH	Departmental health council
MDB	River authority

However, in the present procedure, the inquiry is opened in the commune where the operations in question are to be carried out and also in other communes 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 local river authority (Mission déléguée de bassin) or the public agency administering the public domain. He also sends the application file, for information, to the local water commission.

· 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 Environment.

Authorisation is granted by a joint ministerial order signed by the ministers for Health, Industry and Environment.

Within the framework of general technical rules defined by an order of the ministers for Industry, Environment and Health of 26 November 1999, which has been further clarified by a circular sent out to the prefects, signed by the same ministers on 17 January 2002 (see below in § 2|2|1) this document stipulates:

a) the intake and release limits with which the operator must comply;

b) the approved methods of analysis, measurement and monitoring of the installation, work or activity and of surveillance of environmental effects;

c) the conditions under which the operator shall report to the ministers for Health and Environment and to the Prefect, concerning the water intakes and releases it has performed together with environmental impact surveillance results;

d) the means to be used for information of the public.

At the request of the licensee or on their own initiative, the ministers for Health, for Industry and for Environment may, after consultation with the Health Council for the concerned department, use a ministerial order to modify the conditions provided for in the authorisation order.

Finally, any modification 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 Environment, who will consult the Minister for Health. If it is then considered that the modification could cause environmental hazards or difficulties, the operator may be required to submit a new licence application.

Main licenses issued in 2004

Nuclear plant (Chooz-Ardennes)	26 April 2004	Order authorising EDF to carry out liquid releases resulting from anti-amoeba treatment for operation of the Chooz nuclear power plant
Nuclear plant (Nogent-sur-Seine - Aube)	26 April 2004	Order authorising EDF to carry out liquid releases resulting from anti-amoeba treatment for operation of the Nogent nuclear power plant

Nuclear plant (Bugey - Ain)	26 April 2004	Order authorising EDF to carry out liquid releases resulting from anti-amoeba treatment for operation of the Bugey nuclear power plant
Nuclear plant (Dampierre - Loiret)	27 April 2004	Order authorising EDF to carry out liquid releases resulting from anti-amoeba treatment for operation of the Dampierre nuclear power plant
Nuclear plant (Golfech - Tarn-et-Garonne)	27 April 2004	Order authorising EDF to carry out liquid releases resulting from anti-amoeba treatment for operation of the Golfech nuclear power plant
Nuclear plant (Grenoble - Isère)	25 May 2004	Order authorising the CEA to continue with water intake and liquid and gaseous effluent releases for operation of its nuclear site in Grenoble
Nuclear plant (Golfech - Tarn-et-Garonne)	11 June 2004	Order authorising EDF to carry out thermal liquid releases in exceptional climatic situations for operation of the Golfech nuclear power plant
Nuclear plant (Tricastin - Drôme)	11 June 2004	Order authorising EDF to carry out thermal liquid releases in exceptional climatic situations for operation of the Tricastin nuclear power plant
Nuclear plant (Bugey - Ain)	11 June 2004	Order authorising EDF to carry out thermal liquid releases in exceptional climatic situations for operation of the Bugey nuclear power plant
Nuclear plant (Cattenom - Moselle)	23 June 2004	Order authorising EDF to continue with water intake and liquid and gaseous effluent releases for operation of the Cattenom nuclear power plant
Nuclear plant (Nogent-sur-Seine - Aube)	15 October 2004	Order authorising EDF to carry out liquid releases resulting from anti-scale treatment of the cooling systems for reactors 1 and 2 in the Nogent-sur-Seine nuclear power plant
Nuclear plant (Nogent-sur-Seine - Aube)	29 December 2004	Order authorising EDF to continue with the water intake and liquid and effluent releases for operation of the Nogent-sur-Seine nuclear power plant

2 | 2

Technical rules

Technical nuclear safety rules and practices are set out in a series of texts, classified according to relative specificity. They are summarised below in order of increasing detail. The first texts, of regulatory

nature, are very general, broader in scope and do not deal with technical details. The last texts, on the other hand, concern closely analysed specific topics. Their legal context is more flexible.

2 | 2 | 1

General technical regulations

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 facilities.

The applicable regulations are detailed in the following table:

	Nuclear			Conventional
	Main primary system of pressurised water reactors	**Main secondary systems of pressurised water reactors**	**Other equipment**	
Construction	• Decree of 2 April 1926 • Order of 26 February 1974	• Decree of 2 April 1926 • RFS II.3.8 of 8 June 1990	• Decree of 2 April 1926 • Decree of 18 January 1943 or • Decree of 13 December 1999 (1)	• Decree of 13 December 1999
Operation	• Arrêté du 10 novembre 1999			• Decree of 13 December 1999 • Order of 15 March 2000

(1) Pending updating of the applicable regulations through publication of an order covering pressurised equipment "specifically designed for nuclear applications", currently being drafted.

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 in § 2|1|6 above, are subject to the joint authorisation of the ministers for Health, Industry and Environment are henceforth circumscribed by technical rules in 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 the interministerial circular of 17 January 2002 mentioned above, 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 Environment signed an order 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 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 periodic safety reviews. Finally, an order concerning nuclear pressure vessels is currently being drafted.

2 | 2 | 2

Basic safety rules

DGSNR 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 DGSNR 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 it 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 may be consulted, together with the other technical rules issued by DGSNR, in brochure 1606 published by the *Official Gazette* and the Nuclear Safety Authority under the title "The safety of nuclear installations in France - laws and regulations".

In 2003, DGSNR drew up a draft basic safety rule concerning installations for the short or medium term storage of radioactive waste and effluent or spent fuel. This draft was to be examined by the Advisory Committee during the course of 2004. However the Committee has not yet met owing to the lack of consensus around the scope of application of the rule on the part of the various parties involved in drafting it.

The work to revise the basic safety rule concerning packages intended for surface disposal is continuing. Changes to the rule should enable experience feedback from the first 10 years of operation of the Aube repository to be taken into account. ASN will ensure that examination by the Advisory Committee for waste of the revised RFS will lead to conclusions consistent with the information obtained by examination of the safety report on this repository submitted in October 2004 by ANDRA.

Re-examination of RFS I.4.a on fire protection in BNIs other than reactors, began in 1999 and showed that a revision of it was necessary. First, a circular explaining the provisions of the above-mentioned interministerial order of 31 December 1999 on fire protection will be drafted with the assistance of a working group. This document should enable targets to be set in terms of fire risk prevention. A second step will consist in revising RFS I.4.a to bring it into conformity with the order and the circular. Six meetings of the working group devoted to examination of the circular were held in 2004. The work will continue into 2005.

2 | 2 | 3

French nuclear industry codes and standards

In the industrial field, current industrial rules and practices are codified in standards by standardisation organisations or in a series of industrial codes by professional associations. These codes and standards are a concrete transposition of the requirements of the general technical regulations, while

reflecting best industrial practices, thereby facilitating contractual relations between customers and suppliers.

In the particular field of nuclear safety, the French association for design, construction and in-service surveillance rules for nuclear power plant nuclear steam supply system equipment (AFCEN), of which EDF and Framatome ANP are members, drafts industrial codes to cover different phases concerning the important equipment in the installations. The RCC codes, or "design and construction rules", were drafted for the design, manufacture and commissioning of electrical equipment (RCC-E), civil engineering work (RCC-G) and mechanical equipment (RCC-M). As of 1990, a code of "mechanical equipment in-service surveillance rules" (RSE-M) was drafted to deal with operation of this equipment.

Drafting these documents is the responsibility of industry and not of ASN. ASN nonetheless examines them to ensure that they are in conformity with the general technical regulations, which in most cases leads to drafting of an RFS or a decision which thus recognises overall acceptability on the date of the version in question.

The new version of the RCC-E code was accepted by ASN in 2003. ASN in particular checked that this fourth edition of the code is consistent with RFS II.4.1.a of 15 May 2000 concerning the software in safety-rated electrical systems in PWR plants.

The 2000 edition of the RCC-M code was accepted by ASN with reserves in a decision of 10 July 2001 (available on www.asn.gouv.fr). A modification to the code is currently being examined (see chapter 12, § 3|3|2).

The 2000 edition of the RSE-M code was accepted by DGSNR in June 2002 and has been implemented on all nuclear power plants since January 2003. A modification to this code is also being examined (see chapter 12, § 3|3|2).

2 | 3

Installations classified on environmental protection grounds

Installations liable to prove dangerous or harmful for the environment are governed by law 76-663 of 19 July 1976, as modified, concerning installations classified on environmental protection grounds (ICPE). This law is now included in articles L.511-1 to L.517-2 of the Environment Code. The installations concerned, listed by type in a document regularly updated by the Ministry for Environment, are the subject of special arrangements when they are located within the perimeter of a Basic Nuclear Installation.

Decree 63-1228 of 11 December 1963, as modified, concerning nuclear installations, makes a distinction between Basic Nuclear Installation equipment and ICPEs, clarified by the 4 October 1983 recommendation of the Council of State:

– Basic Nuclear Installation equipment is that constituting an element necessary to the operation of such installations. This equipment is covered by articles 2 and 3 of the above-mentioned 1963 decree and must comply with the procedure applicable to BNIs. In particular, in all cases where new or modified equipment would be such as to substantially alter the initial capacity or purpose of a BNI or would increase the risks it entails, a public inquiry must be held;

– installations classified on environmental protection grounds located within the perimeter of a Basic Nuclear Installation are those which have no functional link with the latter. They are governed by the aforementioned law of 19 July 1976, although with three specific provisions, specified in article 6a of the 11 December 1963 decree:

• the ministers responsible for nuclear safety replace the prefects for the granting of licences or registrations,

• operating permit applications may be substantiated by the public inquiry documents submitted in the course of the initial BNI authorisation procedure and the permit may be granted by the BNI authorisation decree,

• the technical requirements with which the operator is required to comply are notified by the ministers with responsibility for nuclear safety.

Moreover, as indicated in § 2|1|6 above, effluent release from ICPEs located within the perimeter of a BNI is regulated by the decree of 4 May 1995 concerning BNIs.

DGSNR is empowered to examine application files and the surveillance functions defined in the above-mentioned law of 19 July 1976 for installations falling within its scope, are entrusted to the BNI inspectors.

3 OUTLOOK

In the very near future, the transposition of the Euratom directives adopted by the Council of the European Union, in particular directive 96/29/Euratom setting basic rules for protection of the population and workers against the hazards of ionising radiation and directive 97/43/Euratom concerning the protection of persons exposed for medical purposes, should be completed. The work on transposition of directive 2003/122/Euratom concerning the control of high-level radioactive sources and orphan sources will continue. Without waiting for the end of this work, which will supplement the regulatory base enshrined in the Public Health Code and on the basis of the experience acquired since 2002, the ASN has already undertaken to update these regulations, in order to simplify them.

The nuclear transparency and safety bill should be tabled before Parliament in the spring of 2005.

However, the legislative provisions applicable to the new system of specialised radiation protection inspections, which were initially included in the nuclear transparency and safety bill, have now been adopted as part of law n° 2004-806 of 9 August 2004 concerning public health policy, of which they constitute article 82.

Furthermore, a framework decision by the Council of the European Union dated 27 January 2003 concerning protection of the environment by penal law is currently being transposed into French law. The law comprising various measures to adapt community law should incorporate certain provisions of the nuclear transparency and safety bill with respect to penal sanctions.

In June 2004, the council was unable to adopt the "nuclear package" which designates both of the directives prepared by the European Commission, one defining general principles of nuclear installation safety and the other concerning the management of spent fuel.

In its conclusions dated 28 June 2004, the European Council observed the lack of consensus on these projects but it did recommend that work be continued into advancing harmonisation of nuclear safety, such as the work done by WENRA, the Western European Nuclear Regulators' Association.

During their latest meeting, the members of WENRA made commitments to:
- finalising the assessment of national practices, scheduled for November 2005;
- presenting a plan of action designed to bring these national practices into conformity with the defined reference levels, which should be completed by the end of 2006;
- finally, harmonising national practices, scheduled for 2010.

APPENDIX 1

VALUES AND UNITS USED IN RADIATION PROTECTION

1 The main values used in radiation protection

Radiation protection rules cannot be implemented without metrology, as the most important exposure indicators for radiation protection are the doses received by man. Transposition of directive 96/29/Euratom led to updating of the definitions of the main values used in radiation protection (Appendix 13-7 of the Public Health Code).

Activity and becquerel

Activity (A): the activity A of an amount of a radionuclide in a particular energy state at a given time is the quotient of dN by dt, where dN is the expectation value of the number of spontaneous nuclear transitions with emission of ionising radiation from that energy state in the time interval dt.

$$A = \frac{dN}{dt}$$

The unit of activity of a radioactive source is the becquerel (Bq).

Absorbed dose and gray

Absorbed dose (D): energy absorbed per unit mass

$$D = \frac{dE}{dm}$$

where:

dE is the mean energy communicated by the ionising radiation to the matter in a volume element;
dm is the mass of the matter in this volume element.
The term "absorbed dose" designates the mean dose received by a tissue or an organ.

The absorbed dose unit is the gray (Gy).

The absorbed dose D represents the quantity of energy absorbed per unit mass of tissue. 1 gray (Gy) corresponds to the absorption of 1 joule per kilogram. This quantity designates the mean dose absorbed by a tissue, organ or the whole body. However, the absorbed dose cannot be directly used in radiation protection because it does not take account of the fact that the biological effects of the energy intake depend on a number of parameters:

- the quality of the radiation, in other words how it loses its energy in the micro-volumes along its path. This depends on its nature, whether electromagnetic (X or gamma rays) or electrically charged or uncharged particle (alpha, beta or neutrons);
- the characteristics of the organ or tissue into which the energy is deposited, as not all tissues have the same sensitivity to radiation;
- the dose rate, that is the inclusion of the time factor in the energy intake.

A large number of experiments have analysed the importance of each of these factors with regard to the biological effects of irradiation. To manage all the doses received by an individual, equivalent doses must be used which take account of these exposure parameters. Weighting factors are thus applied to the "absorbed dose" when one wishes to define the "equivalent dose" which takes account of the nature of the radiation and the "effective dose" which concerns the whole body.

Equivalent dose, committed equivalent dose and sievert

Equivalent dose (H_T): dose absorbed by the tissue or organ T, weighted according to the type and energy of the radiation R. It is given by the following formula:

$$H_{T,R} = w_R \, D_{T,R}$$

where:
$D_{T,R}$ is the mean for the organ or tissue T of the absorbed dose of radiation R;
w_R is the weighting factor for the radiation R.

When the radiation field comprises radiation of types and energies corresponding to different values of w_R the total equivalent dose H_T is given by the formula:

$$H_T = \sum w_R \, D_{T,R}$$

The equivalent dose unit is the sievert (Sv).

The ICRP's values for w_R, published in the order of 1 September 2003, are given in the following table. For the types of radiation which do not appear in the table, an approximate value of w_R is obtained from the mean quality factor determined by the ICRU.

Type of radiation and energy range	w_R
Photons all energies	1
Electrons and muons all energies	1
Neutrons of less than 10 keV	5
Neutrons from 10 to 100 keV	10
Neutrons from 100 keV to 2 MeV	20
Neutrons from 2 MeV to 20 MeV	10
Neutrons of more than 20 MeV	5
Protons of more than 2 MeV	5
Alpha particles	20

Committed equivalent dose [$H_T(\tau)$]: integral over time (t) of the equivalent dose rate in the tissue or organ T to be received by an individual following the intake of radioactive material. For an intake or activity at time t_o, it is defined by the formula:

$$H_T(\tau) = \int_{to}^{to+\tau} H_T\,(t)\,dt$$

where:

$H_T\,(t)$ is the equivalent dose rate in the organ or tissue T at time t;
τ the period over which intake is carried out.

In $H_T(\tau)$, τ is given in years. If the value of τ is not given, for adults it is implicitly taken at fifty years and for children as the number of years remaining until the age of 70.

The committed equivalent dose unit is the sievert (Sv).

Effective dose, committed effective dose and sievert

Effective dose (E) : sum of the weighted equivalent doses delivered by internal and external exposure to the various tissues and organs of the body. It is defined by the formula:

$$E = \sum_{T} w_T H_T = \sum_{T} w_T \sum_{R} w_R D_{T,R}$$

where:

$D_{T,R}$ is the mean for the organ or tissue T of the absorbed dose of radiation R;
w_R is the weighting factor for the radiation R;
w_T is the weighting factor for the tissue or organ T.

The effective dose unit is the sievert (Sv).

Committed effective dose [E(τ)] : sum of the committed equivalent doses in the various tissues or organs [$H_T(\tau)$] following intake, each multiplied by the appropriate weighting factor w_T. It is given by the formula:

$$E(\tau) = \sum_{T} w_T H_T(\tau)$$

In $E(\tau)$, τ is the number of years of integration.

The committed effective dose unit is the sievert (Sv).

The choice made in 1990 by the International Commission on Radiological Protection (ICRP) is to express doses by the effective dose, which is the result of an equivalence calculated in terms of a related risk of radiation-induced fatal cancers and serious genetic consequences. The effective dose E is the result of a second weighting by a factor describing the relative importance of the effects on the tissues in which the dose is distributed. It is thus already the result of a modelling of the risk. The values of w_T are given in the following table.

Tissue or organ	w_T
Gonads	0,20
Red marrow	0,12
Colon	0,12
Lungs	0,12
Stomach	0,12
Bladder	0,05
Breasts	0,05
Oesophagus	0,05
Thyroid	0,05
Liver	0,05
Skin	0,01
Bone surface	0,01
Others[1]	0,05

Comments - The choice of the same unit to express the equivalent dose, defined in an organ, and the effective dose which takes account of all irradiated organs, is frequently a source of confusion.

1. For the calculations, the "other" organs are represented by a list of 12 organs for which selective irradiation is possible by internal contamination. If one of them concentrates most of the radionuclides, a w_T of 0.025 is given to it and a factor of 0.025 assigned to the mean dose received by the other 11 organs.
The sum of the different w_T values is equal to 1, which corresponds to uniform irradiation of the whole body. The w_T values are adapted to the expression of internal contamination.

The effective dose can be used to compare irradiations of different types, with regard to both the nature of the radiation and whether irradiation is overall or partial. On the other hand, the effective dose comprises a weakness: that of not being a measurable value. In the case of external exposure, measurable operational values are defined (ambient equivalent dose, directional equivalent dose, etc.) which will be used to calculate the dose in variable volumes, according to whether or not the radiation is penetrating and according to the effects (dose on the eye, dose on the skin).

The means of calculating the effective dose also has the drawback of having varied with time, in line with the changes made by the ICRP to the w_R and w_T coefficients, which were reviewed in the light of fresh data as it became available. Comparing the effective doses calculated at intervals of several years means that the weighting coefficients used in the calculations must be known for each period.

In the case of internal contamination from a long-lived radionuclide, we use the committed dose (committed equivalent dose or committed effective dose). At the time of contamination, it expresses integration of all the tissue doses, up to complete elimination of the radionuclide or for 50 years in workers and 70 years in children. The committed effective doses are calculated using the dose coefficients of directive 96/29/Euratom published in France in the order of 1 September 2003. Radionuclide by radionuclide, these coefficients give the effective dose (in sieverts) committed per unit of activity taken in, expressed in becquerels.

Collective dose and man.sieverts

The collective dose for a given population or group is the sum of the individual doses in a given population; it is obtained by the formula:

$$S = \sum H_i P_i$$

H_i is the mean of the total doses or the doses in a given organ of the P_i members of the ith subgroup of the population or group.

The collective dose unit is the man.sievert.

Comment - For the ICRP, the advantage of the collective dose is to allow optimisation of exposure to the lowest possible collective level, which contributes to the advancement of society as a whole, with the exception of the cost generated, which was not taken into account. This value, little used in France, was not included in the European and national regulations.

2 Uncertainties

The values recognised for the various weighting factors (w_R and w_T) were chosen from a relatively wide range of values. These are approximations designed to provide a tool for risk management.

The w_R values are taken from physical measurements describing the intensity of ionisation per unit volume, a value which varies with the residual energy along the path. When choosing a single value for a given radiation, account is therefore only taken of the direct biological observations, comparing the effects of this radiation with those of a reference radiation. Depending on the dose level and the biological effects considered, the relative biological effectiveness (RBE) can vary widely. The w_T were also chosen with a view to compromise and simplification. A few numerical values alone characterise them. Some have debatable scientific grounding. Thus the value of 0.2 for the gonads presupposes the existence of genetic effects which have not been observed and the animal experimentation data used are probably highly over-evaluated. Finally, the distribution of the risk among the various organs is primarily the result of epidemiological observations in Hiroshima and Nagasaki and we do not know exactly on what basis these risks should be transposed to a human group with a significantly different way of life.

APPENDIX 2

LIMITS AND DOSE LEVELS

Annual exposure limits contained in the Public Health Code (CSP) and in the Labour Code (CT)

	Definition	Values	Observation
Annual limits for the population Art. R.1333-8 of the CSP	• Effective doses for the body • Equivalent doses for the lens of the eye • Equivalent doses for the skin (average dose over any area of 1 cm^2 of skin, regardless of the area exposed)	1 mSv/year 15 mSv/year 50 mSv/year	☞ These limits comprise the sum of effective or equivalent doses received as a result of nuclear activities. These are limits that must not be exceeded.
Limits for workers over 12 consecutive months Art. R.231-77 of the CT	Adults : • Effective doses for the body • Equivalent doses for the hands, forearms, feet and ankles • Equivalent doses for the skin (average dose over any area of 1 cm^2 of skin, regardless of the area exposed) • Equivalent doses for the lens of the eye Pregnant women (exposure of the child to be born) Young people from 16 to 18 years old* : • Effective doses for the body • Equivalent doses for the hands, forearms, feet and ankles • Equivalent doses for the skin • Equivalent doses for the lens of the eye	20 mSv 500 mSv 500 mSv 150 mSv 1 mSv 6 mSv 150 mSv 150 mSv 50 mSv	☞ These limits comprise the sum of effective or equivalent doses received as a result of nuclear activities. These are limits that must not be exceeded. ☞ As an interim measure, until 31 March 2005, the whole-body limits are set at 35 mSv/12 months, without exceeding 100 mSv over 5 consecutive years. ☞ Exceptional waivers are accepted: • when justified beforehand, they are scheduled in certain working areas and for a limited period, subject to special authorisation. These individual exposure levels are planned according to a upper limit which is no more than twice the annual exposure limit value; • emergency occupational exposure is possible in an emergency situation, in particular to save human life.

* Only if covered by waivers, such as for apprentices.

Optimisation levels for patient protection (Public Health Code)

	Definition	Values	Observation
Diagnostic examinations: Diagnostic reference level Art. R.1333-68, order of 16 February 2004	Dose levels for standard diagnostic examinations	E.g.: entrance dose of 0.3 mGy for an X-ray of the thorax	☞ The diagnostic reference levels, the dose constraints and the target dose levels are used in order to implement the principle of optimisation. They are no more than points of reference. ☞ The reference levels are defined for standard patients by dose levels for standard radiological examinations and by radioactivity levels for radio-pharmaceutical products used in diagnostic nuclear medicine. ☞ The dose constraint can be a fraction of a diagnostic reference level, in particular for exposure in the context of biomedical research or medico-legal procedures. ☞ The target dose level (specialists talk of a target volume in radiotherapy) is used to adjust the equipment.
Dose constraint Art. R.1333-65, order expected in 2005	Used when exposure offers no direct medical benefit to the person exposed		
Radiotherapy: Target dose level Art. R.1333-63	Dose necessary for the target organ or tissue during radiotherapy (experimentation).		

Intervention trigger levels in cases of radiological emergencies (Public Health Code)

	Définition	Valeurs	Observation
Protection of the general public Intervention levels Art. R.1333-80, order of 14 October 2003, circular of 10 March 2000	Expressed in effective dose (except for iodine), these levels are designed to assist in deciding the relevant response to protect the population:		☞ The Prefect can make adjustments to take account of local factors.
	• sheltering	10 mSv	
	• evacuation	50 mSv	
	• administration of stable iodine (thyroid dose)	100 mSv	
Protection of intervention personnel Reference levels Art. R.1333-86	These levels are expressed as effective dose:		
	• for the special teams for technical or medical intervention	100 mSv	☞ This level is raised to 300 mSv when the intervention is designed to prevent or reduce exposure of a large number of people.
	• for the other intervention personnel	10 mSv	

Action trigger levels (Public Health Code and Labour Code)
(Activity or dose levels above which action must be taken to reduce exposure)

	Definition	Values	Observation
Lasting exposure (contaminated sites) Art. R.1333-89 of the CSP IRSN Guide 2000	Selection level: individual dose above which the need for rehabilitation must be examined	Not defined	☞ The notion of selection level is introduced by the IRSN guide for management of industrial sites potentially contaminated by radioactive substances.
Exposure to radon **Protection of the population** Art. R.1333-15 and 16 of the CSP, order of 22 July 2004 **Protection of workers** Art. R.231-115 of the CT	 Premises open to the public Working environment	 400 Bq/m^3 1000 Bq/m^3 400 Bq/m^3	 ☞ See notice published in Official Gazette of 11 August 2004 defining radon measurement methods.
Enhanced natural exposure (excluding radon) **Protection of the population** Art. R1333-13 and 41 of the CSP **Protection of workers** Art. R.231-114 of the CT	 Effective dose	 None 1 mSv/year	 ☞ Any population protection action to be taken will be defined on a case by case basis.
Water intended for human consumption Decree n°2001-1220 of 20 December 2001, order of 12 May 2004	Annual total indicative dose (TID), calculated based on the radioelements present in the water, except for tritium, potassium 40, radon and daughter products. Tritium	0,1 mSv 100 Bq/l	☞ The TID can be used to estimate the exposure attributable to the radiological quality of the water. Any corrective measures to be taken if the TID is exceeded depend on the value of the TID and the radioelements in question. ☞ Tritium is a contamination indicator.
Foodstuffs (emergency situation) European regulations *Codex alimentarius…*	Marketing limits		See table below.

Consumption restrictions on contaminated foodstuffs

In the event of an accident or any other radiological emergency, the restrictions to be placed on the consumption or sale of foodstuffs are determined in Europe by two regulations[1] published in the *Official Gazette* of the European Communities. The purpose of these restrictions is to *"safeguard the health of the population while maintaining the unified nature of the market".*

Thus maximum allowable levels in Bq/kg or Bq/l were set according to the nature of the radioelement concerned, the product concerned and its end-use (baby food, foodstuffs and feedingstuffs).

A list of "minor foodstuffs" was drawn up (foodstuffs for which the annual consumption does not exceed 10 kg). For these products, levels ten times higher are set. These are thyme, garlic, cocoa paste, truffles, caviar, etc.

Foodstuffs or feedingstuffs in which contamination exceeds these levels, may not be sold or exported. Nonetheless, in the event of an accident, "automatic" application of this regulation may not exceed a period of three months, after which time it would be replaced by more specific provisions.

MAXIMUM ALLOWABLE LEVELS FOR FOODSTUFFS (Bq/kg or Bq/l)	**Baby foods**	**Dairy products**	**Other foodstuffs** except those of lesser importance	**Liquids** intended for consumption
Isotopes of strontium, notably ^{90}Sr	75	125	750	125
Isotopes of iodine, notably ^{131}I	150	500	2 000	500
Alpha-emitting isotopes of plutonium and transplutonium elements, notably ^{239}Pu and ^{241}Am	1	20	80	20
All other nuclides of half-life greater than 10 days, notably ^{134}Cs and ^{137}Cs	400	1000	1250	1000

Maximum allowable radioactive contamination levels of feedingstuffs (caesium 134 and caesium 137):

Pork: 1250 Bq/kg
Poultry, lamb, veal: 2500 Bq/kg
Others: 2500 Bq/kg.

The WHO also proposed indicative values to facilitate international trade. The national authorities may use these values as the basis for determining their own thresholds, thus helping to harmonise these intervention criteria.

Indicative values of the *Codex alimentarius* for foodstuffs offered for sale (FA91) Bq/kg

FOODSTUFFS INTENDED FOR GENERAL CONSUMPTION	
Americium 241, plutonium 239	10
Strontium 90	100
Iodine 131, caesium 134, caesium 137	1000
BABY FOOD AND MILK	
Americium 241, plutonium 239	1
Iodine 131, strontium 90	100
Caesium 134, caesium 137	1000

1. * Council regulation (Euratom) n° 3954/87 of 22 december 1987 and following.
Regulation (EEC) No 2219/89.

SUPERVISION OF NUCLEAR ACTIVITIES

CHAPTER 4

1 BNI SUPERVISION

1|1 Scope of supervision
1|1|1 Supervision of nuclear safety
1|1|2 Supervision of radiation protection
1|1|3 BNI design, construction and operation quality
1|1|4 Pressure vessels
1|1|5 Protection of installations against hazards
1|1|6 BNI working conditions

1|2 Supervision procedures
1|2|1 Inspection
1|2|2 Pressure vessel supervision
1|2|3 Technical examination of operator files

1|3 ASN decisions and formal notices
1|3|1 General framework
1|3|2 Formalisation of ASN decisions and formal notices

2 "LOCAL" NUCLEAR SUPERVISION

2|1 Scope of supervision

2|2 Supervision procedures
2|2|1 Radiation protection inspection
2|2|2 Supervision of radiological and biomedical activities
2|2|3 Supervision of radiation sources and installations
2|2|4 ASN examination of the procedures laid down by the Public Health Code

3 OUTLOOK

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

In the particular case of BNIs and the transport of radioactive materials, 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 to justify its actions. This supervision applies to all stages in the life of the installations: design, construction, commissioning, operation, final shutdown, dismantling.

In the other fields known as "local" nuclear fields, the ASN is gradually setting up an inspection process based on the one hand on examination of files concerning procedures stipulated in the Public Health Code, and on the other on a system of nuclear activity radiation protection inspections.

1 BNI SUPERVISION

1|1

Scope of supervision

1|1|1

Supervision of nuclear safety

The ASN's supervisory activities cover all elements contributing to plant safety. Supervision thus concerns both the equipment constituting the installations and those 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 checks 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 also checks the manufacture of pressurized water reactor main primary system (CPP) and main secondary system (CSP) equipment. In accordance with the same principles, it supervises the packages intended for the transport of radioactive materials.

Once the nuclear installation has started operating, all safety-related modifications made by the operator are subject to ASN approval. In addition to meetings 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 (see § 1|2|1).

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 notices. Penalties in such cases may consist in prohibiting restart of a plant or suspending operation until the requisite corrective measures have been taken (see § 1|3).

Finally, the ASN is informed of unforeseen events impacting safety, radiation protection or the environment, such as equipment failures or errors in applying operating rules. The ASN ensures that the operator has carried out a pertinent analysis of the event and taken appropriate steps to remedy the situation, prevent it happening again and ensure that experience feedback is sent out to the operators.

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 (DRIREs). The DSNR 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 DSNR also examine certain authorisation or waiver applications and conduct an initial examination of incident reports. The DGSNR is responsible for coordinating and steering the DSNR in these areas, deals with all matters of national importance and defines and implements national nuclear safety policy.

1 | 1 | 2

Supervision of radiation protection

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

In the BNIs, the ASN therefore monitors application of the regulations concerning protection of individuals against ionising radiation. As with nuclear safety, this work takes place for the entire duration of the life of the nuclear installations. The aim is to ensure that the operator takes all steps to monitor and limit the doses received by the persons working in the installations.

The ASN ensures compliance with these rules by ensuring that the principles of radiation protection are followed on the various work sites, by examining specific files and through dedicated inspections. Defining and implementing criteria for declaration of radiation protection related events, common to all operators, makes it easier to notify the ASN of any abnormal situations encountered.

1 | 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 elaborate, obtain and maintain plant and operating quality standards compatible with safety requirements.

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

The quality order also requires:
- that detected discrepancies and incidents be thoroughly corrected and that preventive action 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.

1|1|4

Pressure vessels

A large number of nuclear plant systems contain pressurised fluids and are consequently subjected to general pressure vessel regulations (see chapter 3, § 2|2|1).

At central government level, responsibility for supervising application of the regulations lies with the ASN for nuclear pressure vessels containing radioactive products inside BNIs, and the Directorate for Regional Action, Quality and Industrial Safety (DARQSI) 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 of particular importance. 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:
- with regard to the design and construction phase, on the order of 26 February 1974 for the main primary system (CPP) and on basic safety rule II.3.8 of 8 June 1990 for the main secondary systems (CSP);
- with regard to the operating phase, on the order of 10 November 1999 which collates the requirements applicable to these 2 types of systems.

Pressure vessel operation is supervised. This supervision in particular applies to the in-service surveillance programmes, non-destructive testing, maintenance work, disposition of nonconformities affecting the systems and periodic post-maintenance testing of the systems. The principal PWR main and secondary system files currently being dealt with are discussed in Chapter 12.

1|1|5

Protection of installations against hazards

BNI operation can entail detrimental effects and risks for the environment in the broadest sense, that is for the surrounding installations and their workers, but also for the public and the environment off the site. The policy conducted by the ASN with respect to environmental protection is described in Chapter 5. It primarily aims to prevent and minimise the risks for the installations by ensuring that the following are applied:
- the decree of 11 December 1963 concerning BNIs, clarified by its implementing order of 31 December 1999, which in particular sets the rules concerning risks related to fire, lightning, criticality and radiolysis applicable to all nuclear equipment, including that located outside the sensitive parts of the BNIs;
- the legislation concerning installations classified on environmental protection grounds and included within the perimeter of BNIs.

1|1|5|1

Protection against the risk of fire

The fire risk is specifically dealt with by articles 41 to 44 of the order of 31 December 1999 mentioned above. The relevant provisions of the order lead in particular to a change in certain principles of protection against the risk of fire (for example sectorisation) defined previously by the basic safety rules alone (RFS I.4.a for installations other than reactors and RFS V.2.f and RFS V.2.j for pressurised water reactors). The purpose of the order is to define the objectives, while that of the

RFS is to specify the practical aspects, in particular in terms of risk studies. After examining the conformity studies submitted by the operators, the ASN found that the application of certain articles left considerable room for interpretation and led to differences between the operators. In order to draft a guide for implementation of the order on this subject, the ASN set up a working group which met 6 times during the course of 2004, with the aim of ensuring consistent application of the order of 31 December 1999. Given the impact of these provisions on the structure of the existing installations, the project is being discussed with the nuclear operators. Once this work is completed, the corresponding RFS will have to be adapted.

1 | 1 | 5 | 2

Protection against lightning

Article 35 of the order of 31 December 1999 enables the general rules for protection against the direct effects of lightning to be applied to nuclear equipment. The various operators therefore reviewed their installations through "lightning" studies and proposed conformity work for those installations which so required. The nonconformities are currently being analysed by the ASN.

1 | 1 | 5 | 3

Prevention of risks related to criticality, thermal effects and radiolysis

Articles 45 to 47 of the order of 31 December 1999 are used to set the rules applicable to nuclear equipments so as to prevent all criticality accidents, take account of the risk of radiolysis and to require the use of cooling systems that are reliable enough to avoid the harmful effects of the release of heat. Radiolysis entails the production of hydrogen from hydrated materials subjected to radiation. When these materials are enclosed in leaktight containers, the production of hydrogen can lead to pressurisation of the first containment barrier or to explosion.

1 | 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's nuclear power plants, supervision is carried out by DRIRE agents under the authority of the Directorate for Energy Demand and Energy Markets (DIDEME) at the Ministry for the Economy, Finance and Industry, by delegation of the Ministry for Labour. The DRIRE agents undertaking these tasks may also be BNI inspectors.

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. Whenever necessary, the ASN and the DIDEME therefore aim to co-ordinate their respective actions.

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.

1 | 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.

1 | 2 | 1

Inspection

1 | 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 safety or radiation protection.

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

- nonconformities in 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, DRIRE and 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 of the DRIREs, 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 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 an 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 for those matters for which the possibility of penal sanctions exists.

1 | 2 | 1 | 2

2004 activities

· Inspection practices

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, or for other work in particular during the dismantling phase.

It is to be noted that the more complex inspections are directed by senior inspectors (see Chapter 3).

· Inspections in 2004

As at 31 December 2004, there were 143 BNI inspectors, including 72 with the DRIREs and 70 at the DGSNR, with 1 on assignment with foreign safety authorities (United Kingdom). The list of these inspectors is given in Appendix A.

In 2004, 757 inspections were conducted, 215 of which were unannounced. The breakdown of the various categories of installations is described in the graph below.

Of the topics dealt with, the following had high priority for 2004 and will be reviewed:

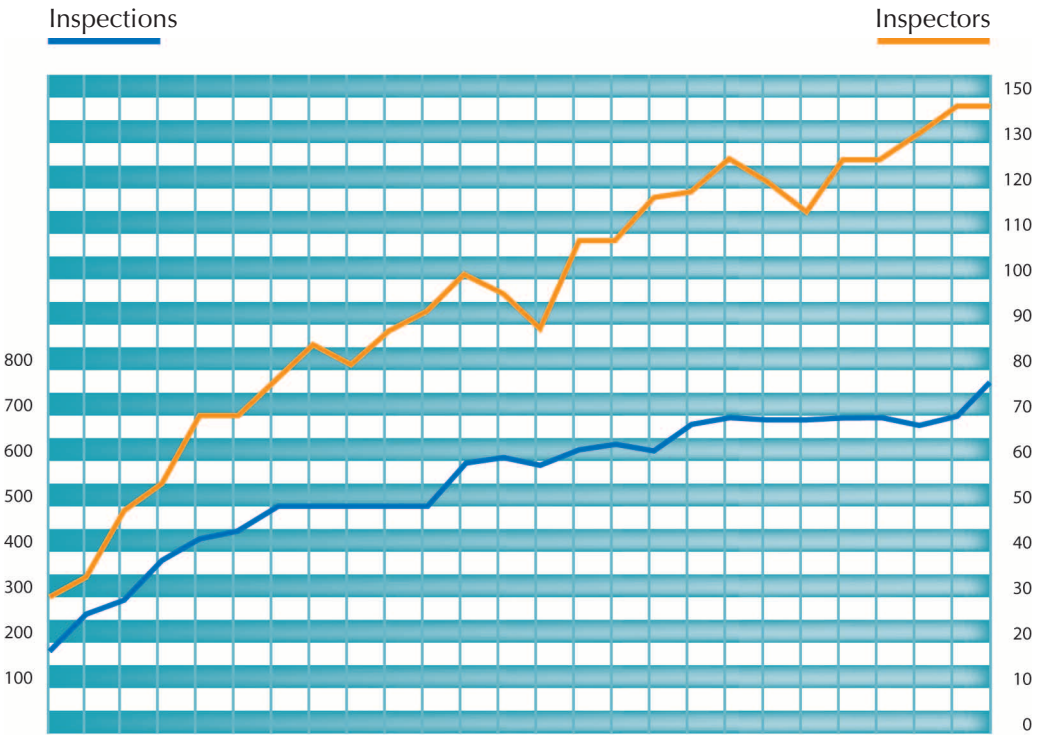
BNIs:	
- Safety committee and internal authorisations system	5 inspections
- Containment/static, ventilation	32 inspections
- ICPEs and general environmental provisions	32 inspections
- Emergency response (including PUI)	20 inspections
- Maintenance (including periodic checks and tests)	49 inspections
- BNI waste	27 inspections
Transport:	
- Conformity with certificate	10 inspections
- Worker exposure	3 inspections
- Maintenance	2 inspections
- Air transport	27 inspections

1 | 2 | 2

Pressure vessel supervision

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

Trends in numbers of inspectors and of inspections

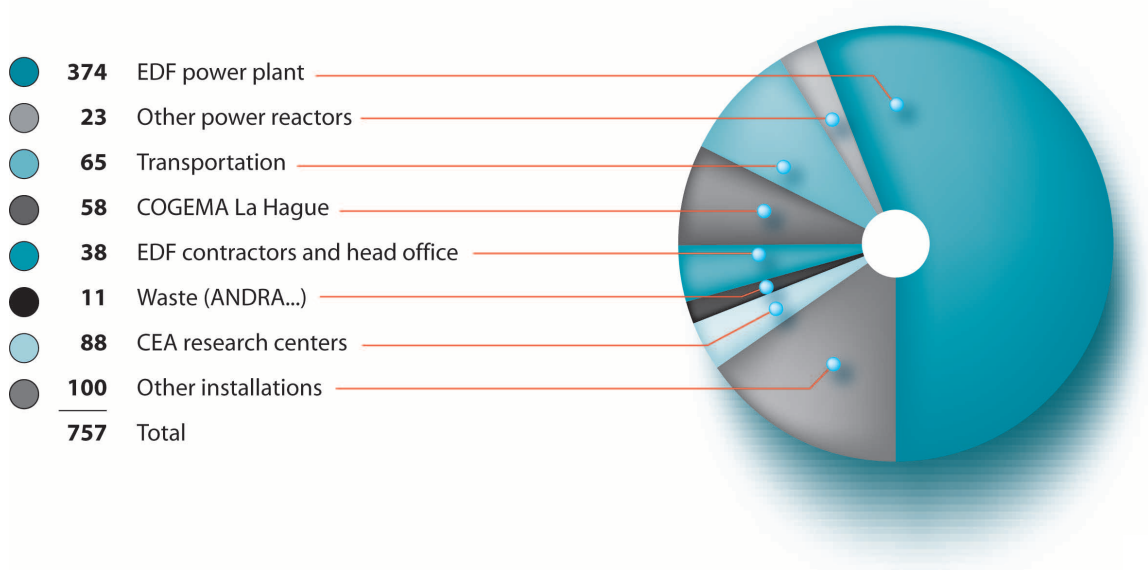


Year	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	00	01	02	03	04
Number of inspectors	29	34	49	54	68	69	78	85	80	87	91	98	95	89	106	107	114	117	125	118	113	124	124	129	143	143
Number of inspections during the year	187	257	298	379	432	443	500	497	495	498	490	595	605	576	614	622	615	667	693	674	667	678	674	666	670	757

Note:

This table does not take account of the surveillance inspections carried out by the DGSNR on behalf of the Defence High Official of the Ministry for Industry and which concern protection against malicious acts. Action taken further to these inspections is the responsibility of the Defence High Official.

Breakdown of inspections carried out in 2004



It directly supervises the construction (design and manufacture) of the main primary and secondary systems (see Chapter 12). In-service supervision of the main primary and secondary systems, as of all other pressure vessels, is the responsibility of the relevant DRIRE.

1 | 2 | 3

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.

1 | 2 | 3 | 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 to be 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 DRIREs, which check that corrective provisions have been duly implemented without delay and make the requisite preparations for informing the public in cases where this is necessary. The ASN ensures co-ordination of DRIRE action in this field and provides suitable training courses each year for the engineers concerned.

Assessment of a significant incident by the DRIREs 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 DRIREs 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.

Given the importance for safety of the maintenance work done during the outage and the safety hazards involved in certain outage situations, the ASN requires detailed information from the operator. This information mainly concerns the work programme involved (see Chapter 12) and any anomalies observed during the outage. During "work site inspections", the inspectors will carry out spot checks on the conditions in which work is done on the various work sites, whether installations repair or modification, in-service supervision of equipment or periodic equipment tests.

Approval of outage programmes has been a DRIRE 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 periodically submits activity reports and summaries concerning water intake and liquid and gaseous effluent 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 subcontractors, etc.

1 | 2 | 3 | 2

Evaluation of the 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 DGSNR and the DRIREs have 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 co-ordination structures to highlight the essential safety issues. The IRSN assessment relies on research and development programmes and studies focused on risk prevention and improving our knowledge 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 2. 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.

1 | 3

ASN decisions and formal notices

1 | 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: complete and exhaustive arguments must be submitted. 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 information or additional commitments on the part of the operator;
- 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.

1 | 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 2004, we can for example mention the decision of 3 February 2004 concerning vibration fatigue cracking of the valve nozzles installed on safety-related systems of PWR reactors. The decision asked that within the next 3 years, EDF assess the consequences of cracking of these valve nozzles for the safety of the reactors and draw the necessary conclusions. For a particular valve in the 1300 MWe reactors, the decision requires treatment during the second ten-yearly outages of these reactors, given the large numbers of cases of cracking detected.

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 frame 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.

On 15 December 2004, formal notice was served on EDF. It concerned the Creys-Malville site and required EDF to take the necessary action within 2 months for real-time management of all alarms from the spent fuel removal shop (APEC).

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.

2 "LOCAL" NUCLEAR SUPERVISION

2 | 1

Scope of supervision

Decree 2002-255 of 22 February 2002 stipulates that, jointly with the competent government departments, the DGSNR is responsible for preparing and implementing all measures for preventing or mitigating health risks linked to exposure to ionising radiation, in particular by drafting and monitoring

implementation of technical regulatory provisions concerning radiation protection, except with regard to worker protection against ionising radiation.

This decree also states that, without compromising the inspections provided for in the Labour Code and the Environment Code, the DGSNR is responsible for organising radiation protection inspections stipulated by the Public Health Code and by the law of 2 August 1961 and its implementation decrees, and for co-ordinating all radiation protection checks in the industrial, medical and research fields, including by monitoring the sources of ionising radiation used in these applications.

The scope of radiation protection supervision exercised by the DGSNR therefore encompasses the use of ionising radiation in all nuclear activities, as defined in article L.1333-1 of the Public Health Code and exposure to natural radiation likely to be enhanced by human activity. This function is conducted jointly with other inspection organisations, such as the Labour inspectorate, the inspectorate for installations classified on environmental protection grounds and the inspectorate of the French Health Products Safety Agency (AFSSAPS). The AFSSAPS is competent to issue licences for the manufacture, possession, distribution, import and export of radionuclides intended for medical purposes and for performing tests on devices emitting ionising radiation also intended for medical purposes. With regard to exposure to natural radiation, the supervisory function is mainly entrusted to ASN inspectors, and to DDASS and DRASS staff.

2 | 2

Supervision procedures

The ASN aims to set up supervision based on the one hand on radiation protection inspections and on the other on examination of documents produced by the users of ionising radiation, under the licensing procedures stipulated by the Public Health Code (articles R. 1333-1 to R. 1333-54) recalled in Chapter 2.

2 | 2 | 1

Radiation protection inspection

Responsibility for supervision of radiation protection lies with the Minister for Health and the Minister for Labour. Decree 2002-255 of 22 February 2002 amending decree 93-1272 of 1 December 1993 and creating the DGSNR entrusts this latter, under the authority of the above-mentioned ministers, with responsibility for defining and implementing radiation protection policy.

Within this framework, the DGSNR strives to organise and develop radiation protection inspection outside BNIs. The supervision priorities are identified in parallel with definition of the intervention procedures and deployment of the necessary manpower.

2 | 2 | 1 | 1

ASN preparation for a radiation protection inspection

Various missions were carried out in 2003:
- the “reconnaissance” mission initiated in the DRIREs of the Basse-Normandie and Rhône-Alpes regions, in order to introduce the practice of radiation protection supervision into the “local” nuclear field;
- the Vroussos mission which proposed action priorities in the radiation protection field;
- the working group comprising representatives of the DRIREs, DRASS and DDASS, responsible for drafting procedures for co-operation by these entities in this field;
- the working group comprising representatives of the ASN, the DARPMI and the DRIREs, responsible for considering the future organisation of the DRIREs once their manpower levels are increased to deal with radiation protection supervision.

2004 was an opportunity to implement a number of recommendations from these groups:
- as a result of the increased workforce devoted to radiation protection, all the DSNRs were in 2004 able to begin reconnaissance in their regions, making contact with the various users of radioactive sources. The DSNR which had acquired experience in the previous years were able to initiate inspection programmes in industry, particularly concerning gammagraphy, as well as in hospitals;
- the report from the DDASS/DRASS/DRIRE working group helped in the preparation of the circular of 29 July 2004 concerning the DDASS and DRASS radiation protection missions;
- with regard to radiation protection inspection in the ICPEs, a circular was published on 19 January 2004 and the director for the prevention of pollution and risks and the ASN general director signed a joint note on inspection procedures on 16 June 2004;
- a number of recommendations from the Vroussos commission were incorporated either into the government's national health and environment plan (radon) adopted in June 2004 or are being incorporated into the PNGDR or the PASEPRI. Others contributed to guiding the ASN's inspection priorities (industrial gammagraphy) or will be taken into account in the ASN entities action plans in 2005.

2 | 2 | 1 | 2

Setting up radiation protection inspections

Article 82 of law 2004-806 of 9 August 2004 concerning public health policy, as published in the Official Gazette of 11 August 2004 introduced new measures into the Public Health Code (articles L.1333-17 to L.1333-19 and article L.1336-1-1) creating the post of radiation protection inspector. These measures were presented by the Minister for Health and Social Protection in a second reading to the National Assembly and the Senate.

Only a law could give the ASN agents the prerogatives they needed, in particular since the Council of State cancelled article 3 of the decree instituting the DGSNR. This provision had initially been included in the nuclear transparency and safety bill and then in the energy bill and was finally incorporated into the law on public health policy, which was a particularly appropriate framework for completing the ionising radiation chapter of the Public Health Code.

As specified in the new article L.1333-17 of the Public Health Code, the radiation protection inspectors will, for a given nuclear activity, be required at the same time to check application of the provisions of the Public Health Code and the Labour Code concerning radiation protection. For example, they will be able simultaneously to check the rules for management of the radioactive sources held in a given place along with the measures taken for radiation protection of the workers handling these sources.

The radiation protection inspectors now have the policing powers defined in the new article L.1336-1-1 of the Public Health Code. The penal sanctions applicable in the event of a breach had already been introduced into articles L.1336-5 to L.1336-9 by the ordinance of 28 March 2001 which transposed the Euratom directives.

By creating this type of inspection, the law on public health policy thus completes the ionising radiation chapter of the Public Health Code.

The radiation protection inspectors will be selected from departments already carrying out inspections in places or premises using ionising radiation for their industrial applications (such as basic nuclear installations or non-destructive testing of welds) or its therapeutic appli-



Radiographer workstation inspection – Health centre in Forcilles (77)

cations (such as nuclear medicine departments) or in premises in which there is enhanced exposure to natural ionising radiation (exposure to radon for instance).

In 2004, the inspections more particularly covered the following topics:
- manufacture and distribution of radioactive sources;
- management and use of unsealed radioactive sources;
- management and use of sealed radioactive sources;
- organisation of radiation protection;
- waste and effluent from non-BNI nuclear activities.

2 | 2 | 2

Supervision of radiological and biomedical activities

2 | 2 | 2 | 1

Purpose and nature of installation supervision

The purpose of the radiation protection checks is to regularly evaluate the radiological safety of installations that use ionising radiation sources, to check its level with respect to current regulations, and if necessary to reinforce it. For medical applications, the ASN carries out the various checks on the radiology, radiotherapy, brachytherapy and nuclear medicine installations, or has them carried out.

Apart from the checks it carries out itself, the ASN calls on the services of the organisations appearing on a list drawn up by the Ministers for Health, Labour and Agriculture, to check medical and dental radiology installations. These approved organisations - 30 in 2004 - must carry out their inspections in accordance with specifications taking account of the specific nature of the medical and dental radiology installations. The inspection reports must be systematically enclosed with the approval application and their installation declaration dossiers, if necessary accompanied by a report confirming implementation of measures to remedy the inadequacies observed during these inspections.

The inspections performed directly by the ASN in the radiotherapy, brachytherapy and nuclear medicine installations fall within the context of procedures for issue (pre-commissioning inspections) or renewal (periodic inspections) of the licences required for possession and utilisation of radioactive sources, granted on the basis of article R.1333-24 of the Public Health Code. Conformity with the measures requested by the ASN further to these inspections determines whether licence notification is obtained. The number and nature of the inspections conducted in 2004, broken down per type of medical installation, is given below. A total of 200 inspections were carried out in 2004.

Summary of medical installation inspections

	Commissioning	Periodic	After incident	Total
Accelerator	33	55	0	88
Cobalt	0	10	0	10
Brachytherapy	6	27	1	34
Nuclear medicine	15	48	0	63
Irradiators	0	3	0	3
Radiology	0	4	0	4
Total	54	147	1	202

The various inspections conducted directly or indirectly by the ASN are supplemented by radiation protection checks, which can be performed by the person competent for radiation protection, designated and authorised by the head of the site, by approved inspection organisations or by the IRSN. On the basis of the provisions of the Health and Labour Codes, decree 2001-1154 of 5 December 2001 concerning medical devices and the order of 30 October 1981 concerning nuclear medicine installations (unsealed sources), the following tables specify the various operators liable to be involved, depending on the nature of the sources, the installations and the type of inspection to be performed.

Electrical generators in medical radiology

Nature of inspections	Public Health Code (art. R. 1333-7 and R. 1333-43) Inspection of the organisation and technical devices allowing compliance with radiation protection rules	Labour code (art. R. 231-84) Inspection of sources and appliances, protection and alarm systems and measuring instruments (art. R. 231-86) Ambient inspection
	Inspector	Inspector
Inspection on reception in the establishment (1)		Appliances, protection and alarm systems and measuring instruments: IRSN or organisation approved (R. 1333-43) by DGSNR/DRT or person with competence for radiation protection (PCR)
Pre-commissioning inspection	Radiology installation(2): organisation approved (R. 1333-43) by DGSNR/DRT	Appliances, protection and alarm systems and measuring instruments: IRSN or organisation approved (R. 1333-43) by DGSNR/DRT or person with competence for radiation protection (PCR)
After overshoot of public or worker exposure limits	DGSNR(3)	Labour inspectorate and/or DGSNR(3)
After formal notice	Organisation chosen by examining service (DGSNR, prefect)	Organisation chosen by labour inspectorate or check by DGSNR and labour inspectorate
After modification	Radiology installation: organisation approved (R. 1333-43) by DGSNR/DRT	Appliances, protection and alarm systems and measuring instruments: IRSN or organisation approved (R. 1333-43) by DGSNR/DRT or person with competence for radiation protection (PCR)
Périodique	Radiology installation: organisation approved (R. 1333-43) by DGSNR/DRT.	Appliances(4): organisation approved by AFSSAPS, Protection and alarm systems and measuring instruments: IRSN or organisation approved (R. 1333-43) by DGSNR/DRT Inspection frequency: yearly
Ambient inspection in supervised area		Organisation approved (R. 1333-43) by DGSNR/DRT or person with competence for radiation protection (PCR) Inspection frequency: one month to one year

(1) This is an inspection of the performance of the protection systems.
(2) The installation inspection concerns the premises and all means employed for radiation protection.
(3) Measure not specifically mentioned in the Public Health and Labour Codes (radiation protection sections).
(4) In the case of medical devices such as radiology appliances, decree 2001-1154 of 5 December 2001 requires appliance internal and external quality controls, the performance of which is checked by organisations approved by the AFSSAPS. This inspection is equivalent to the periodic inspection required in article R. 231-84 of the Labour Code.

Radiotherapy and nuclear medicine units

Nature of inspections	Public Health Code (art. R. 1333-7 and R. 1333-43) Inspection of the organisation and technical devices allowing compliance with radiation protection rules	Labour Code (art. R. 231-84) Inspection of sources and appliances, protection and alarm systems and measuring instruments (art. R. 231-86) Ambient inspection
	Inspector	Inspector
Inspection on reception in the establishment (1)		Appliances, protection and alarm systems and measuring instruments: IRSN or organisation approved (R. 1333-43) by DGSNR/DRT or person with competence for radiation protection (PCR)
Pre-commissioning inspection	Radiotherapy or nuclear medicine installation(2) : DGSNR	Appliances, protection and alarm systems and measuring instruments: IRSN or organisation approved (R. 1333-43) by DGSNR/DRT or person with competence for radiation protection (PCR)
After overshoot of public or worker exposure limits	DGSNR(3)	Labour inspectorate and/or DGSNR(3)
Sur mise en demeure	Organisation chosen by examining service (DGSNR, prefect)	Organisation chosen by labour inspectorate or check by DGSNR and labour inspectorate
After formal notice	Radiotherapy or nuclear medicine installation: approved organisation (R. 1333-43) or DGSNR	Appliances, protection and alarm systems and measuring instruments: IRSN or organisation approved (R. 1333-43) by DGSNR/DRT or person with competence for radiation protection (PCR)
After modification	Radiotherapy or nuclear medicine installation: approved organisation (R. 1333-43) or DGSNR.	Appliances(4): organisation approved by AFSSAPS, Appliances, protection and alarm systems and measuring instruments: IRSN or organisation approved (R. 1333-43) by DGSNR/DRT Inspection frequency: yearly
Cessation of activity	DGSNR (check on future of sealed sources)	Organisation approved (R. 1333-43) by DGSNR/DRT or person with competence for radiation protection (PCR) for certification of radiological cleanness if unsealed sources are used (nuclear medicine)
Ambient inspection in supervised area		Organisation approved (R. 1333-43) by DGSNR/DRT or person with competence for radiation protection (PCR) Inspection frequency: one month to one year

(1) This is an inspection of the performance of the protection systems.
(2) The installation inspection concerns the premises and all means employed for radiation protection.
(3) Measure not specifically mentioned in the Public Health and Labour Codes (radiation protection sections).
(4) In the case of medical devices such as radiology appliances, decree 2001-1154 of 5 December 2001 requires appliance internal and external quality controls, the performance of which is checked by organisations approved by the AFSSAPS. This check is equivalent to the periodic inspection required in article R. 231-84 of the Labour Code.

2 | 2 | 2 | 2

Nature of checks during supervision

Given the specific nature of medical installations and the procedures applicable to radiation protection supervision, the checks to be performed in the radiology, radiotherapy and nuclear medicine fields chiefly concern:
- the installation conditions, with examination of compliance with the standards and rules applicable to each type of installation (floor area of premises, nature and thickness of walls, arrangement of rooms, types of flooring and wall coverings, ventilation, etc.);
- measurement of the radiation field around the radiology and radiotherapy installations and search for radioactive contamination if artificial radionuclides are used in unsealed sources (nuclear medicine or biomedical research). These operations require the use of portable dedicated radiation protection appliances (ionisation or scintillation chamber type radiation meters to measure gamma rays, X-rays or neutrons, and a surface contamination detector);
- whether safety and protective equipment appropriate to each installation is installed and functional (illuminated and/or audible signalling, marking out of monitored and controlled areas, emergency stop systems, door safeties, radioactive source handling and storage chambers, portable radiation protection equipment, leaded aprons and gloves, etc.);
- whether procedures covering handling of radiation sources and safety instructions such as to guarantee permanent radiation protection of the users of the installation, the public and the environment exist and are implemented;
- the procedures for management of the radioactive sources used and the radioactive waste and effluents produced (accounting of source movements, traceability of waste and effluents, etc.);
- monitoring of external and/or internal exposure of the personnel classified A for radiation protection purposes using sources of radiation (individual, photographic and electronic dosimetry, radiotoxicological analysis, anthropogammametry), and appropriate medical follow-up of this personnel;
- the conformity of the appliances emitting ionising radiation with the rules in force (CE marking, type approval, certification, etc.), and appropriate maintenance to ensure that their initial characteristics and performance are maintained as time goes by.

2 | 2 | 3

Supervision of radiation sources and installations

2 | 2 | 3 | 1

Design checks and source monitoring

The checks applied to radiation sources depend on the nature of the source and the stage of production and utilisation reached.

Design checks
For unsealed sources, which can be considered "consumables", supervision will chiefly take place during manufacture, with the user checking that the products delivered correspond to the support documents and the purchase order.
The sealed sources, generally delivered in their source-holder, which is an integral part of an appliance, undergo a series of checks during the various stages of their existence:
- checks by the manufacturer to establish the source characteristics and the integrity of the packaging for the intended uses. The manufacturer therefore draws up a certificate in particular specifying the activity and nature of the radionuclide, the date of manufacture of the source, its type, its identification number, the manufacturer's identifier and conformity with a standard as applicable;
- radiation protection checks on appliances containing sources before there are marketed (presence of markings, isodose measurements, check on correct operation of safety devices, radiation beam masking systems, etc.). These checks are conducted either by the manufacturers, or by the organisations recognised by the ASN.

Source monitoring

In accordance with the requirements of the Public Health and Labour Codes, regular radiation protection checks must be carried out at the various stages of the life of the sources. They are conducted by the person with competence for radiation protection, appointed and empowered by the head

Table 9: source inspectors

Nature of inspections	Public Health Code (art. R. 1333-7 and R. 1333-43) Inspection of the organisation and technical devices allowing compliance with radiation protection rules	Labour Code (art. R. 231-84) Inspection of sources and appliances, protection and alarm systems and measuring instruments (art. R. 231-86) Ambient inspection
	Inspector	Inspector
Inspection on reception in the establishment (1)		Appliances, protection and alarm systems and measuring instruments: IRSN or organisation approved (R. 1333-43) by DGSNR/DRT or person with competence for radiation protection (PCR)
Pre-commissioning inspection	Installation using sources of ionising radiation(2): organisation approved (R. 1333-43) by DGSNR/DRT	Appliances, protection and alarm systems and measuring instruments: IRSN or organisation approved (R. 1333-43) by DGSNR/DRT or person with competence for radiation protection (PCR)
After overshoot of public or worker exposure limits	DGSNR(3)	Labour inspectorate and/or DGSNR(3)
After formal notice	Organisation chosen by examining service (DGSNR, prefect)	Organisation chosen by labour inspectorate or check by DGSNR and labour inspectorate
After modification	Installation using sources of ionising radiation(2): organisation approved (R. 1333-43)	Appliances, protection and alarm systems and measuring instruments: IRSN or organisation approved (R. 1333-43) by DGSNR/DRT or person with competence for radiation protection (PCR)
Periodic	Installation using sources of ionising radiation(2): organisation approved (R. 1333-43) by DGSNR/DRT	Appliances, protection and alarm systems and measuring instruments: IRSN or organisation approved (R. 1333-43) by DGSNR/DRT Inspection frequency: yearly
Cessation of activity	DGSNR (check on future of sealed sources)	Organisation approved (R. 1333-43) by DGSNR/DRT or person with competence for radiation protection (PCR)for certification of radiological cleanness if unsealed sources are used
Ambient inspection in supervised area		Organisation approved (R. 1333-43) by DGSNR/DRT or person with competence for radiation protection (PCR)Inspection frequency: one month to one year

(1) This is an inspection of the performance of the protection systems.
(2) The installation check concerns the premises and all means employed for radiation protection.
(3) Measure not specifically mentioned in the Public Health and Labour Codes (radiation protection sections).

of the establishment, by approved monitoring organisations or by the IRSN. These checks do not stand in the way of those carried out directly by the ASN as part of its inspection duties concerning licence renewal or modification, or in the event of a source loss or theft incident. Table 9 (precedent page) specifies the various operators likely to be involved, depending on the nature of the sources, the installations and the type of inspection to be performed.

2 | 2 | 3 | 2

ASN checks carried out in 2004

During the course of 2004, the ASN carried out 59 visits to industrial or research establishments using sources of ionising radiation, 16 of which concerned companies distributing radionuclide sources, and one BNI (with respect to radioactive source management). The number and nature of inspections, broken down per type of installation, are given in the table below.

These checks are in particular designed to compare the data in the dossiers with the actual situation (source inventory, check on conditions of production, distribution or utilisation of the sources and appliances containing them). They also enable the ASN to ask the establishments to improve their in-house provisions for source management and radiation protection.

Reactive inspections were also organised further to incidents and a number of inspections were carried out jointly with the inspectorate of installations classified on environmental protection grounds and/or the Labour inspectorate.

Summary of industrial and research installation inspections

Industrial or research establishments	41
Establishments supplying radioactive sources	16
BNI and transports (topic: radioactive source management)	2
Total	**59**

2 | 2 | 4

ASN examination of the procedures laid down by the Public Health Code

It is up to the ASN to examine applications for the use of ionising radiation for medicine, dentistry, human biology and biomedical research, as well as for any other nuclear activity. The ASN also deals with the specified procedures for the acquisition, distribution, import, export, transfer, recovery and disposal of radioactive sources.

ASN actions in this field in 2004 are explained in chapters 9 and 10.

3 Outlook

2004 was marked by the publication of law 2004-806 of 9 August 2004 concerning public health policy and giving radiation protection inspections a legal basis incorporated into the Public Health Code. A decree currently being drafted and a circular will specify the conditions in which the inspectors are appointed. 2005 will see the nomination of the first radiation protection inspectors. The inspectors, the numbers of whom will rise as the planned recruitment plan is implemented, will be able to

carry out their duties as part of a programme of inspection of the various activities using ionising radiation which has already been drawn up by the ASN.

Alongside these radiation protection inspection efforts, the ASN is continuing to improve supervision of nuclear safety as part of its continuous progress goal.

Finally, article R. 1333-13 of the Public Health Code and article R. 231-114 of the Labour Code now make it obligatory to assess exposure of the population and the doses received by workers resulting from professional activities entailing exposure to enhanced natural radiation. In application of these articles, the DGSNR is preparing an order listing the industrial installations concerned. These installations will be required to carry out individual workplace studies taking account of external exposure (gamma radiation), internal exposure through ingestion of dust and inhalation of radon, and an assessment of the impact on the surrounding populations.

ENVIRONMENTAL PROTECTION

CHAPTER 5

1 FIELD OF ACTION

2 MONITORING RADIOACTIVITY IN THE ENVIRONMENT

2 | 1 Laboratory approval

2 | 2 Creation of the national network for environmental radioactivity measurement

2 | 3 Information of the public

2 | 4 The radiological quality of water intended for human consumption

3 BNI EFFLUENT RELEASES

3 | 1 The regulatory context of BNI effluent releases

3 | 2 ASN policy concerning BNI release licences

3 | 3 The impact of nuclear facilities

3 | 4 The ASN's primary scope of work

3 | 5 Progress with implementation of decree 95-540

3 | 6 Accounting and monitoring of radioactive releases

3 | 7 The other releases from nuclear installations

4 RELEASES FROM OTHER INSTALLATIONS

5 PREVENTION OF HARMFUL EFFECTS

5 | 1 Application of the order of 31 December 1999 concerning environmental protection

5 | 2 Prevention of water pollution

5 | 3 Protection against noise

5 | 4 Protection against the microbiological risk (legionella, amoebae)

5 | 4 | 1 Legionella

5 | 4 | 2 Amoebae

6 WASTE STUDIES

7 ENVIRONMENTAL INCIDENTS

8 OUTLOOK

1 FIELD OF ACTION

Under decree 2002-255 of 22 February 2002, which created the Directorate General for Nuclear Safety and Radiation Protection (DGSNR), the Directorate is in particular responsible for:

- organising a permanent radiation protection watch, in particular through radiological monitoring of the environment nationwide;

- supervising gaseous and liquid effluent releases and waste from basic nuclear installations.

Nuclear safety, radiation protection and environment concerns share the same goal of protecting workers, the public and the environment against the risks inherent to nuclear activities. Thanks to this regulatory change which confirms the broader view of nuclear safety, the ASN can now tackle the issues of safety, radiation protection and the environment in a more general way, using an integrated approach and calling on the same tools (inspections) and applying the same requirements of thoroughness, competence, transparency and independence.

With regard to the environment, the ASN's actions are primarily focused on 3 areas:

- monitoring radioactivity in the environment with a view to informing the population of the health impact of nuclear activities in France;

- minimising the dispersal into the environment of radioactivity and toxic substances from the nuclear industry. This involves strict control of effluent releases and waste management. The ASN supervises the release of liquid and gaseous radioactive effluents from the BNIs;

- the prevention and limitation of harmful effects and hazards resulting from the operation of basic nuclear installations (BNIs), as of inconvenience to the neighbourhood or for public health, safety and hygiene, agriculture, nature and environment protection purposes, or for conservation of sites and monuments.

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 procedures 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 new release permits issued since that of the Saint-Laurent nuclear power plant (2 February 1999) reflect this policy.

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.

2 MONITORING RADIOACTIVITY IN THE ENVIRONMENT

Article R. 1333-11 of the Public Health Code provides for the creation of a national network of environmental radioactivity measurements in order to help estimate the doses to which the population is subjected as a result of all nuclear activities. The creation of this network is meant to meet two major objectives: to create a quality policy for radioactivity measurement and to increase the transparency of information concerning the health impact of nuclear activities in France. The plan is to create a web portal to inform the public of those laboratories authorised to work in the nuclear sector and the results of the surveillance measurements taken throughout the country. To this end, the DGSNR is responsible, once it has obtained the opinion of a steering committee, for setting the guidelines for the national network, management of which has been entrusted to the IRSN.

The initial action taken by the DGSNR following publication of the order of 17 October 2003 clarifying the organisation of the national network and the approval procedures for the measurement laboratories, consisted in setting up the national network steering committee and the radioactivity measurement laboratories approval board.

The members of these two bodies, appointed by joint order of the Minister for Health, in particular comprise representatives of the ministries for health, the environment, consumer affairs, agriculture and defence, representatives of national agencies dealing with health and environmental issues, such as the InVS, AFSSE and AFSSA, and representatives of measurement laboratories from industry and various associations.

The first meeting of the laboratories approval board was in January 2004 while that for the Steering Committee was held in June 2004. Given the programme for future inter-comparisons, the Board will be required to meet at least twice a year.

Work began on revision of the 17 October 2003 order to take account of the lessons learned during examination of the initial approvals. The draft of the revised order, presented to the Steering Committee in November 2004, was extensively discussed with the various stakeholders in the network at the end of 2004.

2 | 1

Laboratory approval

In 2004, the DGSNR's primary goal was to ensure the continuity of the work done for technical qualification of the laboratories, previously handled by the Ministry for Health, with the technical support of the OPRI for organising inter-laboratory tests. To do this, the DGSNR together with the IRSN for organisation and processing of inter-comparisons between laboratories, focused on defining the table of approvals and the criteria for issuing approvals to the environmental radioactivity measurement laboratories subsequently accepted by the approval Board. Two types of criteria, one technical concerning statistical processing of inter-comparison results, the other concerning the quality system implemented within the laboratories, are used to obtain a picture of the technical and organisational competence of each laboratory applying for approval. Examination of the dossiers for the laboratories which do not hold COFRAC accreditation could be completed by performance of an audit of the quality system in these laboratories by organisations delegated by the DGSNR.

To ensure that the conditions for laboratory approval are fully transparent, these criteria supplementing the general procedures specified in the ministerial order were published on the ASN and IRSN web sites. These provisions will come into force fully for those approvals issued as of 2005.

The Approval Board also gave its favourable opinion to the tentative 4-year schedule for the inter-comparison tests which, with about fifty tests spread over 8 inter-comparison campaigns (2 campaigns per year) will cover virtually all the artificial and natural radionuclides likely to be measured in the environment (water, air, soil and foodstuffs). While there are no technical organisation problems for the tests on matrices such as water, the homogeneity of which can be guaranteed after artificial contamination, the same does not apply to tests with solid matrices such as soil or foodstuffs. This multi-year inter-comparisons programme will therefore require specific work to develop certain tests, in particular to ensure the homogeneity of the artificially contaminated samples submitted for testing. The Board will also be required to propose approval procedures for laboratories using automatic systems for continuous measurement of radioactive aerosols and atmospheric components.

The Approval Board is also responsible for proposing to the Ministers for the Environment and Health those laboratories for which the ministerial approval is to be issued. About forty laboratories took part in two inter-comparison tests organised in 2003 for approval in 2004. On the basis of the dossiers prepared by the DGSNR and the IRSN, and on proposals from the Board, the list of approved laboratories, mentioning the scope of their approval, was published by ministerial order of 18 May 2004. The next approvals will be issued in 2005 on proposals from the Approval Board, after

analysis of the results of the four new inter-laboratory tests organised by the IRSN in 2004 and assessment of the approval application dossiers submitted by the laboratories before 30 June 2004.

The list of laboratories approved according to the various matrices can be consulted on the ASN's web site at the following address: http://www.asn.gouv.fr/actualite/mesures/liste_labo.pdf and will be accessible on the forthcoming web portal which, as of the first half of 2005, is to host the national network for environmental radioactivity measurement.

2 | 2

Creation of the national network for environmental radioactivity measurement

The launch of the national network for environmental radioactivity measurement is the other main part of the function dealing with organisation of environmental radioactivity monitoring. The IRSN participates in this function through its contribution to radiological monitoring of the entire country and through its management of this future national network.

This national network will use a data bank to collect, manage and process all the results of environmental radioactivity measurements taken by the approved laboratories or the IRSN's laboratories.

One of the first duties carried out by the DGSNR jointly with the IRSN was to identify the main parties involved in the measurement process, optimising identification of their measurement framework, their environmental monitoring field and the sensitivity of their analyses in order to propose a management strategy for these data as a whole. This inventory needs to be continued in order to guarantee that the measurements conducted nationwide are exhaustive.

The preliminary inventory of the various radioactivity measurements and the context in which they were taken, was presented to the Steering Committee meeting of June 2004 at the same time as initial consideration was given to how the radioactivity data and other information are to be presented on the web site.

The next steps will consist in supplementing the documentation, continuing the data inventory work and characterising the measurement results in order to be able to define the conditions for creation of the data bank and the corresponding IT tools. A working group was set up during the 3 November 2004 Steering Committee meeting to define the format of the database. A web portal development methodology incorporating "user" tests will then also have to be adopted in order to offer the best solution for the information needs of all potential project audiences.

2 | 3

Information of the public

The second part of the national network is linked to its communication-information aspect with development of a web portal, shared between the ASN and the IRSN. It will offer all audiences (general public, media, government departments, national health agencies, nuclear industry players, environmental protection associations, etc.) free access to the results of these radioactivity measurements and the summary report on the radiological status of the environment and estimated radiological impacts of the main nuclear activities prepared by the IRSN, plus any information of use for the network participants, as well as any member of the public with no specific knowledge of environment radiation protection matters.

At the same time, the ASN and the IRSN are developing a temporary web portal devoted to the national network and accessible from the ASN and IRSN web sites. The 3 November 2004 meeting of the Steering Committee was an opportunity for examination of a first rough draft of the documentation which will be available during the first half of 2005 on this web site: regulatory status of the network,

presentation of its various stakeholders and the organisations which are the sources of radioactivity data, laboratory approval procedures and criteria, approved laboratories, without forgetting links to the web sites of network participants or to other environmental radioactivity sites. It offers access to data already available on other sites. The aim is for it to be supplemented by measurement results once the data base has been created, by 2007.

2 | 4

The radiological quality of water intended for human consumption

New radiological inspection programmes for public mains water and non-mineral bottled water (see Chapter 3) will eventually produce a complete balance of the radiological quality of the water intended for human consumption, in particular on the basis of total alpha and beta radioactivity measurements and that of tritium. These programmes have already begun in a number of departments, at the initiative of the DDASS, picked up speed during 2004 and will become mandatory as of 1 January 2005. The corresponding information will be integrated into the DDASS's health/environment information system (SISE-Eau), providing an overview of the natural radioactivity in the water distributed.

Since 2003, the ASN has examined approval applications from laboratories responsible for radiological analyses of water intended for human consumption. At the end of 2004, four laboratories were approved using a provisional procedure and three procedures are currently under examination.

3 BNI EFFLUENT RELEASES

Like any other industry, basic nuclear installations (BNIs) generate by-products, whether or not radioactive, and despite the efforts made for recycling or reuse. These unwanted products are dealt with by concentrating them, leading to solid waste, or by dispersal into the environment in the form of effluent releases. The borderline between effluent release and waste production depends on an optimisation process specific to each installation, itself dependent on the feasibility of recovering the radionuclides present within the effluent. The cost and complexity of these processes increase as the radionuclide concentration decreases. Below a certain level the radionuclides cannot reasonably be retrieved. They are then released into the environment if their impact is acceptable. It should be pointed out that the radioactivity released in effluent represents a marginal fraction of what is confined in waste. It is therefore necessary to strike the right balance between these two solutions, as well as on the type of effluent (liquid or gaseous), in order to minimise the overall impact of the nuclear installation.

3 | 1

The regulatory context of BNI effluent releases

In the past, liquid and gaseous radioactive releases from nuclear installations were regulated separately by interministerial order. The first authorised release limits were set on the basis of the health standards applicable at the time, given the lack of any real experience feedback from actual releases. Subsequently, progress made by the operators in reducing releases (for example the liquid releases from the Flamanville NPP containing radionuclides other than tritium and carbon 14 decreased from 151 GBq in 1986 to 1.2 GBq in 2003) led to a situation in which the limits were so much higher than the actual releases, that there was no incentive for the operators to continue to make progress. In addition, an incident which would have led to release of, for example, ten times the activity normally released was covered by the existing authorisation and might not have been immediately noticed by the public and the authorities. Clearly this situation was unsatisfactory. As of 1987, following a decision by the Council of State, chemical releases associated with radioactive releases were included

in the interministerial authorisations, mainly on the basis of an annual limit and the concentrations added to the environment. The other non-radioactive "chemical" liquid releases were regulated by order of the Prefect.

Since 1995, the ASN has been following a policy of permanent progress aimed at further reducing the impact of nuclear installations both on mankind and on the environment. Within this context, all liquid or gaseous effluent releases, whether or not radioactive, and water intake by BNIs are the subject of a single procedure governed by decree 95-540 of 4 May 1995, prepared at the initiative of the ASN. A single order issued by the Ministers for Health, Industry and the Environment now covers all effluent releases and water intake. It regulates:
- the intake and release limits for which the operator is authorised;
- the analysis, measurement and inspection resources for the facilities, installations, works or activities authorised, and the means for monitoring their effects on the environment;
- the conditions in which the operator notifies the public authorities of its releases, along with the results of the monitoring of their effects on the environment;
- the inspections carried out by the public authorities;
- the methods to be used for public information.

This decree also enables the Administration to revise the existing licences at any moment, regardless of whether applications are submitted by the operators. Finally, this decree confirms the ASN as the body with competence for examination of the licence applications submitted by the operators.

Decree 95-540 marks a significant step in improving control of the administrative procedures governing effluent releases into the environment from BNIs. It will eventually enable the public to obtain a clearer picture of the impact of BNIs on the health of the population and the environment, and enable the public authorities to improve their BNI supervision. This is why its application to all existing BNIs is the subject of a sustained, proactive effort on the part of the ASN.

3 | 2
ASN policy concerning BNI release licences

The ASN's policy takes account of the following main elements:
- The procedure specified in decree 95-540 represents real progress. On the one hand it involves the various local and national stakeholders (administrations, public, municipal councils, river authorities, departmental health councils). On the other, a single licence can be issued to cover several applications, making the procedure clearer and making it easier to monitor the provisions of the licence. The ASN is therefore aiming to ensure that within a reasonable time all BNIs have a licence in conformity with decree 95-540. This implies considerable administrative work and the nuclear operators will have to submit new release licence applications with a view to revising most licences by the year 2007. This period will give the Administration and its technical support bodies time to analyse the applications.
- In order to put an end to the previous situation in which the authorised limits were too high, the ASN aims to ensure that the new licences do not offer such a wide margin tending to cover incident situations. The ASN aims to reduce the authorised release limits to values close to the actual release values. Although there are no health problems, because the releases from nuclear installations have no recognised harmful effect on the health of the neighbouring populations, it is important that in the same way as in non-nuclear industries, the limits set must be as low as is technically and economically achievable, thus obliging the operator to optimise its release processes by employing the best technologies available at acceptable cost, in order to preserve the quality of the environment.
- The ASN duly noted the Sintra declaration of 23 July 1998 by the ministers of States who signed the OSPAR Convention specifying reduction of the release of radioactive and other hazardous substances into the North-East Atlantic, so that the concentration levels in the marine environment approach zero by the year 2020 for artificial substances and background levels for substances naturally occurring. Within this framework, the ASN asked COGEMA La Hague for a study on the measures necessary to reach this objective.

- The new procedure offers improved regulation of chemical substance releases. This aspect was for a long time ignored, but nuclear installations also release these substances and the ASN wants to see BNIs regulated in the same way as other industrial facilities. Monitoring of these recently regulated substances provided a clearer picture of the quantities actually released. This helps lead to a real reduction in the releases, particularly with respect to metals.

As a result of renewal of the release licence orders, the authorised limits were reduced by the following factors:

- for the 900 MWe NPPs:		
Gaseous releases:	- gases (rare gases + tritium):	28
	- halogens + aerosols:	23
Liquid releases:	- tritium:	1.4
	- other radionuclides:	2.3
- for the 1300 MWe NPPs:		
Gaseous releases:	- gases (rare gases + tritium):	32
	- halogens + aerosols:	34
Liquid releases:	- tritium:	1 to 40
	- other radionuclides:	2.6
- for COGEMA La Hague:		
Gaseous releases:	- gases (other than tritium):	1
	- tritium:	15
	- halogens + aerosols:	9
Liquid releases:	- tritium:	2
	- other radionuclides:	12
	- alpha emitters:	10

3 | 3

The impact of nuclear facilities

Attempting to identify the health impact of nuclear facilities in normal operation consists in detecting the possible appearance of effects that are harmful for health owing to low exposure to ionising radiation, the main risk being inducing cancers. The impact of a nuclear installation is not simply linked to the activity released by the identified outlets (stack, outfall to river or sea), and account must also be taken for diffuse liquid and gaseous emissions and the sources of irradiation present in the installation. This leads to a correct assessment of all possible channels for internal or external irradiation of the population.

The impact is determined on the basis of an exposure source and reference groups described in the impact assessment. These are homogeneous groups of persons receiving the highest average dose from among the population exposed to a given installation according to realistic scenarios. To assess the impact of the installation, the impact of other nearby industrial activities and all sources of exposure must be taken into account so that the total dose can be compared with the annual dose limit. The exposure source consists of a spectrum of radionuclides for the pre-measurement theoretical calculation and the activity measured in the releases for the subsequent verification, to which must be added irradiation (mainly due to the various storage areas).

According to the principle of optimisation, the operator must reduce the dosimetric impact of its installation to values that are as low as reasonably achievable in the light of economic and social factors.

In practice, the activity levels present in the environment are low enough to be undetectable by the measuring instruments, so it is necessary to use dispersion models supplied with installation release measurement data. In addition, the operators are required to conduct environmental radioactivity monitoring programmes (milk, grass, soil, air, water) to check compliance with the scenarios posited in the impact assessment.

The calculated radiological impact on the reference group most exposed to the releases at the values defined in the release and water intake licensing orders remains far below the allowable limits.

The annual effective dose received by a few reference groups (EDF and COGEMA La Hague) is given in chapters 12 § 4|2|3 and 14 § 2|4|4 as an illustration.

3 | 4

The ASN's primary scope of work

Under decree 95-540 the ASN has to examine the liquid and gaseous effluent release and water intake licence applications from BNIs. The procedure is complex and involves many stakeholders. Therefore, by drawing on experience feedback from the first applications, the ASN initiated a number of actions aimed at processing the applications within a reasonable time set at 2 years and at improving the procedure transparency. So that the procedure completion times are not excessive, the ASN attempted to raise operator awareness - in particular EDF - concerning the quality of their application dossiers. Experience shows that these times would be shorter if the dossiers submitted were of higher quality and did not need to be revised before being considered complete and admissible by the ASN, which is a pre-condition to holding a public inquiry. Many central and local administrative departments are also involved throughout the procedure, so one of the ASN's concerns is to improve coordination between all these departments in order to keep times down. In order to boost transparency the ASN, jointly with the Directorate General for Health (DGS), asked its technical support organisation, the Institute for Radiation Protection and Nuclear Safety (IRSN) to prepare a guide for interpreting the radiological impact assessments submitted with the release licence applications. This public guide enables the reader to judge more easily whether the impact assessments are adequate. Similarly, owing to the variable quality of the impact assessments supplied in the dossiers submitted by the operators, the growing complexity of this type of dossier and in order to formalise the experience acquired in examination of the initial dossiers, an impact assessment analysis guide for non-radioactive releases is currently being planned. Production of this guide could be delegated to a specialised organisation in 2005.

Finally, as part of its BNI supervision function, the ASN intends to conduct unannounced inspections to check that the BNI operators are indeed complying with their obligations under the terms of the orders. This is why, in addition to the existing inspections, the ASN has set up a system of unannounced inspections during which the BNI inspectors check compliance with the licences, take effluent samples and have them analysed by a specialised, independent laboratory. The ASN carried out 10, 15, 13, 23 and 14 inspections with effluent sampling in 2000, 2001, 2002, 2003 and 2004 respectively.

3 | 5

Progress with implementation of decree 95-540

The first order which was examined in accordance with the procedure laid down in decree 95-540 was published in 1999 (Saint-Laurent-des-Eaux NPP). To date, 17 new licences have been granted to the EDF nuclear power plants (NPP) at Saint-Laurent-des-Eaux, Belleville, Chinon, Paluel, Flamanville, Saint-Alban, Cruas, Cattenom, Le Blayais, Gravelines, Nogent-sur-Seine, to COGEMA La Hague, ANDRA La Hague, to the CEA Grenoble, to the spent fuel engineering laboratory (LECI) at the CEA's Saclay centre, to Centraco and to the FBFC fuel fabrication plant in Romans (see table on page 142).

Operator	Site	Regulatory situation
CEA	Cadarache	Licensed according to old procedure
	Fontenay-aux-Roses	Licensed according to old procedure
	Grenoble	Order of 25/05/2004 according to new procedure
	Marcoule Phénix	Licensed according to old procedure
	Marcoule Atalante	Licensed according to old procedure
	Saclay	Licensed according to old procedure (site) Order of 30/12/2002 according to new procedure (LECI)
EDF	Belleville	Order of 08/11/2000 according to new procedure
	Blayais	Order of 18/09/2003 according to new procedure
	Bugey	Licensed according to old procedure Order of 26/04/2004 according to new procedure (T 4 and 5 biocide treatment)
	Cattenom	Order of 23/06/2004 according to new procedure
	Chinon	Order of 20/05/2003 according to new procedure
	Chooz	Licensed according to old procedure Order of 26/04/2004 according to new procedure (T 1 and 2 biocide treatment)
	Civaux	Licensed according to old procedure
	Creys-Malville	Licensed according to old procedure
	Cruas-Meysse	Order of 7/11/2003 according to new procedure
	Dampierre	Licensed according to old procedure Order of 27/04/2004 according to new procedure (T1 and 3 biocide treatment)
	Fessenheim	Licensed according to old procedure
	Flamanville	Order of 11/05/2000 according to new procedure
	Golfech	Licensed according to old procedure Order of 27/04/2004 according to new procedure (T1 and 2 biocide treatment)
	Gravelines	Order of 7/11/2003 according to new procedure
	Nogent-sur-Seine	Order of 29/12/2004 according to new procedure
	Paluel	Order of 11/05/2000 according to new procedure
	Penly	Licensed according to old procedure
	Saint-Alban	Order of 29/12/2000 according to new procedure
	Saint-Laurent	Order of 2/02/1999 according to new procedure
	Tricastin	Licensed according to old procedure
COGEMA	La Hague	Order of 10/01/2003 according to new procedure
	Marcoule	Licensed according to old procedure
	Pierrelatte	Licensed according to old procedure (TU5)
COMHUREX	Pierrelatte	Order revision in progress
SOCATRI	Pierrelatte	Order revision in progress
EURODIF	Pierrelatte	Order revision in progress (GB1)
MELOX	Marcoule	Licensed according to old procedure
ILL	Grenoble	Licensed according to old procedure
SOMANU	Maubeuge	Licensed according to old procedure
CENTRACO	Marcoule	Order of 07/05/1998 according to new procedure
FBFC	Romans-sur-Isère	Order of 22/06/2000 according to new procedure
ANDRA	La Hague	Order of 10/01/2003 according to new procedure
	Soulaines	Procedure in progress

Regulatory situation concerning releases from nuclear sites

Along with the BNI operators, the ASN has undertaken the revision of all the existing orders. For the main operators, the progress reached in the procedures is as follows:

– EDF installations: without waiting for the dates stipulated in the orders currently in force, EDF at the request of the ASN drew up a schedule to ensure that the last NPP release licence application is submitted in 2007. This schedule could however be reviewed, in particular if a release licence application is made for the EPR project.

– CEA installations: the CEA's centres are complex sites on which the installations are usually under the control of different authorities: ASN for the BNIs, Defence nuclear safety and radiation protection delegate (DSND) for secret BNIs, DRIREs for installations classified on environmental protection grounds (ICPEs) located outside BNI perimeters. For these centres, the release licence renewal procedures are currently under way and are being coordinated between the various administrations. To make analysis of the dossiers easier and improve information of the public, the ASN asked the CEA to draw up a dossier for each centre enabling the overall impact of the site releases on the environment to be assessed.

– CEA/Grenoble: the release licence order was signed on 25 May 2004.

– Fuel cycle installations: the site primarily concerned is that of La Hague. As COGEMA did not wish to submit a release licence application with a view to revision of its 1980 and 1984 licences, the ASN under article 13 of decree 95-540 unilaterally reviewed these licences. The new order is in conformity with the ASN policy explained above, with the limits being appreciably lowered. For the Tricastin site which comprises a number of facilities with different operators, a licence revision procedure is in progress.

At present 7 dossiers are being examined (ANDRA Soulaines, CEA Cadarache, ILL, EDF Golfech, COMHUREX, SOCATRI, EURODIF). Owing to changes in certain installations or the replacement of certain substances, updates to licences already issued have been examined (EDF Belleville).

3 | 6 Accounting and monitoring of radioactive releases

The reduction in the level of radioactive effluent released by the BNIs (numerous activity concentration values that cannot be routinely measured), the changing categories of radionuclides regulated by the release licensing orders and the need to be able to calculate the dosimetric impact of the releases on the reference groups, led the ASN to set radioactive release accounting rules, in particular to deal with activity concentrations lower than the decision threshold. These rules, based on the principle described below, were also designed to avoid being declared as non-existent releases of very small quantities of radionuclides which could then be concentrated in certain species sampled in the environment (sediments, mosses, etc.).

Accounting principle:

• for reach regulated radionuclide category, the released activity levels are based on specific analysis of the radionuclides rather than on total alpha, beta or gamma measurements;

• setting detection limits to be followed for each measurement;

• for each BNI and for each type of effluent, a reference spectrum is defined, in other words a list of the radionuclides for which the activity concentration must systematically be taken into account, whether or not higher than the decision threshold, when calculating the released activity. These reference spectra can be changed and are based on experience feedback from the analyses conducted;

• the other radionuclides that may occasionally be present are taken into account once their activity concentration is higher than the decision threshold.

Liquids: ^{3}H,
^{14}C,
Iodines : ^{131}I,
Other fission and activation products:
^{54}Mn, ^{58}Co, ^{60}Co, ^{110m}Ag, ^{123m}Te, ^{124}Sb, ^{125}Sb, ^{134}Cs, ^{137}Cs.

Gas: ^{3}H,
^{14}C,
Rare gases: - ventilation (permanent releases): ^{133}Xe, ^{135}Xe
- "RS" tank drainage: ^{85}Kr, ^{131m}Xe, ^{133}Xe
- decompression of reactor buildings: ^{41}Ar, ^{133}Xe, ^{135}Xe.
Iodines : ^{131}I, ^{133}I
Other fission and activation products: ^{58}Co, ^{60}Co, ^{134}Cs, ^{137}Cs.

Example of reference spectra adopted for EDF:

These rules are now applied in all plants, in CENTRACO, in the COGEMA and ANDRA facilities at La Hague, at FBFC Romans. They will be applied in the other sites as the release licence orders are renewed.

In accordance with the provisions of their release licence orders, the sites keep up to date registers in which they record the results of the various release and environmental measurements made, along with the release conditions. These registers are sent every month to the ASN, which examines them and checks that the self-monitoring performed by the operators complies with the requirements of the orders. In the event of an anomaly, requests for explanations are sent out to the operator. Alongside this check, the operator regularly sends the IRSN a number of samples taken both from the releases and from the environment, for analysis. The results of the analysis of these samples are sent to the ASN who can thus evaluate the quality of the measurements made by the nuclear operators. These checks supplement those conducted during the inspections.

3 | 7
The other releases from nuclear installations

Nuclear power plants release cooling water, known as "thermal releases", into watercourses or the sea, either directly for those plants operating in "open circuit" or after cooling through cooling towers which partially evacuate heat into the atmosphere. Thermal releases from plants into the watercourses lead to a temperature rise between the upstream and downstream parts of the release of between a few tenths of a degree and several degrees.

These thermal releases are regulated by the nuclear power plant release licence orders.

An NPP exceptional thermal releases monitoring committee has been set up to supervise the impact of these releases on the watercourses.

From the environmental viewpoint, the limits stipulated in the orders aim to prevent changes to the host medium, in particular to ichthyofauna, and ensure acceptable health conditions if water intake for human consumption takes place downstream.

These limits may therefore differ according to the environment and the technical characteristics of each plant.

No exceptional fish mortality was observed downstream of the nuclear power plants concerned during the 2003 heat wave and in the following months. Prudence however remains in order regarding the long-term effects on the aquatic media of the climatic conditions of the summer of 2003.

From the viewpoint of the reliability of the electricity grid, which is extremely important for public safety, but also for nuclear safety, interruption in the operation of a large number of power plants, in particular at key points on the grid, can be unacceptable.

Experience feedback from the summer 2003 heat wave should focus on:
- design measures to reduce release temperatures;
- strengthening of the electricity grid to make it less sensitive to shutdown of certain reactors;
- establishing regulations and an organisation to ensure that if there is an electricity supply crisis, the impact on the environment of releases above the usual levels will be managed sensibly.

4 RELEASES FROM OTHER INSTALLATIONS

The public health code states that regulatory provisions for management of radioactive waste and effluent in installations other than installations classified on environmental protection grounds or basic nuclear installations must be specified in an order signed by the Ministers for Health and the Environment. This is why the DGSNR, together with professionals handling radioactive sources and the administrations concerned, is drafting an order on this subject. The main requirements will be taken from the DGS/DHOS circular of 9 July 2001 concerning management of effluent and waste from health care activities contaminated by radionuclides. Problems with application of this circular by research and health professionals have been identified, in particular during meetings on production of the National radioactive waste management plan. A working group was set up to propose solutions for inclusion in the draft order on management of radioactive waste and effluent.

5 PREVENTION OF HARMFUL EFFECTS

5.1

Application of the order of 31 December 1999 concerning environmental protection

For several years now, particular attention has been focused on the chronic or accidental environmental effects of conventional or nuclear industries. The interministerial order of 31 December 1999 stipulates the general terms and conditions to be complied with by BNIs with regard to 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. 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 environmental pollution (water and atmosphere).

Most of the provisions are applicable as from 15 February 2002, which is 2 years after publication of the order in the *Official Gazette*. However, if the operators can prove that they are experiencing difficulties, article 48 of the order of 31 December 1999 provides for extra time allowances, without however exceeding 15 February 2006.

Considerable work has been undertaken by the operators to check the conformity of the installations with the requirements of the order, to identify discrepancies, assess the conformity work required or propose preventive measures able to achieve a level equivalent to that of the requirements which cannot be met and propose a tentative schedule of these measures. For the ASN, the

work consisted in analysing the dossiers, ruling on the operators' proposals and, during site inspections, running spot-checks to ensure that the information given in the dossiers is complete. The Director General for Nuclear Safety and Radiation Protection set a schedule for conformity of those installations for which the analysis is completed.

5 | 2

Prevention of water pollution

The ministerial order of 31 December 1999 sets measures designed to prevent or, in the event of an accident, to minimise direct or indirect release of toxic, radioactive, flammable, corrosive or explosive liquids into the natural environment and the sewers. It leads to:

- revision of the design of storage, loading and unloading areas for toxic, radioactive, flammable, corrosive or explosive liquids, by requiring effective retention facilities;
- creation of a response organisation for dealing with accidental release of liquid substances before they reach the natural environment;
- installation of confinement tanks in particular for collecting and treating fire-fighting water.

Implementation of these measures by the operators has led to significant progress in the prevention of pollution. The routing and condition of pipes were checked, as was the condition of the retention facilities. The resources and the response organisation for combatting water pollution were put in place and tested.

5 | 3

Protection against noise

Article 48.II.2 of the ministerial order of 31 December 1999 requires, by 15 February 2004, a verification of compliance with prescribed limits together with a spectral analysis aimed at characterising noise with a specific tonality. The dossiers submitted by the operators are currently being examined.

5 | 4

Protection against the microbiological risk (legionella, amoebae)

The presence of bacteria in the water is linked to the existence of the nutrients and minerals they need in order to grow. Temperature also plays an important role in their growth. Most natural surface water (lakes, rivers) is naturally contaminated. Micro-organisms can consequently be found in installations which use surface water as a resource: sanitary facilities (showers, taps, etc), air-conditioning and cooling systems (cooling towers, industrial cooling circuits), ponds and fountains, thermal spa water and medical equipment producing aerosols.

The particularity of some nuclear installations is their very large size, which makes them different from conventional cooling systems. Owing to their size, the exchange surface areas are considerable and their honeycomb structures can be up to 5,000,000 m^2.

A cooling system functions as a biological reactor with a growth medium, a top-up bringing in nutrients and a drain evacuating the micro-organisms. The temperature, dwell time and circulating water renewal conditions are all favourable to the development of micro-organisms. As the feedwater is raw water, the micro-organisms are already present in the medium and nutrients are available in sufficient quantities.

The condenser temperature - up to 40 °C – is highly favourable to the growth of the more thermophilic species.

Some of these bacteria are in fact pathogenic. This is particularly the case with *legionella* and *amoebae* such as *Naegleria fowleri*, for which particular measures are specified.

5 | 4 | 1

Legionella

Legionnaire's disease is an infectious pathology caused by *legionella* bacteria. The germ responsible is a bacillus living in freshwater, for which the optimum proliferation temperature is between 35 and 40 °C. It can be found in all natural or artificial aquatic media. Transmission to man is through inhalation of contaminated water aerosols. Human contamination requires that the following 3 conditions are met simultaneously: contaminated water, production of an aerosol and a sufficient level of contamination for which the threshold is as yet unknown.

For this bacterium, no regulatory limit has been set for drinking water, and it can grow in all installations that promote the development of these micro-organisms:
- warm water between 25 and 45 °C,
- presence of nutrients (available carbon, Fe^{++} ferrous iron or Fe^{+++} ferrous iron essential for growth, as is the presence of an amino acid, L-cysteine),
- an aerobic environment (presence of oxygen),
- the possible existence of hosts (*amoebae*, etc.).

Numerous aerosols can be generated in industrial installations: showers, hand-basins, and other uses of water from the sanitary hot water networks, cooling towers, washing with sprayed water (sheet washing on paper machines, washing of belt-filters and press-filters).

The relationship between the level of contamination of the water from which the aerosol is produced, and the risk of legionnaire's disease has not yet been established. A preventive vigilance threshold has been set for ICPEs at 1000 CFU/l (1000 *legionella* per litre), and 100,000 CFU/L for installation shutdown. The concentration in water can vary widely in just a few hours and the bacterium in question can be found in biological deposits (biofilm) on the walls of the installation (hot water tanks, pipes, valves, shower heads in sanitary hot water installations, or heat exchangers, tower basin and cooling tower exchanger body in cooling circuits), or in a host organism (protozoa: amoebae, etc.) which in bursting can release large quantities of *legionella*. Current trends are to consider that if a circuit is contaminated, then it is definitive and the risk exists. Curative treatment will only have a temporary impact as the water feeding the loop is usually contaminated.

The recent cases of legionnaire's disease linked to wet cooling towers have led the Ministers for Health and Ecology to combine their efforts to improve prevention of the health risk from these installations, under the 2004-2008 legionnaire's disease prevention plan (June 2004). A reform of the nomenclature of classified installations is currently being adopted which will expand the scope of installations requiring declaration or authorisation with the creation of a new heading (2921). Special prevention and limitation requirements already apply to these installations, including for those present in the BNIs (excluding cooling towers).

Special requirements were sent to EDF concerning its power plant cooling towers, for which the Director General for Nuclear Safety and Radiation Protection, the Director General for Health and the Director for the Prevention of Pollution and Risks referred the matter to the French Agency for Environment Health Safety (AFSSE) with a view to an evaluation of the current situation (see Chapter 12).

As the release of pathogenic micro-organisms by nuclear installations is not covered by the "water" nomenclature, nor by that dealing with atmospheric pollution or odours, it cannot be regulated by the order implementing decree 95-540.

5 | 4 | 2

Amoebae

Naegleria fowleri is a pathogenic species of amoebae known as free-living because they do not develop in intermediate hosts. They are thermophilic protozoa, among which the *fowleri genus* is the most thermophilic. These amoebae are ubiquitous and can be found in very small quantities in all environmental compartments. They develop mainly in the aqueous phase.

Stainless steel condensers in nuclear power plants have been identified as a favourable location for proliferation of NF *amoebae*. In order to limit the quantities of *amoebae* in surface water to an acceptable threshold level, EDF was obliged to treat its circuits initially with bleach and then with monochloramine (see chapter 12 § 4|4|1). Specific licences were issued to regulate releases linked to these treatments (see § 3|5).

6 Waste studies

Article 20 of the 31 December 1999 order stipulating the general technical regulations designed to prevent the harmful effects and external hazards resulting from operation of basic nuclear installations specifies:

"The operator drafts a study on the management of its waste, known as the "waste study", indicating its objectives concerning reduction of the volume and the chemical, biological and radiological toxicity of the waste produced in its installations, and optimisation of its management with emphasis on reuse and treatment for final disposal in an ultimate waste repository. It defines the steps involved in achieving these objectives."

Articles 20 to 27 of the order of 31 December 1999 give the regulatory procedures linked to the waste studies and waste management.

These articles were the subject of two memoranda (SD3-D-01 and SD3-D-02), which are intended to serve as the specifications to which nuclear operators must refer in drafting their waste studies and their annual waste summaries.

The waste studies for the nuclear sites are one aspect of the drive for progress designed to promote improved management of the waste produced on the sites. In particular, the operator of a nuclear site must control its waste inventory, minimise waste production, recycle and reuse the waste produced, insofar as this is technically and economically possible, and package the residual waste in the form of ultimate waste for disposal. These studies must lead to definition of a waste reference framework which can act as a reference for the statutory inspection.

The problem of waste management is described in greater detail in Chapter 16.

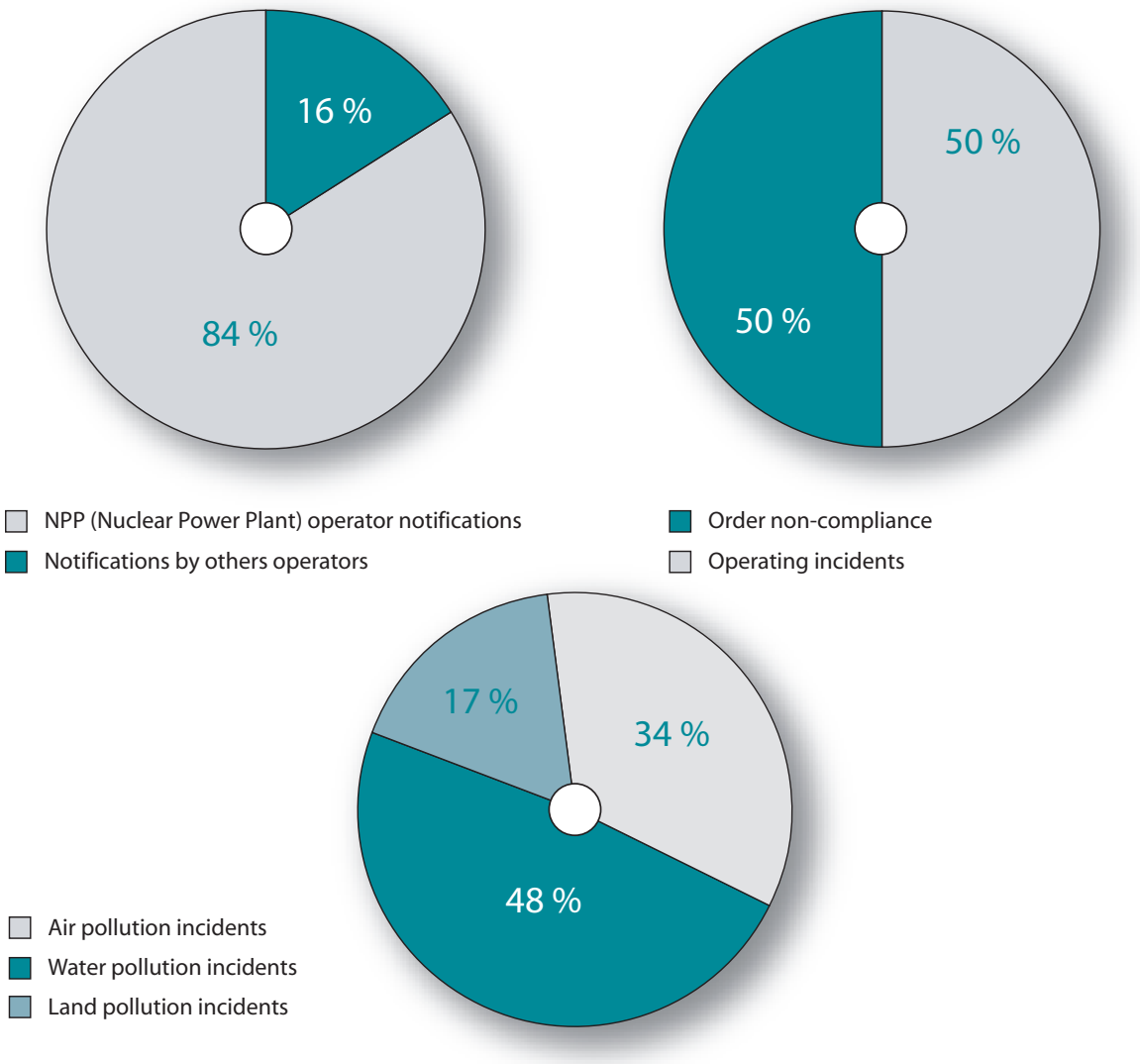
7 Environmental incidents

The detection and handling of incidents play a fundamental role in nuclear safety. When an incident occurs, the necessary countermeasures must be set up along with the appropriate experience feedback to prevent it happening again. This first of all implies the existence of a reliable system for detecting incidents and distributing the relevant information. For a number of years now, there has been a rise in the number of fields in which events have to be declared or the ASN notified, particu-

larly concerning the environment under the terms of the release orders or the interministerial order of 31 December 1999.

Under the order of 26 November 1999 (article 29), any incident or operating anomaly in a nuclear installation and liable to directly or indirectly concern the provisions of the order or the licensing order, such as a leak from a tank or gaseous and liquid effluent pipe, uncontrolled release, abnormal rise in radioactivity or in any other released effluent parameter, unavailability of statutory tanks, filter deterioration, overshoot of the trip threshold, reduction in rate on main stack, failure of instruments measuring rate, activity, or physicochemical parameters, etc., must be immediately brought to the attention of the authorities.

Under the order of 31 December 1999 (articles 3 and 4), incidents or accidents likely to prejudice the interests mentioned in article 1 must be immediately declared to the DGSNR and the relevant DRIRE. In the event of accidental pollution originating within the perimeter of a BNI, the operator must be able to provide the competent authorities immediately with all information of use in determining the measures to be taken to protect the interests mentioned in article 1 exposed to this pollution.



Breakdown of environmental-related incidents occured in 2004

In 2004, 64 events with an environmental impact were declared by the operators as shown in the breakdown illustrated in the previous graphs.

8 Outlook

2004 saw the laying of the foundation of the environmental radioactivity measurement network, with the first inter-laboratory comparisons, the first laboratory approvals for measurement of radioactivity in the environment and the creation of a web portal giving information about the network and approvals. 2005 will be devoted to improving the regulatory arrangement, with updating of the order of 17 April 2003 specifying the organisation of the national network and the measurement laboratory approval procedures, continuation of the inter-laboratory tests to approve laboratories in the new measurement fields and initial work on the environmental radioactivity database.

The efforts made to reduce harmful effects will be continued with examination of about ten BNI effluent release licence orders, implementation of measures to reduce effluent and waste in establishments performing radiological and nuclear activities and continued field inspections for bringing the installations into conformity with the requirements of the order of 31 December 1999 setting the general technical regulations for preventing and limiting harmful effects and external hazards as a result of the operation of basic nuclear installations.

The ASN also began to look at how to improve the procedures for declaring and analysing incidents. The experience feedback accumulated in recent years shows major discrepancies between operators in how events are declared on the one hand, and how the various declaration criteria are applied on the other. These discrepancies are to a large extent due to the increasing numbers of fields in which events have to be declared or notified to the ASN, in particular with implementation of the Public Health Code, decree 95-540 of 4 May 1995 and the interministerial order of 31 December 1999. Following the operator consultation phase, this approach will lead to a DGSNR decision in 2005 allowing harmonisation of declaration procedures for events or incidents that are significant with respect to safety, radiation protection or the environment.

CHAPTER 5
ENVIRONMENTAL PROTECTION

INFORMATION OF THE PUBLIC AND TRANSPARENCY

CHAPTER 6

1 DEVELOPMENT OF RELATIONS BETWEEN THE NUCLEAR SAFETY AUTHORITY AND THE PUBLIC

1|1 From information of the public to transparency
1|2 ASN information media
1|2|1 The ASN web site: www.asn.gouv.fr
1|2|2 The ASN's MAGNUC viewdata magazine
1|2|3 The annual report: "Nuclear safety and radiation protection in France"
1|2|4 *Contrôle* publication
1|2|5 Other ASN publications
1|3 The public information and documentation centre
1|4 The ASN and the media
1|4|1 Regular relations with the press
1|4|2 The ASN and the media in emergency situations
1|5 ASN regional actions
1|5|1 DSNR public information actions
1|5|2 The "Nuclear activities under close supervision" exhibition
1|6 Symposia

2 THE LOCAL INFORMATION COMMITTEES AND THE NATIONAL ASSOCIATION OF LOCAL INFORMATION COMMITTEES

2|1 The Local Information Committees
2|2 The National Association of Local Information Committees

3 THE HIGH COUNCIL FOR NUCLEAR SAFETY AND INFORMATION

4 THE INSTITUTE FOR RADIATION PROTECTION AND NUCLEAR SAFETY

5 OTHER STAKEHOLDERS

6 OUTLOOK

As part of the French Nuclear Safety Authority's (ASN) duty to inform, the purpose of this report is to present the reader with a picture of nuclear safety and radiation protection in France in 2004.

Since this report was first created, the ASN has always tried to use this chapter to provide its readers with a faithful presentation of its actions and tools concerning information of the public and transparency.

Since the 2003 report, the ASN has also used this chapter to present the tools and actions used in informing the public about nuclear safety and radiation protection by other nuclear players.

1 DEVELOPMENT OF RELATIONS BETWEEN THE NUCLEAR SAFETY AUTHORITY AND THE PUBLIC

1 | 1

From information of the public to transparency

The decree of 13 March 1973, which created the Central Nuclear Installations Safety Department (SCSIN), responsible for checking nuclear safety in France, also entrusted it with the role of "proposing and organising information of the public on safety-related issues".

The decree of 1 December 1993 which created the Nuclear Installation Safety Directorate (DSIN), replacing the SCSIN, reiterated this public information duty, in the same terms.

The decree of 22 February 2002 which created the DGSNR (General Directorate for Nuclear Safety and Radiation Protection) expanded this role of information of the public to cover the field of radiation protection. The DGSNR is now tasked with "contributing to informing the public on subjects related to nuclear safety and radiation protection".

Specific information media are therefore proposed to the public. The ASN aims to provide the public with information that is written simply, to make it accessible to as many people as possible.

Modern technology allows increasingly fast circulation of information and the population is asking for increasingly precise information. For its part, the ASN aims constantly to improve how it reports on what it is doing.

This naturally leads the Nuclear Safety Authority to continue its commitment to transparency, while taking care to avoid saturating the information channels and to set up support, awareness and even training measures enabling the citizens and their representatives to gain easier access to information.

The ASN also whenever possible informs the various opinion shapers. It contributes to regular information of the media, by organising thematic press conferences as well as encouraging the action of the Local Information Committees (CLI). The nuclear safety authority also handles the secretariat of the High Council for nuclear safety and information (CSSIN) and regularly presents its actions to it. The ASN maintains ongoing relations with elected representatives and environmental protection associations.

This desire for and action in favour of transparency by the Nuclear Safety Authority are reinforced by the content of the future nuclear safety and transparency bill, which should shortly be tabled before Parliament by the Minister for Ecology and Sustainable Development. This text comprises provisions which are designed to substantially reinforce information of the public and transparency concerning nuclear activities and to guarantee the quality and reliability of such information. It stipulates that the public will have direct access to the information in the possession of nuclear operators, users of ionising radiation sources and persons responsible for transporting radioactive materials, thereby extending to the other nuclear stakeholders the transparency obligation hitherto applicable to the ASN.

1 | 2

ASN information media

1 | 2 | 1

The ASN web site: www.asn.gouv.fr

The ASN opened its web site, www.asn.gouv.fr, on 2 May 2000. This site is updated in real time and provides the public with the latest news on nuclear safety and radiation protection in France: events occurring in civil nuclear facilities, press releases, decisions and formal notices issued by the ASN, and the stance it has adopted on various subjects. A web user living near a nuclear facility will find all relevant local information in the "Regions" section. The web site also presents the assignments of the ASN, the fields of activity within its scope, its publications, the legislative and regulatory texts which govern its daily activities and its relations with foreign counterparts.

The CLI and CSSIN also each have a section, for which they have editorial responsibility, accessible from the site's home page.

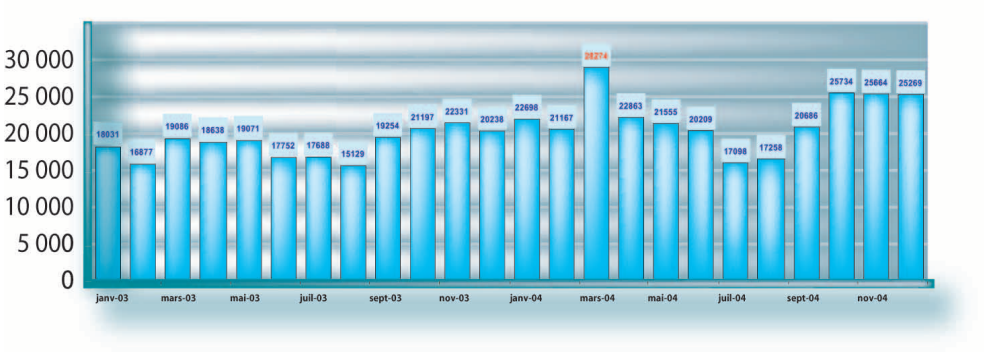
Since 1 January 2002, and in line with its commitment to transparency, the ASN's website www.asn.gouv.fr has published the results of all the inspections (about 670 per year) carried out by its engineers in the basic nuclear installations, including the letters sent to the operators following each inspection.

On this same subject, the Nuclear Safety Authority aims to broaden consultation of the parties concerned when drafting regulatory texts of a general nature. Experiments were therefore started, in June 2003, into on-line consultation about the planned radiation protection events classification scale, based on the INES model and, in November 2003, about the title "Nuclear safety and transparency" of the energy guidelines bill.

In 2004, the ASN also decided that as of 1 January 2005, information about its inspections during EDF unit outages would also be available on-line. Through "information notices" it presents in particular



ASN website home page: www.asn.gouv.fr



Monthly visitor statistics for the ASN website in 2003 and 2004

the main maintenance work carried out by the operator, any significant events occurring during the year and the corresponding inspections carried out.

New features of the ASN's website in 2004 mainly concerned the provision of declaration and authorisation forms for radioactive source possession and utilisation, opening of the public information and documentation centre, the ASN's hiring policy, the 4 May 2004 symposium on the topic "polluted sites and soils" and finally, laboratory approvals as part of the creation of the national network for environmental radioactivity measurement.

The number of visitors to the www.asn.gouv.fr site is constantly rising and in 2004 it received 268,000 hits.

1 | 2 | 2

The ASN's MAGNUC viewdata magazine

The MAGNUC viewdata magazine was set up by the ASN in 1987 at the recommendation of the CSSIN. It took over from the data bank created after the Chernobyl accident.

It consists of 10 sections and presents nuclear safety and radiation protection news in France (notification of significant incidents, ASN press releases, decisions and formal notices issued by the ASN, condition of EDF plants, CEA radioactivity measurements per site) as well as information on the organisation of nuclear safety and radiation protection control in France, the INES scale and ASN publications.

In 2004, there were an average of 66 logins to the MAGNUC magazine per month.

1 | 2 | 3

The annual report: "Nuclear safety and radiation protection in France"

Every year, this report informs its readers of the state of nuclear safety and radiation protection in France. It also presents all ASN actions performed during the past year to check and improve the safety of French civil nuclear facilities and the transport of radioactive materials, and to check and minimise exposure of workers, patients, the public and the environment to ionising radiation. It is therefore more than just an ASN activity report, and has set itself the goal of describing the state of nuclear safety and radiation protection in France.

This report, which is the fruit of collective analysis and synthesis work, in which all ASN entities take part, enables an annual record to be drawn up of the changes and difficulties encountered, in both the technical and organisational spheres, within the companies and organisations subject to

supervision. This report also widens the scope of the debate to include nuclear safety and radiation protection projects and prospects.

The report and its summary are sent to many of our partners abroad, notably the nuclear safety authorities of various countries. Since 1996, the report has been translated into English to further exchanges between nuclear safety authorities and inform all foreign stakeholders in the nuclear safety and radiation protection sector.

The annual report is available in French and in English on the website www.asn.gouv.fr.

1 | 2 | 4

Contrôle publication

Since 1978, the ASN has published a two-monthly information publication on nuclear facility safety which, in October 1994, changed its name to "*Contrôle, the Nuclear Safety Authority publication*".

In France, *Contrôle* is distributed to national and local elected representatives, the media, journalists, members of the CSSIN and the CLI, associations, the operators and administrations concerned. Private individuals can also obtain it on request. Abroad, *Contrôle* is in particular sent out to the nuclear safety authorities of the countries with which the ASN has frequent contacts.

8000 copies of *Contrôle* are printed.

Contrôle consists of two parts.

The first part is devoted to news and comprises four headings reporting on the ASN's activities over a two-month period: the first two present the latest ASN inspections of each basic nuclear installation and of transports of radioactive and fissile material intended for civil uses. The third presents ASN decisions and notifications as well as the activities of the CLI, the CSSIN, the interministerial commission on basic nuclear installations (CIINB) and advisory committees, while the last presents the ASN's international relations.

The second part of *Contrôle*, entitled "*Dossiers de Contrôle*", presents a special report on an aspect of nuclear safety or radiation protection. *Contrôle* presents ASN doctrine concerning the subject chosen and also makes its pages available for the expression of a wide variety of opinions. Publication of these points of view helps lay the foundations for a broader debate and encourages the emergence of a pluralistic form of information, taking greater account of the concerns and expectations of public opinion.

The press conferences organised at each publication of *Contrôle*, are regularly attended by journalists from the general and specialist "nuclear", "environment" and "medical" press. These presentations are useful both for journalists wishing to bring themselves up to speed on fundamental issues and for ASN representatives who have an opportunity to face questions from the press and acquit their duty to inform.

In 2004, *Contrôle* dealt with the following subjects:

- January → Epidemiology and ionising
- March → ASN report on nuclear safety and radiation protection in France in 2003: extracts (n° 157)
- May → Worker radiation protection (n° 158)
- July → Nuclear safety harmonisation in Europe (n° 159)
- September → Nuclear safety and radiation protection research (n° 160)
- November → Radioactive contamination: what steps for polluted sites? (n° 161)



Covers of the issues of *Contrôle* published in 2004

Contrôle is free and is distributed on the basis of voluntary subscription (subscription form available on www.asn.gouv.fr or by mail from the following address: ASN Publications, 6, place du Colonel Bourgoin, 75572 Paris Cedex 12).

The special reports are also published separately and widely distributed to the public at fairs and exhibitions attended by the ASN. They can also be obtained from the web site www.asn.gouv.fr. Back numbers can also be consulted in the public information and documentation centre.

1 | 2 | 5

Other ASN publications

The ASN presentation brochure



ASN presentation brochure

This ASN presentation brochure describes the resources employed by the ASN so that on behalf of the State it can check nuclear safety and radiation protection and inform the population. It presents the organisation chart, activities and values of the ASN, "independence, competence, stringency and transparency". This brochure is widely distributed at the meetings and events in which the ASN takes part. In 2004, a new version was published in French, along with a version in English to facilitate ASN's international relations.

ASN's public information and documentation center brochure

This document presents the types of audience for whom the centre is intended, the information needs it is designed to meet, the main characteristics of its documentary base and how it actually works in practice.

It is widely distributed to various information providers: pedagogical documentation centres, "major risks" correspondents in the academies, science museum media libraries, libraries of the "Ecoles des mines" colleges, CLI, exhibition sites and symposia in which the ASN participates, as well as the communication departments of the DRASS, DDASS and the prefectures.

The public information sheets

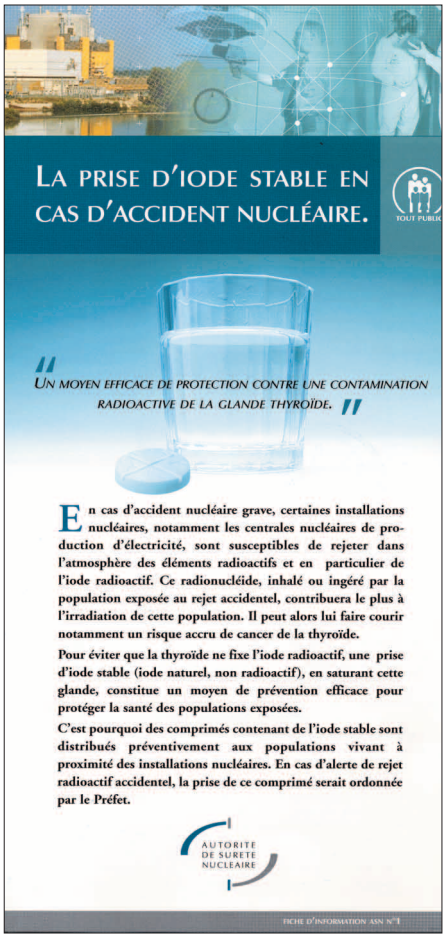
The "ASN information sheets", a new collection which was launched in 2003, are designed to provide targeted, concise and pedagogical information on the main topics of nuclear safety and radiation protection.

These sheets are intended for very wide distribution to the general public and the world of education. They are available from the exhibition sites and symposia in which the ASN participates as well as from various providers such as the CLI and the pedagogical documentation centres. They are also available to the DSNR (Nuclear Safety and Radiation Protection Departments) for local communication operations.

The collection currently comprises 2 numbers.

Sheet n° 1, intended for the general public, is devoted to "The absorption of stable iodine in the event of a nuclear accident". It presents the absorption of stable iodine as a means of preventing the possible effects on the thyroid gland of a release of radioactive iodine.

Sheet n° 2, "Radiation protection principles", presents the principles of justification, optimisation and limitation of ionising radiation exposure doses and the application of these principles to radiation protection of the public, patients and workers.



ASN information sheet concerning administration of stable iodine in the case of a nuclear accident

"Results of the 1999-2001 radon measurement campaign" publication



1999-2001 radon measurement campaign

The results of the 1999-2001 campaign to measure radon in establishments open to the public were published in 2003. These results propose a summary of the methodology employed when choosing the locations likely to be most concerned by the "radon hazard". All the radon measurement results are presented by department and then by region.

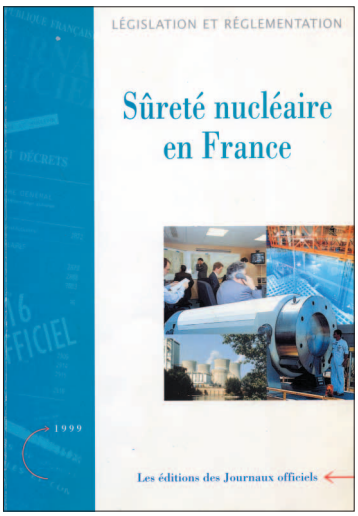
As part of the ASN's policy of transparency, this publication presents all the raw results of the campaign and enables any citizen who so wishes to find out the situation in his or her own area.

The "Medical, industrial and research uses of ionising radiation: declarations and authorisations" publication

A collection aimed specifically at nuclear safety and radiation protection professionals was launched in 2003 with publication of the "Medical, industrial and research uses of ionising radiation: declarations and authorisations" brochure. The purpose of this document was to explain the administrative and regulatory procedures applicable when authorising the use of radioactive sources. It also answered the need expressed by the professionals to find out about recent regulatory changes and identify the stakeholders in their activity sector.



"Medical, industrial and research uses of ionising radiation: declarations and authorisations" publication



Code of nuclear safety regulatory texts

Collected regulatory texts on nuclear safety

In June 1999, the ASN had the *Official Gazette* publish the fourth edition of the collected regulatory texts on nuclear safety. This document, entitled "The safety of nuclear installations in France - laws and regulations" is available from the *Official Gazette*, under number 1606. A new edition is currently being prepared.

Collected regulatory texts on protection against ionising radiation

In August 2000, under number 1420, the *Official Gazette* published the latest edition of the collected legislative and regulatory provisions concerning radiation protection, entitled "Protection against ionising radiation". A new version, which in particular takes account of the regulatory changes that have been made since 22 February 2002, is currently being prepared. The regulatory texts at present in force can also be consulted on the ASN's website.



Code of ionising radiation protection regulations

1 | 3

The public information and documentation centre





Information and documentation center of ASN

On 31 March 2004, the ASN opened its public information and documentation centre in its Paris premises at 6, place du Colonel Bourgoin, 75012 Paris (telephone: 01 40 19 87 23).

This centre gives visitors an opportunity to consult documentation concerning the Nuclear Safety Authority's areas of competence and offers the public access to all of the ASN's publications.

The public can also consult publications about nuclear safety and radiation protection, ionising radiation, its uses and biological effects, produced by the other stakeholders (CLI, CSSIN, nuclear operators, IRSN and other technical experts, health and safety agencies, radiology and radiation protection learned societies, professional associations, environmental protection associations, and so on ...).

To meet the specific needs of a certain informed public, in particular science students and teachers or specialised journalists, the public information and documentation centre also offers a selection of specialised French and English books and reviews, for consultation on the premises.

Finally, certain categories of visitors, such as association representatives, elected officials, journalists and researchers, may want to consult original administrative documents. The public information and documentation centre aims to satisfy specific requests for on-site consultation of administrative documents, such as those generated by the public inquiry prior to authorisation for creation or modification of basic nuclear installations.

The centre can welcome 8 visitors at the same time and offers Internet access, in particular to enable visitors to consult the ASN's website as well as those of French and foreign stakeholders in the sector. Video documents can also be viewed there.

Nine months after opening, the ASN's public information and documentation centre has met the needs of nearly 1000 people. It has sent 2400 ASN publications out to 460 correspondents, answered information requests from 120 web users and 300 phone callers, and welcomed 80 visitors.

1 | 4

The ASN and the media

1 | 4 | 1

Regular relations with the press

In order to meet its duty to inform, the ASN has adopted a policy of close ties with the press. This policy follows the traditional format of press conferences held to present the annual report and the two-monthly issues of Contrôle, regular interviews with journalists interested in a particular subject, press releases, direct and regular contacts with national and regional media, and so on.

The information issued to the media by the ASN in the form of press releases chiefly concerns:

• the implementation of nuclear plant basic regulations (authorisation to start up or shut down installations, environmental release permits, etc);

• the decisions taken and stances adopted on sensitive nuclear safety and radiation protection issues;

• the loss or theft of radioactive sources;

• incidents of a certain importance, in particular incidents classified 2 and higher on the INES scale.

In 2004, questions from journalists primarily concerned:

• the accident at the Mihama plant in Japan, where a steam pipe break in the non-nuclear part of the facility led to the death of 5 workers, and the probability of a similar accident occurring in France;

• the EUROFAB operation, involving fabrication in France of a few MOX fuel test assemblies using American military plutonium declared as surplus to defence requirements.

Believing as it does that nuclear safety and radiation protection are not just the business of specialists, the ASN strives to disseminate information that is high-quality, clear and comprehensible, stripped of over-technical terminology. To do this, a communication training program offers all personnel training opportunities appropriate to their various responsibilities, in the fields of spoken and written communication and crisis management.

In 2004, the communication training programmed enabled:

• the ASN senior management, in regular contact with the national and local written and audiovisual media, to practice communications with the media, in particular in the capacity of spokesperson;

• the ASN's inspectors to familiarise themselves with communication and press relations, including in emergency situations, particularly through writing press releases and interviews with radio and television journalists.

1 | 4 | 2

The ASN and the media in emergency situations

The ASN must be ready to deal with the urgent demand for information that would occur in case of a serious event, particularly in a nuclear facility or during transport of radioactive materials. For this reason most emergency response exercises regularly organised (at the rate of about ten per year) include media pressure. This media pressure, simulated by journalists accredited for the exercise, is designed to assess the responsiveness of the ASN and the ministries concerned when faced with the media, as well as the consistency and coordination of the message put across by the various stakeholders, be they operators or authorities, both nationally and locally.

In addition, "real" media requests are often made during these exercises, with journalists anxious to observe decision and information channels in action, the deployment of the emergency assistance

The INES scale for classification of nuclear incidents and accidents

Presentation and goals of the INES scale

In 1987, France set up a scale to rank the severity of nuclear events which was extensively used by the IAEA in creating its own INES scale (International Nuclear Event Scale). This scale, based partly on objective criteria and partly on subjective criteria, is designed to facilitate media and public understanding of the significance, in terms of safety, of nuclear incidents and accidents. It is not a safety assessment tool and can, under no circumstances, be used as a basis for international comparisons. There is in particular no strict correlation between the number of non-serious incidents declared and the probability of a serious accident occurring in a facility.

Nature of the events concerned by the INES scale

The INES scale is designed to cover events occurring in all civil nuclear facilities, including those classified as secret, and during transport of nuclear materials.

At the initiative of the Nuclear Safety Authority, the member countries of the International Atomic Energy Agency are experimenting with a new part of the INES scale concerning radiation protection incidents dealing with radioactive sources and transports of radioactive materials. This new part incorporates the principle of the relationship between the radiological risk and the severity of the event. Initially, France experimented with systematic application of this scale exclusively to BNIs. A broader application to medical, industrial and research facilities will be subsequently envisaged.

Use of the INES scale in France

All events with significance for nuclear safety are to be declared by the operators within 24 hours. This declaration comprises a proposed classification subject to the approval of the Nuclear Safety Authority, which alone is responsible for the final classification decision.

Using the INES scale enables the ASN to select those events and incidents which are sufficiently important for it to issue a communication:

- all incidents rated level 1 and above are systematically published in the MAGNUC viewdata magazine and on the www.asn.gouv.fr website;
- incidents rated level 2 and above are also the subject of a press release;
- incidents rated level 0 are not always made public by the ASN. They are published if temporarily classified pending the result of further investigations, if they are of interest in terms of safety analysis or methodology, or if they are of particular interest to the media.

Level	Pressurised water reactors	Other facilities	Transports	Total
3 and +	0	0	0	0
2	1	0	0	1
1	56	25	11	92
0	593	100	56	749
Total	650	125	67	842

Classification of nuclear events on the INES scale in 2004

teams, population sheltering or evacuation operations organised for the exercise and the simulated absorption of stable iodine tablets.

Apart from the media pressure simulated by the journalists, the intervention of experts and other players (ministers' advisers, CLI, elected officials, etc.) during the exercises constituted a further step forward in simulating a real nuclear accident situation, which would inevitably lead to many and varied voices being heard at the same time.

The ASN had the opportunity to test its emergency preparedness in a real situation when fire broke out in the Cattenom nuclear power plant in May 2004. The ASN emergency response centre was operational throughout the day and the ASN had to answer questions from journalists which concerned the consequences of this event on the safety of the facility.





ASN emergency response centre

1 | 5

ASN regional actions

1 | 5 | 1

DSNR public information actions

The ASN wishes to ensure greater involvement by the regions, through the Regional Directors for Industry, Research and the Environment (DRIRE) and their Nuclear Safety and Radiation protection Divisions (DSNR).

Every year, a number of regional directors organise a nuclear safety and radiation protection press conference to present a review of their activities and of the safety of the nuclear installations and shipments under their supervision. This approach has been favourably received by the local media, anxious to provide the populations living in the vicinity of nuclear installations with a clear idea of their safety level, often more detailed than that to be derived from national media accounts.

The heads of the various DSNR also grant numerous interviews with local and regional media. In 2004, the Caen DSNR and the Lyon DSNR in particular took part in a France 5 TV documentary about the nuclear risk in France.

Some DSNR also take part in training seminars designed to familiarise journalists with industrial risks. They more specifically deal with nuclear safety and radiation protection.

Similarly, the DSNR attend CLI meetings to help improve local media understanding of issues linked to nuclear safety and radiation protection.

The prefects' offices also contribute to informing the media, in particular during the emergency response exercises organised by the ASN, to which the local press is regularly invited. This is an opportunity for the journalists to understand the decision-making processes, the organisation of the emergency services in the field and the steps taken to shelter or evacuate the populations.

1 | 5 | 2

The "Nuclear activities under close supervision" exhibition

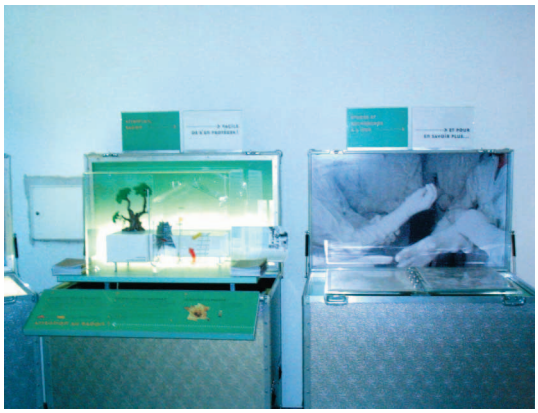
For the past 6 years, the ASN and IRSN have been organising an exhibition travelling around the regions, principally targeted at schools and the general public and designed to provide simple, attractive and direct information about assessment of the risks involved in the use of nuclear power and the corresponding means of supervision. Every year, town halls and schools, scientific, technical or industrial culture centres and museums in 3 or 4 towns host this 250 square metre exhibition for periods of from 6 to 8 weeks.

In 2004, after a presentation at the Pierre Noël museum in Saint-Dié-des-Vosges and the Higher arts and crafts college in Metz, the exhibition was set up at the Industrial systems engineering college in La Rochelle, and then at the tourist office in Martigues town hall. A total of 6120 visitors, including 1120 schoolchildren and teachers, saw the exhibition.

The conferences organised at each stop involve the DSNR of the DRIRE contributing to the inaugural events and disseminating information to elected officials, local press journalists and the general public. In 2004, 210 people in the towns of Saint-Dié-des-Vosges, Metz, La Rochelle and Martigues attended the 8 conferences presented to the general public by the DSNR of Strasbourg, Bordeaux and Marseille. The topics covered were nuclear power plant safety and earthquakes, nuclear power plants and extreme climatic phenomena, radioactive waste management, sources of ionising radiation working for health, and supervision of radioactive sources in non-nuclear industrial facilities.

Finally, to complete this regional public information system, all the ASN's publications were proposed, in particular to science teachers visiting the exhibition.







Exhibition ASN-IRSN
"Nuclear activities under close supervision"

1 | 6

Symposia

In 2004, the ASN aimed to ensure a higher profile for itself at symposia, meetings with professionals and international seminars.

On 4 May 2004, together with the Directorate for the Prevention of Pollution and Risks at the Ministry for Ecology and Sustainable Development, it therefore organised the first national symposium entitled "Radioactive contamination: what steps for polluted sites?". The purpose of this symposium was to review strategies for dealing with radioactive pollution of sites. It brought together some 250 people representing the public authorities, industry, various players from the medical and research worlds, environmental protection associations, local authorities and legal specialists.

The ASN also took part in various professional symposia by sending delegates, providing stands and publishing posters. In 2004, ASN delegates and a stand were proposed for the French radiology days in order to present the new regulatory framework for radiation protection. The ASN played an active role in the conference of the association for radiation protection technologies and sciences, held in Grenoble from 6 to 8 October 2004, on the subject of managing radiological emergency situations.

On 8 December, the ASN also organised the 16th conference of the Local Information Committee chairmen, on the subject of epidemiology (see § 2|2).

2 The local information committees and the national association of Local Information Committees

2 | 1

The Local Information Committees

Local Information Committees (CLI) work alongside the nuclear facilities. These Committees, created at the initiative of the county councils as recommended by a circular from the Prime Minister on 15 December 1981, have a twofold role: to monitor the impact of these facilities and to inform the populations by means they consider most appropriate.

To do this, they require:

• the necessary information, in particular that forwarded by the operators and by the administrations that control them;

• funding which, according to the above-mentioned circular, must be provided by the local authorities reaping economic benefits from the facility considered.

To help the CLI develop their activities, financial aid was also included in the budget of the Ministry for Industry. This sum is used in particular to finance 50% of the specific action and diversified assessment expenses of CLI requesting assistance, and up to 100% of the cost of public information activities. The DSNR also provide technical support as and when needed.

The CLI must aim whenever possible to develop their own opinions and adopt a questioning attitude to their various contacts. They comprise locally elected representatives (generally about half



CLI information brochures

the members), representatives from environmental protection associations, trade unionists, socio-professionals and representatives of the public authorities.

Nearly 30 CLI were created under the terms of the circular of 15 December 1981. To this must be added the local information and monitoring committee (CLIS) of the Bure underground laboratory, created under application of the law of 30 December 1991 concerning research into radioactive waste management (the corresponding legal provision now appears in article L. 542-13 of the environment code), along with about fifteen information committees created around defence-related nuclear sites, in application of articles 4 and 5 of the decree of 5 July 2001.

As in previous years, CLI activity reached high levels in 2004.

The CLI generally held one or more plenary meetings, often supplemented by meetings of specialist committees ("technical" and "population safety" sub-committees at Gravelines, working party on the environmental monitoring plan around the FBFC plant in Romans, "environment", "communication" and "socio-economic" sub-committees at Cadarache, "science", "health", "communication and information" sub-committees in the Gard CLI, "science and society", "information, training and governance" and "news" groups at Saclay, and so on).

The Nogent-sur-Seine CLI set up a monitoring watchdog group which meets on a monthly basis or whenever needed.

Site annual operating reports were presented to most of the CLI. The incidents which occurred were generally examined in depth.

The CLI also dealt with subjects such as the problems of amoeba and legionella in releases (Civaux CLI), the steps taken to deal with the heat wave (Cattenom CLI), procedures under way on facility releases (Cattenom, Chinon, Cruas and Tricastin CLI), plans for new facilities on the site (Cadarache and Tricastin CLI), the EPR (Bugey and Cattenom CLI) or the law on the status of EDF (Chinon CLI).

16th Conference of Local Information Committee Chairmen

The 16th conference of local information committee chairmen was held on 8 December 2004 in Paris, at the initiative of the Ministers for Industry, Ecology and Health.

In addition to the CLI chairmen, this conference attracted members of parliament, representatives of the county councils and prefect's offices in the departments containing a CLI, representatives of the ministries concerned, of associations and operators of nuclear facilities.

The conference took a whole day, with the morning devoted to plenary sessions focused on the topic of epidemiology; the aim being to enable the CLI to better assess the contribution and limits of epidemiology in evaluating risks for those living in the vicinity of a facility.

The participants heard general talks about epidemiology and its sociological approach. Other presentations covered the cancer surveillance system and the results of a study into leukaemia around nuclear sites, which concluded that they had no impact. The chairman of the ANCLI's scientific committee concluded the morning's proceedings with a general debate.

In the afternoon, the participants took part in workshops on various practical questions concerning the working of the CLI: organisation, information distribution, conditions in which information is received. Various recommendations emerged from the work concerning either the actions of the CLI, or the role of the public authorities. The CLI representatives in particular wanted to see the State reinforce the status and role of the CLI, while at the same time leaving them the independence they have enjoyed since they were created.

The event was closed by the Director General for Nuclear Safety and Radiation Protection.

A date and topic have already been envisaged for the 17th conference, which could be organised around the subject "Emergencies and preparedness" and could take place on Wednesday 14 December 2005. This was confirmed after discussion between the ASN and the ANCLI.









16th conference of CLI Chairmen

The CLI are generally involved in the emergency drills, and at the very least receive a presentation of their conclusions (Cattenom, Chinon and Cruas CLI).

The CLI are invited to take part in ASN inspections: in 2004, the Gravelines, Golfech, La Hague, Nogent-sur-Seine and Tricastin CLI in particular replied to these invitations. They can also request specific assessments (Cadarache CLI on analysis of the impact of the site, Gard CLI on the radiological consequences of the flooding of December 2003 in the Petite Camargue area, Golfech CLI for the ten-yearly outage, and so on).

For information of the population, about one third of the CLI send out information letters. Others are offered space in the publications of the general council or the municipality. Information about CLI activities appears on the ASN website and that of the national CLI association (ANCLI). Some CLI also have their own websites (Bure CLIS, Golfech CSP, La Hague CSPI). Others have pages on municipal websites.

Some CLI also organised or supported events open to the public (symposium on plant aging and the safety/competitiveness challenge in Flamanville, ANCLI events in Nogent-sur-Seine and, for the Paluel and Penly CLI, in Dieppe).

2 | 2 The national association of local information committes

The National Association of Local Information Committees (ANCLI) was set up on 5 September 2000. The aim of this association is to create a discussion and information network for the CLI, to provide a resource centre and to act as the interface with the public authorities and national and international nuclear organisations

The ANCLI's activities in 2004 were in particular marked by the following actions.

• DÉCLIC magazine
The ANCLI publishes an information bulletin called DÉCLIC, of which it distributes 6000 free copies. In 2004, issue number 8 was published, in particular devoted to CLI participation in inspections conducted in the facilities.

• INFO sheets
These information sheets are distributed as part of the DÉCLIC magazine, or on request. In 2004, the ANCLI published a sheet on the health effects and medical uses of radioactivity. The print run was 10,000 copies.

• ANCLI annual symposium
On 15 and 16 September, the ANCLI held its 4th annual symposium in Dieppe on the subject "Nuclear power and sustainable development". This symposium attracted about a hundred participants. A visit to the Penly plant wound up the proceedings.

• Training
The ANCLI organises training for CLI members. In 2004, a session was devoted to the local safeguard plans.

• Scientific committee
This committee was set up on 5 March 2003 and brings together qualified personalities from various disciplines in order to answer the scientific questions posed by the CLI. It organised a conference on 6 October 2004 in Nogent-sur-Seine on the subject of the microbiological and chemical impacts of nuclear power plant cooling. It also took part in the work by the National heath and environment plan orientation committee. Finally, it drafted a file on graphite waste disposal intended for the CLI concerned by this question. The scientific committee suspended its activities at the end of 2004 pending consolidation of its resources.

• Site visits

In May 2004, the ANCLI organised a visit to the Saint-Laurent-des-Eaux site, based on the subject of dismantling.

Having chaired the association since it was created, Mr Gérard Niquet, chairman of the Valduc SEIVA, stated his intention of retiring. In the wings of the 16th conference of ANCLI chairmen, the association's board elected his successor, Mr Jean-Claude Delalonde, chairman of the Gravelines CLI.

3 THE HIGH COUNCIL FOR NUCLEAR SAFETY AND INFORMATION

The High Council for Nuclear Safety and Information (CSSIN) was created by the decree of 13 March 1973 and its role was extended by the decree of 2 March 1987.

Its role covers all questions concerning the safety of nuclear facilities and information of the public and media with regard to this safety.

The Council comprises personalities chosen for their information and communication skills, or their expertise in scientific, technical, economic or social fields, members of parliament, representatives of environmental protection associations, of labour organisations, of nuclear facility operators and of the administrations concerned.

The CSSIN is currently being renewed.

4 THE INSTITUTE FOR RADIATION PROTECTION AND NUCLEAR SAFETY

The IRSN, created by the law of 9 May 2001 and the decree of 22 February 2002, was set up as an independent public establishment as part of the national drive to reorganise the supervision of nuclear safety and radiation protection, in order to concentrate public assessment and research resources in these fields.

The Institute runs and implements research programmes designed to consolidate national public expertise in the field of the latest scientific knowledge internationally available in these fields. Its role is to provide technical support to the public authorities with competence for safety, radiation protection and security, in both the civil and defence sectors (nuclear facilities installed on national territory, weapons systems and nuclear powered ships). One requirement of its instituting decree is that it provide certain public service missions beyond the field of research, particularly with regard to monitoring of the environment and persons exposed to ionising radiation. These missions in particular include radiation protection training, management of national databases (national radioactive sources file, SISERI file containing worker exposure to ionising radiation, etc.) as well as helping to inform the public of the risks linked to ionising radiation.

In accordance with this same decree, the IRSN publishes the results of its R&D programmes, except for those related to defence, primarily on its website, which underwent a complete visual overhaul in 2004. This same year, www.irsn.org received more than 600,000 visits and received about 900 messages in its contact@irsn.fr mailbox.

The IRSN reports on its activities in the public annual report it officially communicates to the Ministries responsible for Defence, the Environment, Industry, Research, Health and Social Affairs, as

well as to the Higher Council for Nuclear Safety and Information, to the Higher Council for Public Health in France and to the Higher Council for the Prevention of Professional Risks. The 2003 version of this activity report is available in French and English on the IRSN's website and can be obtained on request either on paper or on a CD-ROM from the Institute (IRSN BP17 92262 Fontenay-aux-Roses Cedex). The 2004 version of this report will be available in July 2005.

With regard to relations between the IRSN and the DGSNR, 2004 was marked by the signing of a framework agreement defining the procedures for dialogue between the two organisations, along with the principles governing the technical support the Institute provides to the DGSNR.

In 2004, the IRSN submitted about 700 opinions to the ASN and about 25 reports to the advisory committees. It in particular presented its expert opinions to 24 sittings of the advisory committees. These opinions primarily concerned:
- the start of examination of the preliminary safety report on the future EPR reactor;
- the reference framework of serious accidents affecting PWRs;
- dismantling strategy for EDF's first generation reactors;
- the safety of the Cabri research reactor;
- the safety options for the future G. Besses ultra-centrifuge enrichment plant;
- the concepts chosen by the ANDRA for the preliminary draft project for deep geological storage involving clay formations on the one hand and granite formations on the other.

The IRSN also contributed to the continued reform of radiation protection regulations and the creation of a national programme to reinforce radiation protection in the medical field, referred to by the acronym PASEPRI (plan of action for supervision of exposure of patients to ionising radiation).

Finally, the travelling exhibition managed by the DGSNR, entitled "Nuclear activities under close supervision" was presented in the towns of Saint-Dié, Metz, La Rochelle and Martigues, welcoming more than 6000 visitors (see § 1|5|2).

For further information, contact: www.irsn.org.

5 OTHER STAKEHOLDERS

Nuclear safety and radiation protection are complex areas in which many parties are involved. Given the diversity of available information, the public can now make up its own mind in particular by consulting the websites of the main organisations concerned. The information they make available varies in nature, from the most general to the most scientific, from the layman to the informed professional.

In line with its policy of transparency, the ASN presents a non-exhaustive list of the main websites dealing with nuclear matters in the broadest sense:

• Local Information Committees (CLI) and High Council for Nuclear Safety and Information (CSSIN)
  - www.asn.gouv.fr (the Nuclear Safety Authority's site is also the point of entry for the CLI and CSSIN sites);
  - www.ancli.fr (site of the National Association of CLI).

• Parliamentary assemblies (reports from the parliamentary office for the assessment of scientific and technical options, bills, work done by committees, etc.)
  - www.assemblee-nationale.fr (site of the French Parliament)

- www.senat.fr. (site of the French Senate)

• Operators

- www.andra.fr (site of the National Agency for Radioactive Waste Management);
- www.cea.fr (site of the Atomic Energy Commission);
- www.cogema.fr (site of the General Company of nuclear matters);
- www.nucleaire.edf.fr (EDF site devoted to the French nuclear power plant population);
- www.framatome-anp.com (site of Framatome-ANP, manufacturer of French nuclear reactors);
- www.laradioactivite.com (popularisation site, produced jointly by the CEA and the CNRS).

• Associations

- www.criirad.com (site of the Commission for Independent Research and Information on Radioactivity);
- www.greenpeace.fr (Greenpeace site);
- www.wise-paris.org (Wise site);
- www.sortirdunucleaire.org (site of the "Sortir du nucléaire" association).

• Health agencies and technical experts

- www.afssa.fr (site of the French Food Product Safety agency);
- www.afssaps.sante.fr (site of the French Health Product Safety agency);
- www.afsse.fr (site of the French Environmental Safety agency);
- www.invs.sante.fr (site of the Health Monitoring institute).

• Learned societies

- www.sfr-radiologie.asso.fr (site of the French Radiology Society);
- www.sfrp.asso.fr (site of the French Radiation Protection Society);
- www.sfen.org (site of the French Nuclear Energy Society).

• Higher education establishments and research centres (engineering colleges, universities, university hospitals, etc.)

• Legislative and regulatory texts

- www.legifrance.gouv.fr;
- www.ladocfrancaise.gouv.fr;
- www.environnement.gouv.fr (law-related part of the Ministry for Ecology and Sustainable Development's web site).

6 OUTLOOK

The State's new budget structure, applicable as of 1 January 2006, requires it to identify "missions", "programmes" and "actions" associated with precise targets and indicators for measuring the results obtained.

The targets selected for the ASN as part of its "supervision of nuclear safety and radiation protection", include reinforcing information of the public by continuing the policy of transparency already being implemented.

Two indicators are associated with this action: the extent to which the general public and a more specialist public are familiar with the ASN and the level of satisfaction with the information provided by the ASN. In 2005, the ASN will be setting up an "opinion barometer" devoted to quantify each of these two indicators.

Setting up a "barometer" such as this is a logical extension of the action already taken by the ASN, in particular in 2004, to develop information of the public in its various areas of activity, especially monitoring of radiation protection and progress towards transparency.

It also confirms the ASN's desire to develop the opportunities for the public to consult various administrative documents easily, in particular those stipulated in special administrative procedures such as public enquiries, ensuring that its public information and documentation centre plays a key role.

The Nuclear Safety Authority also wishes to broaden consultation of the parties concerned in drafting general regulatory texts. Experiments will be launched in 2005.

Finally, the ASN is expecting the "nuclear transparency and safety" bill to advance transparency and public information, giving citizens a right of access to the information in the possession of the operators of nuclear facilities.

INTERNATIONAL RELATIONS

CHAPTER 7

1 THE ASN'S INTERNATIONAL OBJECTIVES

2 INTERNATIONAL AGREEMENTS

3 MULTILATERAL RELATIONS

3|1 The International Atomic Energy Agency (IAEA)

3|2 The OECD's Nuclear Energey Agency (NEA)

3|3 UNSCEAR

3|4 The European Union

3|4|1 The European Commission's working parties

3|4|2 The "Nuclear package"

3|4|3 The European Commission' assistance programmes

3|5 The Nuclear Regulator associations

3|5|1 The International Nuclear Regulators Association

3|5|2 The Western European Nuclear Regulators Association (WENRA)

3|5|3 Framatome nuclear regulators association (FRAREG)

4 BILATERAL RELATIONS

4|1 Staff exchanges between the ASN and its foreign counterparts

4|2 Bilateral relations between the ASN and its foreign conterparts

4|3 Experience feedback from international relations in specific technical fields

5 INTERNATIONAL CONFERENCES

6 OUTLOOK

1 THE ASN'S INTERNATIONAL OBJECTIVES

The international role of the ASN was confirmed by decree n° 2002-255 of 22 February instituting the DGSNR and which in particular states: *"Together with the services of the Minister for Foreign Affairs, the Directorate General for Nuclear Safety and Radiation Protection, in its fields of competence, prepares and proposes the French position prior to international and community debates".*

The main international objectives of the ASN are as follows:

• To develop exchanges of information with its foreign counterparts on regulatory systems and practices, on problems encountered in the nuclear safety and radiation protection field and on provisions made, with a view to enhancing its approach and:

– becoming better acquainted with the actual operating practice of these nuclear safety authorities, from which lessons could be learned for its own working procedures;

– improving its position in technical discussions with the French operators, since its arguments would be strengthened by practical knowledge of conditions abroad.

• To make known and explain the French approach and practices in the nuclear safety and radiation protection field and provide information on measures taken to deal with problems encountered. This approach has several objectives:

– to promote the circulation of information about French positions on certain issues, such as very low level waste, creation of an incidents and accidents classification scale as applied to radiation protection, or the French policy of lowering the authorised limits for BNI releases;

– to provide assistance to countries wishing to create or develop their nuclear safety authority, such as the states of the ex-USSR, and certain emerging countries;

– when requested, to help foreign nuclear safety authorities required to issue permits for nuclear equipment of French origin or design.

• To inform the French public about what is happening abroad.

• To inform other countries of events that have happened in France and provide the countries concerned with all useful information about French nuclear facilities located close to their borders.

• To take part in study groups set up by international organisations and in the drafting by these bodies of texts describing nuclear safety and radiation protection principles and practices.

• To take an active part in the work to harmonise nuclear safety and radiation protection principles and standards, as well as the work involved in drafting European Community directives.

• To implement the undertakings of the French government concerning nuclear safety and radiation protection, in particular within the framework of international agreements.

These objectives are pursued within the framework of bilateral agreements but also through ASN participation in proceedings organised by international bodies such as the International Atomic Energy Agency (IAEA), the Organisation for Economic Cooperation and Development (OECD) and the European Union, together with those of nuclear regulators' associations.

Congresses and conferences are also prime opportunities for exchanges, in which the ASN presents its approaches and its practices.

2 International agreements

In the aftermath of the Chernobyl accident (26 April 1986), which had repercussions on a certain number of neighbouring States, the international community negotiated a number of agreements designed to prevent accidents related to the use of nuclear power and to minimise the consequences. These agreements are based on the principle of voluntary commitments by the States, who alone remain responsible for the facilities placed under their jurisdiction.

Two agreements deal with the prevention of nuclear accidents (Convention on Nuclear Safety and Joint Convention on the Safety of Spent Fuel Management and the Safety of Radioactive Waste Management), while two others deal with management of their consequences (Convention on early notification of a nuclear accident and Convention on assistance in the case of a nuclear accident or radiological emergency). France is a contracting party to these four conventions. The International Atomic Energy Agency (see § 3|1 below) is the depository of these conventions and is responsible for the corresponding secretarial services.

2 | 1

The Convention on nuclear safety

The Convention on nuclear safety concerns civil nuclear power reactors. It entered into force in 1996 and, at the end of September 2004, had been ratified by 55 states (of those countries in possession of a power reactor, only India is not to date a contracting party).

In ratifying the convention, the contracting parties agree to submit a report describing how they apply the fundamental principles of safety and good safety practices, which are the subject of the various articles of the Convention. The reports from the contracting parties are examined during a review meeting during which each party may ask questions concerning any issues it wishes to raise.

The first two contracting party examination meetings were held in April 1999 and April 2002. The main topics of the debates in 2002 were the periodic safety reviews, the reduction in release authorisations and maintaining safety in reactors for which shutdown is already programmed. The national reports for the third examination meeting scheduled for April 2005 were sent to the IAEA in September 2004. As with the previous examination meetings, the ASN was responsible for coordinating the French national report.

2 | 2

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

The "Joint Convention", as it is often called, is the counterpart of the nuclear safety convention for spent fuel and radioactive waste management facilities. France approved it on 27 April 2000. The Joint Convention came into force on 18 June 2001. At the end of September 2004, it was ratified or approved by 34 states (Brazil, China, Italy, Russia, and many other countries which have radioactive waste originating from medical, industrial and research uses, have still not signed it).

2 | 3

The Convention on early notification of a nuclear accident

The Convention on early notification of a nuclear accident entered into force in October 1986, 6 months after the Chernobyl accident and at the end of August 2004, it had been ratified by 92 States.

The contracting parties agree to inform the international community as rapidly as possible of any accident leading to uncontrolled release into the environment of radioactive material likely to affect a neighbouring State. A system of communication between States is therefore coordinated by the IAEA and regular drills are held among the contracting parties. The ASN is the point of contact for France.

2 | 4

Convention on assistance in the case of a nuclear accident or radiological emergency

The Convention on assistance in the case of a nuclear accident or radiological emergency entered into force in February 1987 and at the end of August 2004 had been ratified by 89 States. Its purpose is to facilitate cooperation between countries if one of them were to be affected by an accident with radiological consequences. This convention has already been used on several occasions for accidents due to abandoned radioactive sources. Within this context, France's specialised services have already taken charge of treating irradiated victims. The ASN is the point of contact for France.

2 | 5

Other conventions related to nuclear safety

Other international conventions, which do not directly involve the ASN, may be related to nuclear safety.

This is particularly the case with the Convention on the physical protection of nuclear material, the aim of which is to reinforce protection against malicious acts and the unlawful use of nuclear materials. This convention, which entered into force in February 1987, had by the end of August 2004 been ratified by 105 States, including France.

Additional information on these conventions can be obtained from the website of the International Atomic Energy Agency:
http://www-ns.iaea.org/conventions/

3 MULTILATERAL RELATIONS

3 | 1

The International Atomic Energy Agency (AIEA)

The IAEA is a United Nations agency with 137 Member States. With regard to the area of competence of the ASN, the activities of the IAEA primarily consist in:
– organising discussion groups at different levels and preparing texts known as "Safety Standards", describing safety principles and practices which can then be used by Member States as a basis for national regulations. Since the beginning of 1996, this activity has been monitored by the Commission on Safety Standards (CSS), comprised of senior representatives of the regulatory authorities of 20 Member States and required to propose standards to the Director General of the Agency. This commission co-ordinates the activities of four committees entrusted with supervising the drafting of documents in four areas: NUSSC (NUclear Safety Standards Committee) for reactor safety, RASSC (RAdiation Safety Standards Committee) for radiation protection, TRANSSC (TRANsport Safety Standards Committee) for the safe transport of radioactive materials and WASSC (WAste Safety

Standards Committee) for safe radioactive waste management. France is represented on all these committees.
These "safety standards" approved by the CSS and published under the responsibility of the IAEA's Director General, can be broken down into 3 levels of documents: safety fundamentals, safety specifications and safety guides. At the end of 2004, 62 revised safety standards have been published, 4 others have been approved and 38 others are currently being written or revised;

– setting up "services" made available to Member States and designed to give them opinions on specific safety-related aspects. This category of activities includes the OSART, IRRT, PROSPER, TRANSAS, etc.
In 2004, an OSART mission (nuclear power plant operational safety review team) took place in December at Penly NPP. A preparatory OSART mission took place at Blayais NPP in May along with a follow-up mission at Nogent-sur-Seine NPP in November and another at Civaux NPP in December. Reports on the OSART missions carried out in France since 1995 are currently available in English, the original language, on the ASN website (www.asn.gouv.fr).
From 28 March to 8 April 2004, the ASN received a TRANSAS mission ("TRANsport Safety Appraisal Service") comprising 14 experts from 9 different countries and from the IAEA. Based on examination of files and on interviews this mission assessed how France applies international regulations concerning the safe transport of radioactive materials. Following its mission, the TRANSAS team identified 12 good practices and submitted 3 recommendations and 16 suggestions (see chapter 11, § 1.4). These were written up in a report which was made public. The recommendations and suggestions will constitute the basis for implementing a plan of action by the ASN so that it can further improve its practices;

– harmonisation of communication tools. The French proposal of a radiation protection events classification scale led to intense international debate aimed at improving the international nuclear events scale (INES).
In the past, the Nuclear Safety Authority played a pivotal role in the creation of the INES scale. It also played an active role in drafting the scale for classifying radioactive material transport incidents. France is by far the leading user of the INES scale for providing information about events occurring in basic nuclear installations (BNI) and during radioactive material transport.
Since it was set up in February 2002, the Directorate General for Nuclear Safety and Radiation Protection has felt the need for a radiation protection incidents communication tool. The existing INES scale was felt to be an inadequate means of communicating with regard to exposure to ionising radiation, as its radiation protection criterion did not refer to the radiological risk, which is the basis of the current regulations. France therefore rekindled the international debate with a view to adding a radiation protection criterion to the INES scale so as to link the radiation exposure dose received to the radiation protection incident or accident gravity index.
The French proposal led to trials in the member countries of the International Atomic Energy Agency (IAEA) of a new part of the INES scale concerning radiation protection incidents, which takes account of radioactive sources and shipments of radioactive materials. This new part, which includes the principle of the relationship between the radiological risk and the gravity of the event, has been applicable in France since 1 January 2005. Initially, France limited initial application of this new scale to BNIs and to transport. Broader application to medical, industrial and research facilities will then be envisaged.

3 | 2

The OECD's Nuclear Energy Agency (NEA)

The NEA, set up in 1958, comprises all the OECD States, except for New Zealand and Poland, or 29 countries. Its main objective is to promote co-operation between the governments of Member States for the development of nuclear energy as a reliable and environmentally and economically acceptable energy source.

Within the NEA, the ASN takes part in the activities of the Committee on Nuclear Regulatory Activities (CNRA). During its two annual meetings, the CNRA in particular debated the use of perfor-

mance indicators for the safety of nuclear facilities. In May, it also organised a seminar on the effectiveness of Safety Authority communication with the public, during which problems encountered and experiences of interest were raised.

In the radiation protection field, the ASN continued to take part in the CRPPH (Committee on Radiation Protection and Public Health) and one of its sub-groups EGRA (Expert Group on Regulatory Authorisation), which is drafting a new process for categorising exposure situations using a formalised approach with a case by case examination to decide how such exposure may or may not be authorised.

3 | 3

UNSCEAR

Created in 1955, UNSCEAR (United Nations Scientific Committee on Effects of Atomic Radiations) summarises all scientific data concerning radiation sources and their environmental and health risks. The reports published by this scientific body, which constitute the international reference, cover subjects such as the hereditary effects of radiation and the consequences of the Chernobyl accident.

This activity is supervised by the annual meeting of the national representations of the member States, comprising high-level experts, and at which the ASN is represented.

3 | 4

The European Union

3 | 4 | 1

The European Commission's working parties

Frequent contacts with the Commission (DG/TREN) are a means of reviewing the progress and prospects of regulatory work in the field of radiation protection: working of the Euratom treaty committees and transposition of directives in particular.

The ASN also takes party in working groups coordinated by the European Commission and designed to compare certain safety practices in the member States of the Union:

- standing working group for the safe transport of radioactive materials,
- safety authorities working group, whose technical discussions in 2004 concerned a document on in-service inspection.

3 | 4 | 2

The "Nuclear package"

The expression "nuclear package" designates a group of two draft directives prepared by the European Commission, one defining general principles for the safety of nuclear facilities and the other covering the management of spent fuel and radioactive waste.

It has not been possible to adopt these texts owing to opposition from a number of member states within the Union, who felt that texts not legally binding, such as resolutions or recommendations, would be preferable.

The ASN's position

The ASN believes that it is necessary to move towards harmonising nuclear safety principles and standards and therefore played an active part in the debate in order to define the French position, which is favourable to these projects. It supported the "packet", which tends on the whole to correspond to what it expects, with the European Commission respecting national competences. Legally binding directives would have given greater stability to the European nuclear safety legislative and regulatory framework.

In June 2004, the European Council adopted conclusions finding that there was no consensus on this subject and it recommended continuing with the work aimed at achieving progress in nuclear safety harmonisation, similar to the work done by WENRA (see § 3|5|2 below). During its meeting of 27 October 2004, The European Commission's Atomic Questions Group proposed implementation of a plan of action.

3 | 4 | 3

The European Commission' assistance programmes

The aim of the assistance programmes

The G7 summit in Munich, in July 1992, defined three priority areas for nuclear-related assistance to the countries of central and eastern Europe and the newly independent states from the ex-Soviet Union:
- contribute to improving the operating safety of existing reactors;
- provide funding for short-term improvements to the least safe reactors;
- 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.

Assistance programmes were set up by the European Commission to achieve these goals.

ASN participation in the assistance programmes

The European Commission's PHARE and TACIS programmes

In the field of assistance to safety authorities, which falls within the third priority area defined by the G7, the ASN takes part in the programmes funded by the European Union as part of the budgets allocated to PHARE (more particularly concerning the candidates for accession to the Union) and TACIS: these are the programmes of the Regulatory Assistance Management Group (RAMG).

The ASN, which was the pilot for the Czech and Slovak programmes, chaired the final meeting of the project to assist the nuclear safety authorities of these two countries in Bratislava on 8 and 9 March 2004. In 2004, the ASN took part in three other PHARE projects involving the safety authorities of Hungary (transfer of Western European methodology and regulatory practices), Bulgaria (assistance on high-level sealed sources management) and Lithuania (support with the safety culture and organisational aspects related to shutdown of the Ignalina plant).

The ASN is coordinating the project to transfer Western European methodology and regulatory practices to the Ukrainian Safety Authority. As part of a project designed to submit a technical opinion to the European Commission regarding nuclear safety assistance for the safety authorities of the newly independent States, the ASN acts as pilot for the Ukraine and Kazakhstan and took part in an exploratory mission in Georgia. It is also taking part in an assistance project for the Russian nuclear safety authority, piloted by Germany.

Finally, another area of cooperation with the Russian Federation is to help this country's safety authority to construct the regulatory framework necessary to authorise the nuclear facilities that need

to be built for elimination of the military plutonium declared as surplus to Russian defence needs. The ASN therefore took part in meetings of experts from Europe (Germany, Belgium, France) and America, organised under the joint auspices of the United States Department of Energy (DOE) and the European Commission, who together with the Russians are financing the planned construction programme.

These actions are supplemented by other international technical assistance programmes in which the ASN is a participant.

Other international technical assistance programmes

The ASN advises the French delegation to the G7's nuclear safety working group and the corresponding G8 group on nuclear safety matters. This G8 group, called the NSSG (Nuclear Safety and Security Group), also encompasses nuclear safety aspects. The DGSNR in particular took part in the meetings of these groups in Geneva, in February 2004.

The DGSNR is a participant in the expert groups reporting to the EBRD (European Bank for Reconstruction and Development), responsible for managing multilateral funds to finance the following actions:
- decommissioning of nuclear reactors in Bulgaria (Kozloduy 1 to 4), Lithuania (Ignalina 1&2), Slovakia (Bohunice V1 - 1&2), Ukraine (Chernobyl 1&3),
- installation of a new sarcophagus on Chernobyl unit 4,
- dismantling of decommissioned Russian nuclear submarines and radiological clean-up of the Barents sea military bases.

The ASN's position

Significant progress has been made in the three priority areas defined by the G7:
- improvements have been made to in-service safety of reactors,
- certain States (Bulgaria, Lithuania, Slovakia, Ukraine) have undertaken to close down the least safe reactors,
- the role and remit of the nuclear safety authorities have been reinforced and clarified in the European Union accession states.

The safety authorities of the States which joined on the Union on 1 May 2004 have therefore reached a level which should dispense with the need for further assistance.

However, in the states of the ex-USSR, this key objective will not be reached for some time, owing to the profound changes it implies: adaptation of the structures of the State itself, change in mentality to admit the independence of the nuclear safety authorities and thus underpin their credibility, reinforce their status and their means.

3 | 5

The Nuclear Regulators associations

3 | 5 | 1

The International Nuclear Regulators Association

INRA, which brings together the nuclear regulators of Germany, Canada, Spain, the United States of America, France, Japan, the United Kingdom and Sweden, met twice in 2004 under the joint Japanese chairmanship of Messrs Matsuura (NSC) and Sasaki (NISA, METI) in Tokyo in April, and Messrs Matsuura (NSC) and Matsunaga (NISA, METI) in Kyoto in December.

Apart from the presentations of the main events in their respective countries, the INRA members discussed measures to further increase the effectiveness of nuclear safety monitoring organisations, how to respond to a deterioration in the safety culture of the operators, inspector training, the safety consequences of aging facilities, and communication with the public within an international framework.

3 | 5 | 2

The Western European Nuclear Regulators Association (WENRA)

The WENRA association was officially created in February 1999, with the founding members being the nuclear regulators of Germany, Belgium, Spain, Finland, France, Italy, the Netherlands, the United Kingdom, Sweden and Switzerland. The Director of the DSIN was nominated first Chairman for a period of two years and his term of office was extended in 2001 for a further period of two years. Following their March 2003 meeting, the WENRA members appointed Mrs Judith Melin (Sweden) as chairwoman. During this same meeting, they decided to admit to the association the regulators of the seven "nuclear" countries (operating at least one nuclear reactor to produce electricity) applying for membership of the European Union: Bulgaria, Hungary, Lithuania, Romania, Slovakia, Slovenia and the Czech Republic.

The objectives defined by the WENRA members when the association was created are:

- to provide the European Union with an independent capability for examining and regulating nuclear safety problems in the countries applying for membership of the Union;
- to develop a common approach to nuclear safety and regulation, in particular within the European Union.

With regard to the first task, WENRA in October 2000 published a revised version of its report on safety in the seven nuclear countries applying for membership of the Union. This report contributed to the position adopted by the Council of the European Union and the recommendations sent by the Commission to these countries to enable them to attain the high level of nuclear safety required prior to their acceptance into the Union.

With regard to the second task it set for itself (harmonisation of national approaches to safety), WENRA created two working groups:

- one (under the control of the British safety authority) for nuclear power plants (see chapter 12),
- the other (under the control of the ASN) for management of spent fuel and radioactive waste and for dismantling operations (see chapter 16).

In each of these fields, the groups began by defining the reference levels for each technical topic, based on the IAEA's most recent standards and on the most demanding approaches employed within the European Union (and therefore, for all practical purposes, in the world).

An initial pilot study (the conclusions of which are available on the ASN's website), conducted into the harmonisation of nuclear reactor safety in the founding member states, demonstrated the relevance and effectiveness of the methodology adopted, and a process for assessing national practices in relation to these reference levels was then developed.

During its two annual plenary meetings, WENRA is kept informed of the progress of the groups work and determines future guidelines for the groups. Thus, in 2004, during the latest meeting in Stockholm (23 - 24 November), having seen the encouraging way in which the work was progressing, the WENRA members confirmed the following undertakings made during the previous meeting (Munich, 17 - 18 March):

- the working groups will return their final conclusions, containing the results of the national practices assessment process, before the WENRA plenary session scheduled by December 2005,

- before the end of 2006, each member will present a plan of action which, for each technical field in which differences have been identified, aims to bring its national practices into line with the defined reference levels,
- national practices must be harmonised by 2010.

The ASN's position

This work as a whole confirms WENRA's ability to conduct a "bottom-up" nuclear safety harmonisation programme, in addition to any "top-down" European directives of a more general scope.

The INRA and WENRA, created at the initiative of the Director General of the ASN, are two unique and irreplaceable forums for free and informal discussion by the nuclear regulators.

3 | 5 | 3

Framatome nuclear regulators association (FRAREG)

The FRAREG (FRAmatome REGulators) association was created in May 2000 at the inaugural meeting held in Cape Town at the invitation of the South African nuclear safety authority. It brings together the senior executives from the nuclear safety authorities of South Africa, Belgium, China (People's Republic), South Korea and France.

Its mandate is to facilitate transfer of experience gained from supervision of the reactors designed and/or built by the same supplier and to enable the safety authorities to compare the methods they use to handle generic problems and evaluate the level of safety of the Framatome type reactors they supervise.

4 BILATERAL RELATIONS

The ASN works with many countries within the framework of bilateral agreements signed at various levels:
- governmental agreements (Germany, Belgium, Luxembourg, Switzerland),
- administrative arrangements between the ASN and its counterparts (about twenty).

4 | 1

Staff exchanges between the ASN and its foreign counterparts

One way for improving knowledge of the actual workings of foreign safety authorities (and improve ASN) is to develop the system of staff exchanges.

The safety authorities concerned by these exchanges have so far been those of Germany, Belgium, Canada, China, Spain, the United States of America, Japan, the United Kingdom and Spain.

Provision is made for several types of exchange:
- very short term actions (1 to 2 days), where cross-inspections are proposed to our counterparts: they consist in inviting foreign inspectors to take part in inspections carried out by inspectors of the country concerned.

In 2004, cross-inspections were carried out in France, Germany, Belgium, Spain, the United Kingdom and Switzerland in particular. In order to collect foreign experience in the field of radiation protection monitoring, French inspectors took part with counterparts at the British Ministry for Health in an inspection of medical equipment and its use in Northampton hospital in July 2003. Other cross-inspections on this same subject were carried out in the second half of 2004 in Birmingham hospital

in the United Kingdom, in the Lausanne CHUV in Switzerland, and in Spain on the subject of hospital waste and Sweden on the subject of practitioner exposure. Reciprocal inspections were carried out in 2004 in French hospitals with participation by these countries and others being scheduled for 2005.
In the field of nuclear reactor safety, it is worth mentioning the participation by French inspectors in an inspection at Almaraz in Spain, on the subject of effluent monitoring, and the participation by Spanish inspectors in the ten-yearly outage testing of a containment at Le Blayais.
With regard to fuel cycle installations and nuclear facility dismantling sites, we must mention the delegation of British inspectors who in 2004 took part in an inspection at La Hague and the participation by French inspectors on the Dounreay reactor dismantling worksite;

– short-term assignments (3 weeks to 3 months), aimed at studying a specific technical topic.
There were no missions of this type in 2004;

– long-term exchanges (about 3 years) in order to take part in the working of the foreign nuclear safety and radiation protection authority to gain an in-depth knowledge of it.
This type of exchange must obviously be reciprocal. Therefore:
- a succession of ASN engineers have worked at the British nuclear safety authority since 1997, with the latest being in place since the summer of 2002. Similarly, an engineer joined the Spanish nuclear safety authority in early 2000 and stayed there until mid-2003;
- an engineer from the British nuclear safety authority joined the ASN from February 2001 to August 2002 and he was replaced by another engineer in January 2003. Finally, an engineer from the Spanish nuclear safety authority joined the ASN from September 2000 to June 2001 and he was replaced by another from September 2002 to mid-2004.

The first lessons learned from these exchanges have benefited to French practice, for example with the introduction of review inspections in 2000. As the ASN has also been responsible for monitoring radiation protection since February 2002, it is relying heavily on these exchanges to speed up development of its system of radiation protection inspections in the industrial and medical fields, using proven methods and the best practices observed at our counterparts.

4 | 2

Bilateral relations between the ASN and its foreign counterparts

Of the member countries and safety authorities with which the ASN had the most frequent contacts in 2004, we could mention the following examples.

South Africa

Bilateral exchanges in 2004 between the NNR (National Nuclear Regulator) and the ASN mainly concerning power reactors and experimental reactors.

With regard to power reactors, and more particularly the French-designed Koeberg plant, the following topics were primarily dealt with:
– the appearance of corrosion due to the marine atmosphere, which had not been observed in France, including on the older plants;
– the organisation and resources to be deployed in emergency situations and the reactor improvements that have to be made to reduce consequences for the population and the environment.

Cooperative subjects are also included in the field of safety for future reactors (EPR, PBMR projects).

With regard to experimental reactors, France transmitted its experience of the safety assessment conducted when the high-enrichment uranium cores were replaced with low-enrichment uranium cores, in order to comply with the non-proliferation objectives defined by the IAEA.



Meeting of the ASN with its South African counterpart

Germany

In 2004, the plenary meeting of the Franco-German Commission on nuclear facility safety questions (DFK) was held in Berlin. The DFK's working groups exchanged information about safety and radiation protection in plants along the border and worked to improve information exchanges between the various organisations concerned, in particular in the event of an incident or accident. The Commission also visited the BAM (Federal materials research and testing institute) which is in particular working on the strength of transport packages and carries out drop tests on these packages.

In 2004, Franco-German meetings were also held on the subject of radiation protection inspections.

Argentina

In 2004, the ASN and the "Autoridad Regulatoria Nuclear" initiated cooperation in the field of radiobiological scientific watch. This cooperation led to production of a review of the scientific literature in two priority areas:
- what are the genetic and epigenetic factors responsible for or involved in the phenomenon of individual radiosensitivity to ionising radiation? The work done in this field will lead to the publication of two articles in the *European Journal of Nuclear Medicine* in 2005;
- what are the responses of the immune system to an attack by ionising radiation? The work in this area is being done together with UNSCEAR with the aim of publication in 2006 of document A/AC.82/R.641 entitled "Ionizing radiation and the immune system".

The two fields of individual radiosensitivity and impairment of the immune system by ionising radiation were chosen because the large number of publications on these subjects reflects their importance and their implications for radiation protection.

Belgium

Relations with Belgium cover a wide range of fields, particularly safety, waste management, transport and radiation protection. In 2004, the ASN and its Belgian counterpart (AFCN: federal nuclear inspection agency) drafted a doctrinal document on the safety of geological disposal. This docu-

ment was presented on 5 November at a European seminar (see chapter 16). 2004 also saw the ASN and its Belgian counterpart begin to organise cross-inspections in the field of radiation protection.

China (People's Republic)

In 2004, the scope of relations with China was extended to take in radiation protection. The ASN received a delegation of about ten people from regional environmental radiological surveillance organisations. Inspector exchanges with the Guangdong regional office of our Chinese counterpart (NNSA) continued and exchanges began for the first time with the Shanghai regional office. In October, the Director General of the DGSNR took part in the Chinese nuclear safety authority's 20th anniversary ceremonies in Beijing.

Spain

In the Spring of 2004, the ASN together with the IRSN received a delegation from the "Consejo de Securidad Nuclear" (CSN) for a technical meeting about the frequency of containment tightness tests and the corresponding criteria. The debates also concerned the risks linked to aging of these containments.

In 2004, inspections with cross-participation were carried out in two fields: medical radiation protection in Spain and containment tests on nuclear reactors in France.

During the course of 2004, an inspector from the CSN specialising in radiation protection carried out a second nine-month mission at the ASN, bringing to bear her knowledge and personal experience of inspection in this field.

United States

On the subject of the decontamination of polluted sites and management and disposal of low-level radioactive waste, the ASN took part in the Federal Environmental Protection Agency's (EPA) annual conference devoted to the use of special funds for decontaminating "orphan" polluted sites. This delegation followed an extensive programme of visits established jointly with the EPA, the NRC (Nuclear Regulatory Commission) and the DOE (Department of Energy). Regarding safety and radiation protection, the mission was highly fruitful and in particular led to a clearer understanding of certain differences between the practices and regulations in the two countries, in particular those due to geological and geographical particularities.

Concerning power reactors, a visit was made to the United States to look at materials integrity. It covered two technical topics: the 600 alloy zones and the steam generators in pressurised water reactors. The discussions primarily dealt with maintaining the integrity of the steam generator tubes, the vessel heads, the vessel bottom head penetrations and qualification of non-destructive examinations. Information was also exchanged concerning the potential risks of the spread of legionnella by nuclear power plant cooling towers.

With regard to the dismantling of nuclear facilities, technical visits were made to compare the French and American approaches to dismantling and management of the resulting waste:

- visit during Spring to the dismantling site of the first BWR type power reactor at Big Rock Point, in the State of Michigan. This site is reminiscent of that of Brennilis, whose reactor (heavy water) was of a similar power;
- visit during Fall to Creys-Malville, to look at the Superphénix dismantling work.

Concerning exchanges in the field of radiation protection, two ASN inspectors followed an in-depth periodic monitoring inspection in California conducted by the NRC on the competent authority of this State, and to which it delegated authorisation for radiation protection supervision.



Dismantling site (Big Rock Point nuclear plant, Michigan)

Finland

Relations with our Finnish counterpart (STUK) in 2004 were dominated by cooperation on the EPR project, as Finland is the first country to build a reactor of this type (see § 2|4|4 of chapter 12).

Japan

2004 was marked by a considerable rise in the volume of information exchanged with Japan, which is looking for extensive cooperation with France.

On the one hand, the Japanese authorities hope to cooperate with the French nuclear safety authority, and their technical support bodies with the IRSN. This in particular concerns the safety of the fuel cycle (MOX fuel manufacturing plant and spent fuel reprocessing facilities at Rokkasho-Mura), waste management, nuclear power plants (operator certification, maintenance, installation conformity examination, periodic safety reviews of existing facilities and implementation of new safety rules) as well as radiation protection.

On the other, the ASN received numerous requests for visits from regional representatives (Aomori prefecture in particular) and electrical utility federations, primarily on the subject of information of the public and transparency, as well as the provisions adopted by France for emergency situation management in the event of an accident.

United Kingdom

2004 was an opportunity to continue exchanges on the safety problems caused by dismantling of nuclear facilities.

The ASN and the NII have a long-standing programme of inspector exchanges, which have helped stimulate the bilateral processes between the two safety authorities. Cross-participation in French and British nuclear inspections were therefore carried out in 2004, concerning radioactive waste repositories, facilities currently being dismantled and power reactors in operation.

Future exchanges could deal with radiation protection regulations and the use of probabilistic safety studied to assess the safety of nuclear power plants.

Sweden

In 2004, relations with our Swedish counterparts (SKI for safety and SSI for radiation protection) mainly covered the problems of dismantling and waste management. Our Finnish counterparts (STUK) also took part in these exchanges.

Switzerland

In 2004, exchanges with Switzerland mainly covered power reactors, radiation protection and the management of radioactive waste.

With regard to power reactors, the ASN presented its position concerning the risk of sump filter clogging and re-assessment of the seismic hazard and its consequences on the facilities, in particular at the Fessenheim plant. The Swiss safety authority (HSK) for its part presented its research work into a probabilistic approach to determine seismic movement (PEGASOS project).

The discussions also concerned the organisation of mutual exchanges of information at a regional level covering nuclear power plants along the border, both during normal operations and in an emergency situation. In this respect, it is worth noting that the ASN was contacted on many occasions by the authorities of the Swiss cantons concerning the safety of the Fessenheim plant.

Concerning radiation protection, much information was exchanged with the Swiss Federal Office of public health, an inspection with cross-participation was conducted in a Swiss hospital in autumn of 2004 and another is scheduled for a French hospital in early 2005. Exchanges also covered the regulations to be applied concerning the intentional addition of radionuclides to consumer goods and commonplace objects.

With regard to radioactive waste management, the ASN presented the national radioactive waste management plan (PNGDR) the aim of which is to enable all types of existing radioactive waste to be dealt with by an appropriate channel. A visit to the CSA (Aube repository for medium and low level waste, in Soulaines), and the CSTFA (very low level waste repository in Morvilliers) were opportunities to see certain elements of this plan in action. HSK for its part presented the involvement of local communities in the high-level waste repository project.

4 | 3

Experience feedback from international relations in specific technical fields

In addition to the examples given above, special mention must be made of the experience feedback from international contacts in the field of the nuclear fuel cycle.

Fuel fabrication plants

As part of the safety review of the FBFC fuel fabrication plant in Romans-sur-Isère and in order to take advantage of foreign experience gained in the operation of similar installations, an ASN and IRSN delegation went in 2003 to the European countries that operate this type of facility: Sweden, Germany, United Kingdom, Spain and Belgium. These missions (supplemented in 2004 by a visit to Russia) were an opportunity for fruitful technical exchanges between safety organisations and with the operators of the facilities visited. Following a seminar on 27 January 2004, with all of its counterparts who took part in this operation, the ASN presented the experience feedback from this international consultation at the Conference organised by the IAEA in October 2004 in Beijing (see chapter 14, § 2|3|1).



Session of the AIEA international Conference of Beijing (18-22 October 2004) chaired by Director general of the ASN

Uranium enrichment plants

In 2004, COGEMA submitted a request for authorisation to build an ultra-centrifuge natural uranium enrichment plant which would eventually replace the Eurodif plant which uses a gaseous diffusion isotope separation process. Examination of this project involved the nuclear safety authority visiting nuclear facilities throughout Europe that use the same technology and initiating exchanges with its foreign counterparts concerning the corresponding safety considerations (see chapter 14, § 2|2|2).

5 INTERNATIONAL CONFERENCES

The ASN's participation in international conferences was an opportunity to exchange extremely useful information on regulatory practices and the problems encountered in the fields of nuclear safety, radioactive material transport, polluted site management and waste disposal.

Among these events, those organised by the ASN were as follows:
- the symposium of 4 May 2004, organised by the ASN and the DPPR (Directorate for the Prevention of Pollution and Risks) on the topic "Radioactive contamination: what steps for polluted sites?" (see chapter 16, § 5|3|2),
- the European seminar of 5 November 2004, organised by the ASN and the Belgian AFCN on the safety approach to waste disposal repositories (see chapter 16, § 6|2|2).

The organisation of these events clearly reflects the importance that the ASN attaches to the safe management of materials and sites after their use as part of an activity involving radioactive substances.

DATE	PLACE	SUBJECT
1 – 4 March	Tucson (Arizona, United States)	Waste
10 – 12 March	Washington (United States)	Regulatory Information Conference organised by the NRC
4 May	Paris (France)	International symposium: "Radioactive contamination: what steps for polluted sites?", organised by the ASN
17 – 21 May	Ottawa (Canada)	International NEA seminar "Building, measuring and improving public confidence in the nuclear regulator"
23 – 28 May	Madrid (Spain)	11th IRPA conference (International Radiation Protection Association)
26 – 28 July	San Diego (United States)	PVP congress (American Society of Mechanical Engineers)
6 – 10 September	Roma (Italy)	NEA international seminar on dismantling
20 – 24 September	Berlin (Germany)	PATRAM conference (Packaging and Transportation of Radioactive Materials)
21 – 24 September	Obninsk (Russia)	NATO seminar on "Safety improvements through operational feedback from nuclear research and experimentation acilities"
22 – 24 September	Uppsala (Sweden)	NEA seminar (European ALARA network) "Occupational exposure"
18 – 22 October	Beijing (China)	"IAEA Conference on topical issues in nuclear safety"
5 November	Paris (France)	European seminar on "Elements of the Safety Approach related to Geological Disposal of Radioactive Waste", organised by the ASN and the AFCN
13 – 17 December	Cordoba (Spain)	International symposium on disposal of low-level waste

6 Outlook

International relations are important activities for the nuclear safety authority and are an efficient way of taking nuclear safety and radiation protection forward both in France and abroad.

They enable the ASN and its counterparts to gain a clearer picture and better understanding of their mutual operating methods and the problems that each of them faces. They also enable help to be given to any country wishing to develop or adapt its safety authority.

They are also the driving force behind the necessary harmonisation of safety and radiation protection principles and standards.

In the field of radiation protection, few bilateral frameworks exist and the "multi-bilateral" frameworks (associations of radiation protection regulators) are yet to be created. This will lead the ASN to expand the area of the existing arrangements or to sign new arrangements, depending on the organisation of the countries with which it wishes to develop cooperation, as radiation protection is not only an issue in States operating nuclear installations, but is relevant in all countries with modern medical, scientific or industrial activities.

RADIOLOGICAL EMERGENCY SITUATIONS

CHAPTER 8

1 NON-BNI RADIOLOGICAL EMERGENCY SITUATIONS

1|1 Response to radiological emergency situations
1|1|1 Responsibility for the response
1|1|2 Response principles
1|1|3 The role of the ASN
1|1|4 Care and treatment of radiation victims

1|2 Interventions in 2004

2 NUCLEAR EMERGENCY SITUATIONS

2|1 General emergency response provisions
2|1|1 Local provisions
2|1|2 National provisions
2|1|3 Emergency plans

2|2 The role and provisions of the ASN
2|2|1 ASN duties in case of emergency
2|2|2 Provisions concerning nuclear safety
2|2|3 DGSNR emergency response centre
2|2|4 Role of the ASN in the preparation of emergency plans

2|3 Accident simulation drills
2|3|1 Drill sessions involving the ASN
2|3|2 The lessons learned from the drills

2|4 Developments in nuclear emergency provisions
2|4|1 Experience feedback from the storms of 2 and 3 December 2003 in the Rhone valley
2|4|2 Revision of the offsite emergency plans for nuclear sites
2|4|3 Stable iodine preventive distribution
2|4|4 Emergency response provisions regarding radioactive material transport accidents
2|4|5 Post-accident management
2|4|6 Updating of regulatory texts governing nuclear installations or radioactive material transport accident provisions

3 OUTLOOK

Nuclear activities are carried out with the two-fold aim of preventing accidents, but also of mitigating any consequences should they occur. To achieve this, in accordance with the principle of defence in depth, provision must be made to deal with a radiological emergency situation, however improbable. A "radiological emergency situation" is one resulting from an incident or accident likely to lead to the release of radioactive materials or to a level of radioactivity likely to harm public health, as defined in article R. 1333-76 of the Public Health Code. The term "nuclear emergency" is reserved for events which could lead to a radiological emergency on a basic nuclear installation.

For activities with a high level of risk, such as BNIs, the emergency provisions, which can be considered the "ultimate" lines of defence, comprise special organisational arrangements and emergency plans, involving both the operator and the authorities. These plans in particular specify the nature of the responses to be provided for to protect the population, given the scale of the exposure. These emergency provisions, which are regularly tested and evaluated, are the subject of regular revisions to take account of experience feedback from drills organised, as well as from management of incidents such as those which occurred in the Civaux plant on 12 May 1998, the Le Blayais plant on 27 December 1999, and the Cruas and Tricastin plants on 2 and 3 December 2003 following the violent storms in the Rhone valley.

Radiological accidents can also occur outside BNIs, either in an institution carrying out nuclear activities (hospital, research laboratory, etc.), or owing to the loss of a radioactive source, or by inadvertent or intentional dispersal of radioactive substances into the environment. For certain sites, this type of situation could be managed through an onsite emergency plan. It is up to the authorities to ensure protection of the population when necessary. The ASN takes part in this for questions relating to radiation protection.

Whatever the origin of the accident, the irradiated or contaminated victims are treated in hospitals according to the management plans currently being updated.

In 2004, the ASN was involved in (non-BNI) radiation protection incidents which, even if there was no health risk, nonetheless warranted checks and radioactivity measurements.

Other situations can also trigger a response, for example situations arising from nuclear activities or industrial activities which handled materials containing natural radioelements (uranium or thorium) in the recent or more distant past. Although generally less important than accident situations in terms of exposure, these situations, in which exposure is liable to last for a long time if nothing is done ("durable" exposure), do nonetheless present a human health risk in the medium to long term. They are mentioned in Chapter 15.

1 NON-BNI RADIOLOGICAL EMERGENCY SITUATIONS

1|1

Response to radiological emergency situations

Radiological emergencies can arise:
- during performance of a nuclear activity, whether for medical, research or industrial purposes. For example: a fire in a radioactive source storage area, an accident with an industrial irradiator, and so on;
- in the case of intentional or inadvertent dispersal of radioactive substances into the environment. For example: inadvertent incineration of a radioactive source;

- if radioactive sources are discovered in places they are not supposed to be in;
- in the event of theft or loss of radioactive sources.

It is then necessary to respond, to put an end to any risk of human exposure to ionising radiation.

1 | 1 | 1

Responsibility for the response

In these situations, responsibility for the decision to implement and then for actual implementation of protective measures lies with the head of the site on which the nuclear activity takes place (hospital, research laboratory, etc.), who then initiates the onsite emergency plan as stipulated in article L.1333-6 of the Public Health Code (if the potential hazards of the installation so justify), or lies with the owner of the site with regard to the safety of persons on the site, and with the Prefect with regard to the safety of persons in the areas accessible to the public. The role of the ASN is to monitor the actions of the head of the institution or owner of the site and to advise the Prefect with regard to the steps to be taken to prevent or mitigate the direct or indirect effects of the resulting ionising radiation on individuals, including through damage to the environment. In the case of an accident occurring in a place where there is no clearly identified responsibility (irradiation due to an isolated source, contamination by dispersal of radioactive substances, etc.), responsibility for the response lies with the Prefect of the department.

1 | 1 | 2

Response principles

Once the authorities have been alerted, the response generally comprises two main phases:

- Making safe: this is the most urgent phase. The purpose of the steps taken during this phase is to take charge of any victims, ensure that people are safe and protect the environment (clearly signposted security perimeter, containment of radioactive sources, biological protection, etc.) and to return to a controlled situation. They are decided on and implemented under the responsibility of the Prefect, on the advice of the ASN or the head of the establishment or site owner under the supervision of the ASN. This phase comprises four aspects:

• evaluation by one or more teams (operator, CMIR, IRSN, ASN, etc.);

• decision taken by the Prefect, on the advice of the ASN or the head of the establishment or site owner under the supervision of the ASN;

• action taken under the responsibility of the Prefect or the head of the establishment or the site owner;

• communication by the various parties involved, including the ASN.

The Prefect [or the head of the establishment or site owner] co-ordinates the response teams, on the basis of their technical competence, and decides on the protection measures. The ASN assists the Prefect [supervises the head of the establishment or site owner] on the resources to be committed, with the decisions to be taken and communication required concerning the event.

- Cleaning up: this is the post-emergency phase. Once all risk of accidental exposure of humans has been ruled out, the purpose of this phase is to return to a normal situation, in particular by cleaning up the premises or removing the sources to a duly authorised facility. It can require the expertise of the IRSN or another organisation. This phase involves the Prefect [or the owner], the ASN, and as applicable teams of experts, decontamination companies, transporters, etc.

1 | 1 | 3

The role of the ASN

In these situations, as for accidents occurring in nuclear installations, the role of the ASN is to advise the Prefect regarding the steps to be taken to protect the populations, as necessary to supervise whoever is in charge of the nuclear activity in question, and to take part in circulating information. The ASN is supported by the IRSN and DSNR, DDASS and DRASS concerned.

A telephone hot-line (**toll-free number 0 800 804 135**) was opened in 2003 by the ASN to take all calls notifying incidents involving sources of ionising radiation used outside BNIs. It is staffed 24 hours a day, 7 days a week. The information given during the call is transmitted to an ASN supervisor who will manage the incident. Depending on the seriousness of the accident, the ASN can activate its emergency centre in Paris.

1 | 1 | 4

Care and treatment of radiation victims

The terrorist attacks of 11 September 2001 in New York and the explosion of the AZF plant in Toulouse on 21 September 2001 led the authorities to envisage disaster scenarios which could occur anywhere in the country, with large numbers of injured (from several hundred to several thousand). In the case of a nuclear or radiological accident, a significant percentage of these injured could be contaminated by radionuclides, posing specific care and treatment problems for the emergency response teams.

Together with the Hospitalisation and Health Care Directorate (DHOS) of the Ministry for Health, the services of the Defence High Official (HFD) of the Ministry for Health, the specialists of the Paris SAMU (emergency medical service), the armed forces radiological protection service (SPRA), the IRSN, CEA, EDF and universities, the ASN drew up a series of primary response sheets called the "Medical response to a nuclear or radiological event". This document contains all useful information needed by front-line medical personnel responsible for collecting and transporting the injured, as well as by hospital personnel who will be receiving them in the nearby hospital facilities. This guide acts as a teaching aid for the medical emergency professionals national training programme set up by the Ministry for Health and the French SAMU emergency medical service.

The "Medical response to a nuclear or radiological event" file comes in addition to circular DHOS/HFD/DGSNR no. 2002/277 of 2 May 2002 concerning the organisation of medical care in the case of a nuclear or radiological accident. This circular is supplemented by circular DHOS/HFD no. 2002/284 of 3 May 2002 concerning the organisation of the hospital system in the event of arrival of large numbers of victims, setting up a departmental plan of hospital capacity provisions and a zone-based organisation for all nuclear and radiological, but also biological and chemical hazards.

The "Medical response to a nuclear or radiological event" file is currently being revised to take account of the new zone-based organisation and offer improved support for the medical personnel training sessions involving practical work currently being deployed nationally.

A drill was conducted on 10 October 2004 to test how injured persons who had been contaminated by radiation were handled by a hospital. The purpose of this drill was to check the ability of the Necker hospital in Paris to process, manage, treat and counsel victims of a terrorist attack, while ensuring that the hospital could still continue to carry out its normal functions.

The R*53 drill

Since September 2001, the ASN has been actively contributing to preparing the French government's response to the risk of a nuclear and radiological terrorist threat, in particular through the Piratome plan, circular DHOS/HFD/DGSNR no. 2002-277 of 2 May 2002 concerning the organisation of medical care in the event of a nuclear or radiological accident, and circular SGDN/PSE/PPS no. 800 of 23 April 2003 from the General Secretariat for National Defence (SGDN) concerning national doctrine regarding emergency response to terrorism involving radioactive materials.

The ASN naturally joined forces with the AP-HP (Paris public hospitals) and the Paris SAMU in drawing up the R*53 drill, for which it drafted the radiological component of the scenario. The R*53 drill enabled the ASN to test its resources and response and to train its emergency teams in a field as yet little explored.

The drill took place on 10 October 2004 at the Necker hospital. It was organised by the management of the AP-HP and Paris SAMU, jointly with the Paris police department, the DGSNR and the IRSN. The extras were students from the IFSI (nursing care training institute) at Necker hospital, who played the role of 50 injured people and 3 critically wounded.

The scenario was to test the medical component of the response to a terrorist attack in the metro with a dirty bomb containing radioactive materials emitting gamma radiation (cobalt or caesium). The attack had been claimed as radiological and the fire brigade (CMIR) confirmed the presence of radioactivity in the field. Victims with varying degrees of injuries and contamination had come to Necker hospital having slipped through all the checks and controls in the field. This drill comprised 2 phases concerning 50 injured people and 3 critically wounded.

4 points became clear.

- The volunteer personnel from different functions and hospitals were efficiently managed in implementing the care chain, demonstrating that the proposed procedures and training were feasible.

- The drill demonstrated the pertinence of established close cooperation in the field between hospital staff and the DGSNR and IRSN. The conditions for feasible detection and management of waste were identified.

- In general, collaboration with all the services involved proved to be extremely valuable and this joint assessment led to identification of the best ideas for improvement. Including children in future drills will be the next step.

- Audiovisual documents filmed during the drill will be analysed. Some will be used as teaching material while others will be used to highlight inadequacies, in particular concerning personnel safety either because the protective clothes are too fragile or because they are hard to identify. These documents, along with the procedures tested and modified after the above-mentioned analysis, will be used for training purposes, in particular on the NRBC platform in the Broussais hospital.



Decontamination tent: during the emergency exercice, two decontamination tents have been erected. Each tent allows to treat 10 people per hour, who are undressed, showered and decontaminated

Example of an intervention in 2004

Gammagraphy incident during work by the Institut de Soudure Ouest company in the Total refinery in Gonfreville-l'Orcher (76).

In December 2003, the ASN was informed by the Labour inspectorate of an over-exposure incident concerning 2 temporary workers from the Institut de soudure Ouest (IS Ouest) company, who were inspecting a weld in the Total refinery at Gonfreville-l'Orcher. The dose of ionising radiation received exceeded twice the regulation annual limit (35 mSv for 12 consecutive months).

The authorisation to possess and use radionuclides in the form of a sealed source for gammagraphy purposes expired on 18 November 2003, and on 24 September 2003, IS Ouest submitted an application for renewal of its authorisation.

The ASN asked IS Ouest to suspend all gammagraphy activities on its outside worksites.

The ASN conducted a joint inspection with the Labour inspectorate and took part in a number of meetings to identify the reasons for this incident.

IS Ouest analysed the causes of the incident and presented a detailed report specifying the steps to be taken to prevent the incident happening again and to ensure greater compliance with the regulations in force.

After presentation of a further dossier incorporating the lessons learned from this incident, IS Ouest was authorised to resume operations in June 2004.

1 | 2

Interventions in 2004

2004 saw the ASN continue to set up organisational measures to deal with radiological incidents outside basic nuclear installations (BNIs). The ASN has also started talks with the IRSN, the CEA and the Directorate for Civil Security and Defence, which have radiological emergency response units, so that information circulates correctly and the response resources are coordinated. This coordination of the resources available to the Prefect will be explained in a circular being prepared at interministerial level in 2004.

At the same time, the ASN continued to be involved in events which could lead to a radiological hazard. Of these various events which required action on the part of the ASN, we should mention the gammagraphy incident at Gonfreville-l'Orcher (see below).

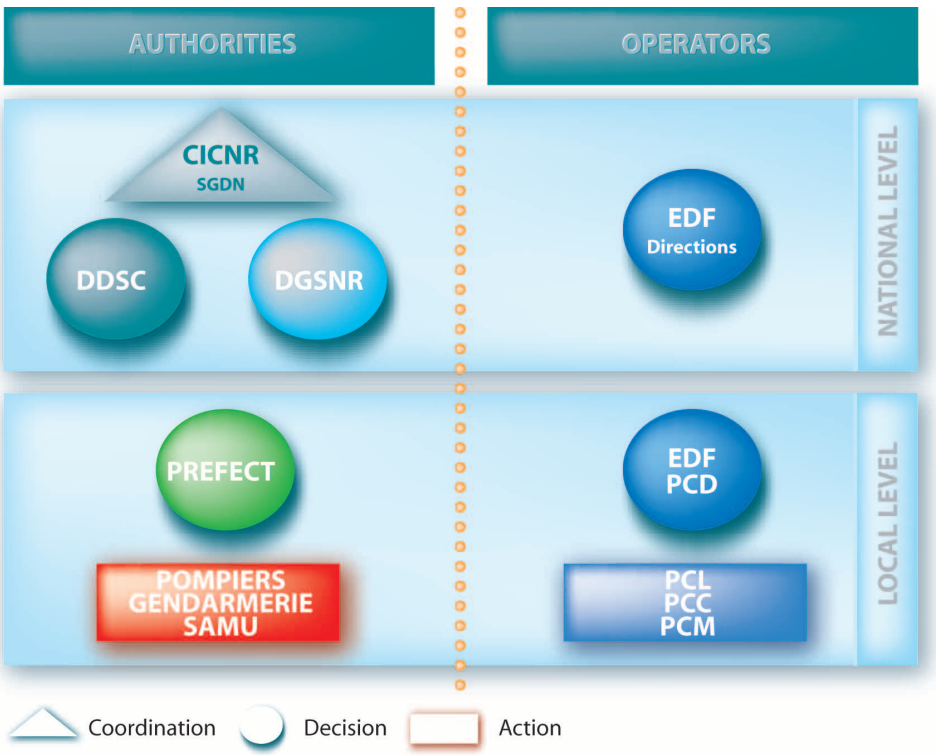
2 NUCLEAR EMERGENCY SITUATIONS

2 | 1

General emergency response provisions

The organisational provisions of the 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 security and also in the emergency plans provided for in decree 88-622 of 6 May 1988. The organisational provisions of both the authorities and the operator are summarised in the diagram hereafter for the case of an accident in an EDF reactor. Similar provisions are made in the case of other nuclear operators.

Crisis organisation



2 | 1 | 1

Local provisions

In a crisis situation, only two parties are authorised to take 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 authorities. These measures are fully defined in the onsite emergency plan (PUI), which it is the operator's duty to prepare;
- the Prefect of the department in which 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 offsite emergency plan (PPI), which he has specially prepared for the vicinity of the installation considered. He is thus responsible for co-ordination of the PPI resources, both public and private, equipment and manpower. He keeps the population and the local elected officials informed of events.

2 | 1 | 2

National provisions

The ministers concerned take all necessary measures to enable the Prefect to make the requisite decisions, notably by providing, as does the operator, all information and recommendations which could assist him in his appraisal of the condition of the installation, the gravity of the incident or accident and possible subsequent developments.

The main bodies concerned are as follows:
- Ministry of the Interior: the Directorate for Civil Security and Defence (DDSC), which has at its disposal the Operational Centre for Interministerial Emergency Provisions (COGIC) and the Nuclear Risk

Management Aid Mission (MARN), which place at the disposal of the Prefect the human reinforcements and supplies he requires to safeguard people and property;
- Ministry for Health: the DGSNR, which is responsible for the health protection of people with regard to ionising radiation effects;
- Ministry for Industry and Ministry for the Environment: the DGSNR for supervision of the safety of nuclear installations with the technical assistance of the IRSN. The Minister for Industry also co-ordinates communication at national level in the event of an incident or accident occurring at a nuclear installation within his sphere of competence or during transportation of nuclear materials; as competent authority, the DGSNR collects and summarises information with a view to issuing the notifications, information and requests for assistance required by the international conventions on informing foreign countries of a radiological emergency;
- Ministry for Defence and Ministry for Industry: the defence nuclear safety and radiation protection delegate (DSND) is the competent authority for supervising the safety of secret basic nuclear installations, military nuclear systems (SNM) and defence-related transports. A draft protocol between the DGSNR and the DSND was produced to ensure coordination between these two entities during an accident affecting an activity under the control of the DSND in order to facilitate the transition from the emergency phase managed by the DSND to the post-accident phase for which the DGSNR has competence;
- General Secretariat for National Defence (SGDN): the SGDN handles the secretarial functions for the Interministerial Committee for Nuclear and Radiological Emergencies (CICNR). It is responsible for coordinating the action of the ministries concerned regarding the planned measures in the event of an accident and for ensuring that drills are scheduled and then assessed.

The CICNR is convened at the initiative of the Prime Minister. Its role is to coordinate governmental action in the event of a radiological or nuclear emergency situation.

2 | 1 | 3

Emergency plans

2 | 1 | 3 | 1

General principle

Application of the defence in depth principle implies inclusion of severe accidents with a very low probability of occurrence 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 onsite emergency plan (PUI), prepared 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 for rapidly informing the authorities.

The offsite emergency plan (PPI), drafted by the Prefect, is aimed at protecting populations in the short term in the event of potential danger and providing the operator with outside assistance for such actions. It defines the tasks assigned to the various services concerned, the warning system utilisation instructions and material and human resources.

2 | 1 | 3 | 2

Technical bases and countermeasures

The emergency plans must be able to respond effectively to accidents liable to occur at BNIs. This implies the definition of technical bases, i.e. the adoption of one or more accident scenarios encompassing the possible consequences, with a view to determining the nature and extent of the remedial means required. The task is difficult, since 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), calculate dispersion in the environment and finally assess 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 the direct impact of the estimated release. Such measures could include:
- sheltering at home, to protect 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, when the above measures offer inadequate protection faced with the levels of activity released.

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 within a radius of 10 kilometres and evacuate populations within a maximum radius of 5 kilometres.

Attention is also drawn to the fact that the PPIs are only concerned with emergency measures and are not intended to anticipate longer term measures with a broader scope, such as restrictions on the consumption or sale of foodstuffs, or the rehabilitation of contaminated areas.

2 | 2

The role and provisions of the ASN

2 | 2 | 1

ASN duties in case of emergency

In an emergency situation, the DGSNR, with IRSN assistance and the co-operation of the DRIRE concerned, has a four-fold function:
1) ensure that judicious provisions are made by the operator;
2) advise the Prefect;
3) contribute to the circulation of information;
4) act as competent authority within the framework of the international conventions.

2 | 2 | 1 | 1

Supervision of operator actions

Whether in normal operating conditions or in an emergency situation, operator actions are supervised by the ASN. In this particular context, it falls to the DGSNR to ensure that the operator fully assumes its responsibilities regarding control of the situation, mitigation of consequences and the rapid and regular provision of information to the authorities; however, the DGSNR assignment in this context stops short of actually prescribing the technical decisions to be implemented to deal with the accident. Notably, when several strategies are open to the operator, some of which could have severe environmental consequences, it is important for the ASN to be fully informed of the conditions under which the operator makes its decisions.

2 | 2 | 1 | 2

Advising the Prefect

The decision by the Prefect concerning the population protection measures to be taken depends on the actual or probable consequences of the accident around the site and it is the DGSNR which advises

the Prefect in this respect, on the basis of the analysis performed by the IRSN. This analysis combines diagnosis (understanding of the situation at the plant concerned) and prognosis (assessment of possible short-term developments, notably radioactive release). This advice also concerns the steps to be taken to protect the health of the public. .

2 | 2 | 1 | 3

Circulation of information

The DGSNR has several functions in this context:
- information of the media and the general public: the DGSNR contributes to informing both the media and the general public in different ways (press releases, web site, press conference). It is obviously important that this should be done in close collaboration with other organisations concerned (Prefect, local and national operator, etc.);
- information of the authorities: the DGSNR keeps the supervisory Ministers informed, together with the SGDN (General Secretariat for National Defence) which in turn informs the President and the Prime Minister. The DGSNR also keeps informed the DGEMP (Directorate General for Energy and Raw Materials) at the Ministry for Industry;
- information of foreign safety authorities: without prejudice to application of the international conventions signed by France concerning information exchanges in the event of an incident or accident liable to involve radiological consequences, the DGSNR informs foreign safety authorities, especially those with which it has mutual safety information agreements.

2 | 2 | 1 | 4

The role of competent authority

Since publication of decree 2003-865 of 8 September 2003, the DGSNR has performed the duties of competent authority as defined in the international conventions (conventions on early notification and assistance in the event of a nuclear accident or radiological emergency, which were signed by France on 26 September 1986, and decision by the Council of European Communities on 14 December 1987, concerning community procedures for rapid exchange of information in the event of a radiological emergency situation). In this respect it collects and summarises information with a view to ensuring the notifications, information and requests required by these conventions concerning notification of foreign countries in the event of a radiological emergency. This information is forwarded to the international organisations (IAEA and European Union).

2 | 2 | 2

Provisions concerning nuclear safety

2 | 2 | 2 | 1

Main components

In the event of an incident or accident at a BNI, the DGSNR, assisted by the IRSN and the Nuclear Safety and Radiation Protection Departments (DSNR) of the DRIREs, activates the following structures:

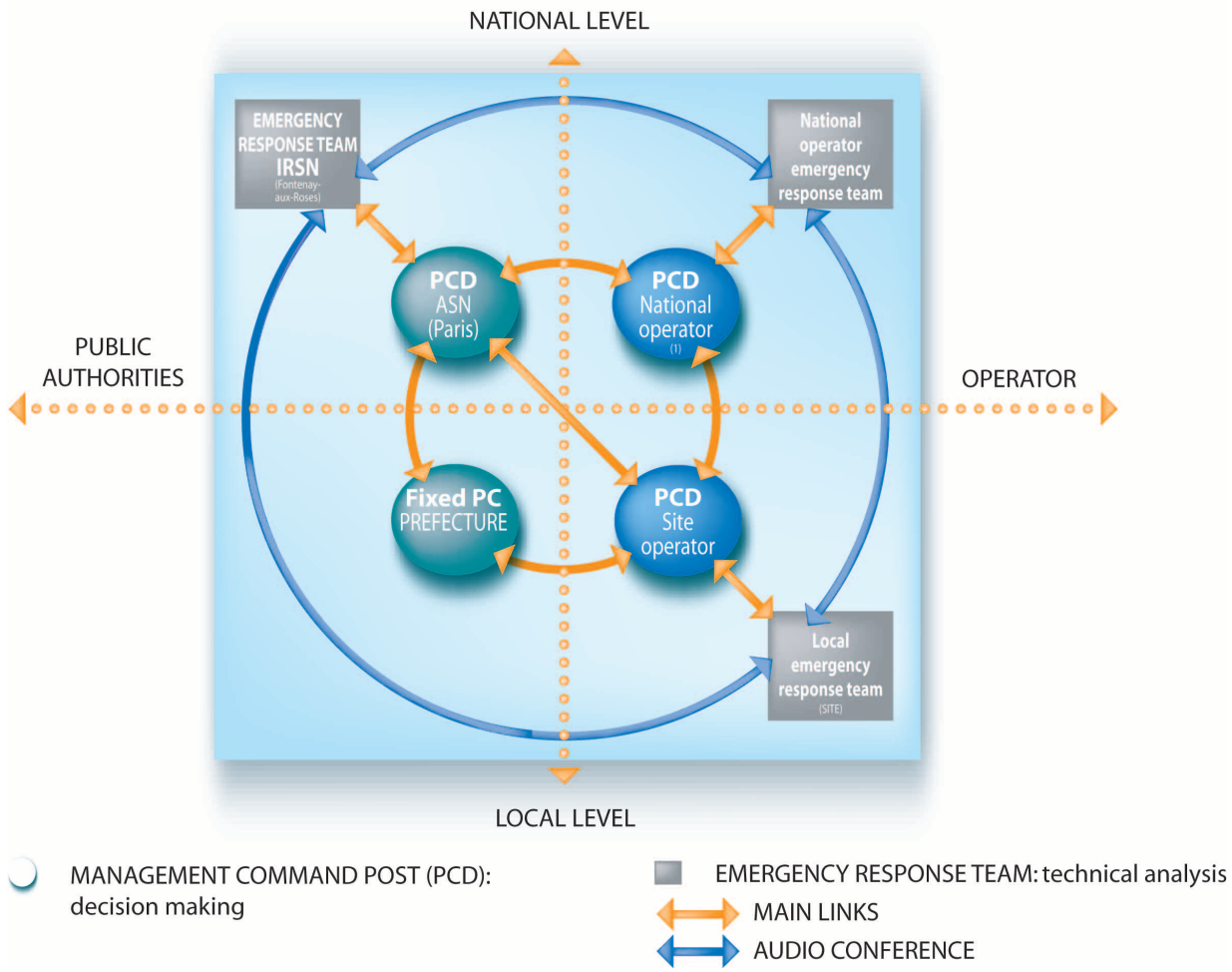
- at national level:
• a decision-making body or command centre (called DGSNR PCD), located in the DGSNR's crisis management centre in Paris. This body is headed by the director of the DGSNR or his representative. It is required to adopt positions or make decisions but to refrain from technical analysis of the ongoing accident. A DGSNR spokesperson, other than the head of the PCD, will be nominated to represent the DGSNR in its contacts with the media;
• an information unit, located near the DGSNR PCD, directed by a DGSNR representative, with the assistance of staff from the Communication Department (SIRCOM) at the Ministry of the Economy, Finance and Industry;

• an emergency response analysis team, led by the IRSN Director General or his representative. This team is resident at the IRSN technical crisis centre (CTC), located in the nuclear research centre at Fontenay-aux-Roses. The DGSNR may delegate an engineer to it. This team works in close co-ordination with the operator technical teams to reach a consensus on analysis of the accident situation and forecasting of developments and consequences;

– at local level:
• a local team at the prefecture, consisting mainly of representatives from the local DSNR, whose purpose is to assist the Prefect in making his decisions and implementing his communication actions by providing explanations enabling understanding of the technical aspects involved, in close collaboration with the DGSNR PCD;
• a local team at the affected plant site, also consisting of DSNR engineers, assisting the site PCD head. It takes no part in operator decisions, but ensures that responsibilities are correctly assumed, notably as regards information of the authorities. This team also collects relevant data for use in the context of the ensuing post-accident inquiry.

The DGSNR, its technical support organisation the IRSN, and the main nuclear operators have signed protocols covering emergency response planning. These protocols designate those who will be responsible in the event of an emergency and define their respective roles and the communication methods to be employed.

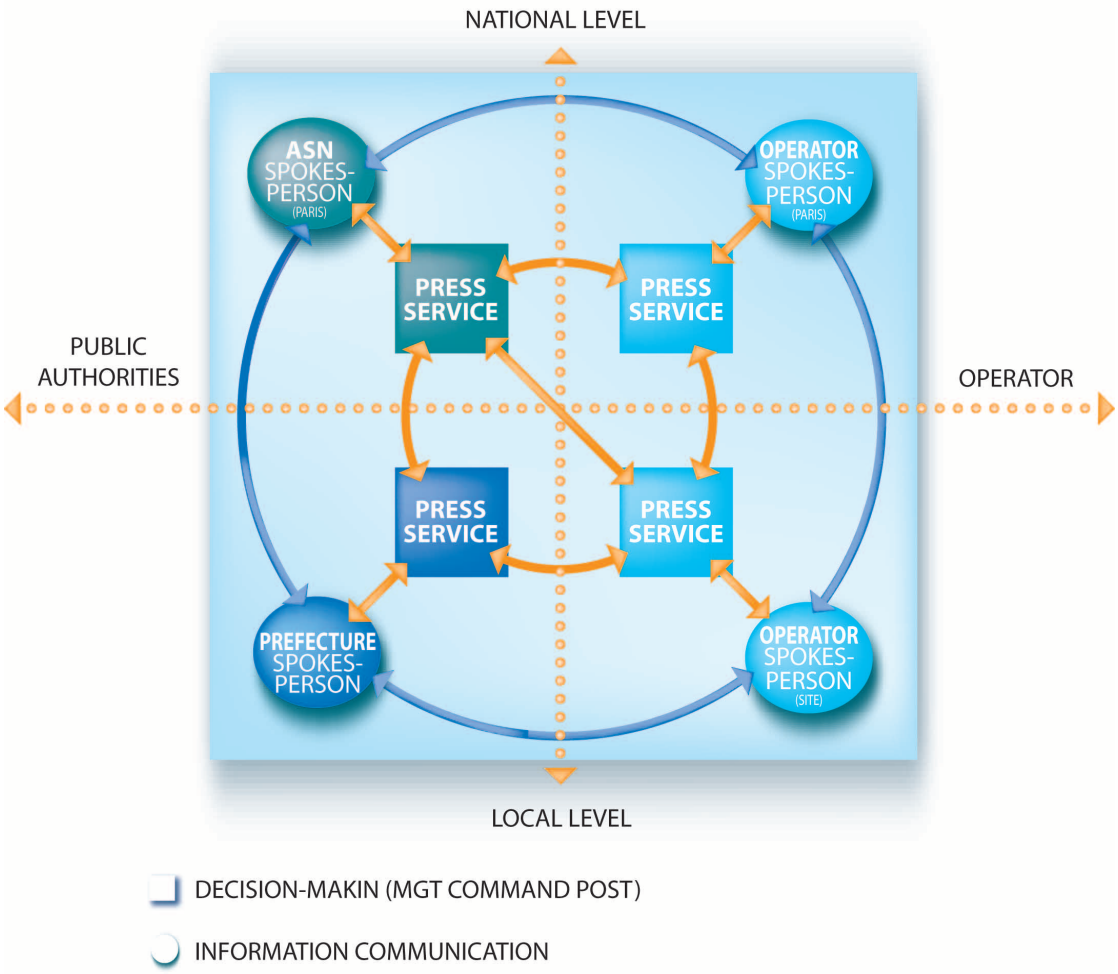
Nuclear safety organisation



The diagram below presents the overall emergency response structures set up, in collaboration with the Prefect and the operator. It shows that the operator has a local PCD on the site and usually a national PCD in Paris, each connected with its own emergency response team. The various connections shown on the diagram indicate information exchanges.

The diagram below shows the structures set up between the communication units and the PCD spokespersons with a view to allowing the necessary consultation ensuring consistency of the information issued to the public and the media.

Information organisation



2 | 2 | 3

DGSNR emergency response centre

In order to be able to carry out these assignments, the DGSNR has its own emergency response centre, equipped with communication and data processing facilities enabling:
- swift mobilisation of ASN staff;
- reliable exchange of information between the many partners concerned.

This emergency response centre was used for the first time under real emergency conditions on 28 and 29 December 1999, in connection with the incident which occurred at the Le Blayais nuclear power plant, further to the violent storm on 27 December 1999. It was used again on 2 and 3 December 2003 during the violent storms in the Rhone valley, which caused the Cruas nuclear power plant to trigger its onsite emergency plan (PUI) and alert the ASN. During the course of these two days, the Tricastin plant and its operational hot unit (BCOT) also triggered their PUI.

In 2004, the emergency response centre was called into action on 16 May, when a fire broke out in the non-nuclear part of the Cattenom power plant.

· Alarm system

The ASN alarm system ensures swift mobilisation of the DGSNR and DSNR teams concerned and the IRSN on-call engineer. This automatic paging or telephone system enables automatic summoning of all agents equipped with dedicated pagers or mobile phones, remotely triggered by the operator of the affected nuclear plant. This alarm system also contacts agents at the Directorate for Civil Security and Defence (DDSC), at the General Secretariat for National Defence (SGDN) and at Météo France.

· Telecommunication resources

In addition to public telephone network facilities, the emergency response centre is equipped with several separate limited-access telecommunication networks and a direct line to the main nuclear sites. The DGSNR PCD also has a video-conferencing system for direct contact with the IRSN's CTC. The DGSNR PCD also makes use of data processing equipment adapted to its assignments, in particular to inform the European Commission and the Member States.

2 | 2 | 4

Role of the ASN in the preparation of emergency plans

2 | 2 | 4 | 1

Onsite plan approval and supervision of application

Since January 1991, and in the same way as the safety analysis report and the general operating rules, the onsite emergency plan (PUI) is among the safety documents which have to be submitted to the DGSNR by the operator at least six months before the installation of radioactive materials in a BNI. In this context, the PUI is assessed by the IRSN and the relevant Advisory Committee expresses its opinion on it.

The PUI updating procedure is as follows:

– if a BNI authorisation decree specifies PUI approval, an updated onsite 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 the 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.

The handling of PUI updating is entrusted to the DRIRE-DSNRs.

Correct implementation of onsite emergency plans is supervised by the ASN in the course of inspections (see Chapter 4).

2 | 2 | 4 | 2

Participation in offsite plan preparation

In application of the decree of 6 June 1988 on emergency plans, the Prefect is responsible for the drafting and approval of offsite 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 corresponding to a decision by the Prefect to immediately trigger intervention, the content of which has been predetermined, in the event of accidents which could cause radioactive releases such as to lead to the response trigger level off the site being exceeded in less than 6 hours. The operator has at its disposal objective criteria approved by the ASN, comprising parameters identified in advance and easily accessible to the operators. Definition of the response levels is based on the most recent international recommendations and, since 2003, has been stipulated in regulatory requirements (order).

As part of this PPI overhaul, the ASN approved the rapidly evolving accident scenarios defined by the operators.

2 | 3

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

2 | 3 | 1

Drill sessions involving the ASN

2 | 3 | 1 | 1

Nuclear alert tests and mobilisation drills

The DGSNR periodically organises tests to ensure that the DGSNR and DRIRE personnel alarm warning system is operating correctly. The system is also used for the drills described below and undergoes unannounced tests.

2 | 3 | 1 | 2

National nuclear accident simulation drills

In 2004, as in previous years, the ASN drafted a national programme of nuclear accident simulation drills, of which the Prefects were notified by a circular signed jointly by the DGSNR, the DSND (defence nuclear safety and radiation protection delegate), the DDSC and the SGDN.

There are two types of drills:
- drills 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;

- drills targeting "civil defence", involving actual application, on a significant scale, of PPI countermeasures for population protection (alert, sheltering, evacuation) built around a technical scenario based on the population participation conditions adopted.

During most of these drills, simulated media pressure is placed on the main parties concerned in the drills, in order to test their ability to communicate.

The following table describes the key characteristics of the national drills conducted in 2004.

In addition to the national drills carried out on average every three years on each nuclear site, the Prefects are asked to conduct local drills in collaboration with the sites in their vicinity, with a view to better preparing for emergency situations.

The ASN is required to activate its emergency centre either in full or in part for other drills: in application of the DSND DGSNR protocol, during a drill on a facility or activity under the responsibility of the DSND, or during special drills, such as the R*53 drill in Necker hospital in Paris on 10 October 2004 or simulation of a package being crushed at a Paris airport on 9 November 2004.

NATIONAL NUCLEAR ACCIDENT SIMULATION DRILL SESSIONS IN 2004

NUCLEAR SITE	DATE OF DRILL	DRILL TARGET	PARTICULAR CHARACTERISTICS
Dampierre (EDF)	20 January	Nuclear safety	
Cattenom (EDF)	29 January	Nuclear safety	Large scale drill (duration: 16h) Participation of EDF board and ministers' staff
Cruas (EDF)	27 April	Civil defence	
Gravelines (EDF)	6 May	Civil defence	Maritime part; participation of Belgian public authorities
Saint-Pierre-des-Corps marshalling yards	30 September	Nuclear safety	Transport drill, in particular involving
Marcoule (CEA)	21 October	Civil defence	Sheltering drill in the towns of Chusclan and Codolet
Saint-Alban (EDF)	26 October	Nuclear safety	
Pierrelatte (COGEMA)	18 and 19 November	Civil defence	Major drill run by the SGDN; test of post-accident consequences
Blayais (EDF)	9 December	Nuclear safety	
Flamanville (EDF)	14 December	Civil defence	Contaminated injured persons; test of relations with the Channel Islands

2 | 3 | 1 | 3

International drill sessions and cooperation

The transport drills on 30 September and in Le Blayais NPP were attended by Hungarian and Brazilian observers respectively. These two delegations also took part in discussions concerning emergency situation management.

The ASN was among the group of observers invited to attend the drill at Koeberg in South Africa.

A Chinese delegation of experts from the NNEMA and provincial authorities was received by the ASN under the terms of the agreement on bilateral emergency situation management exchanges.

Generally speaking, the ASN is of the opinion that emergency situation cooperation should be reinforced with States with which France has common frontier zones. A Franco-Belgian discussion meeting was therefore organised in June 2004 to obtain a clearer identification of the needs of each authority in the event of a radiological emergency. Franco-Belgian cooperation was tested during the drill in Gravelines.

Franco-Swiss discussions, initiated in 2003 to clarify relations in the event of an accident occurring in a nuclear installation in one or other of the countries, were continued. The same applies to cooperation with Germany and Luxembourg. A Swiss delegation attended the Gravelines drill. An exchange of correspondents between Luxembourg and France was set up for the Cattenom drill.

The ASN took part in the IAEA's work to draw up a plan of action for the competent authorities in order to improve the international exchange of information in the event of a radiological emergency. The ASN's contribution to this plan of action is to help define the international assistance needs and resources and create the assistance requests response network (ERNET).

2 | 3 | 2

The lessons learned from the drills

Many lessons can be learned from these drills, some of which are recurrent from one drill to another. To this end, each drill 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 drills, associating the main national public organisations (IRSN, SGDN, DDSC, Météo-France) and the operators. This group met on three occasions in 2004.

The following paragraph describes the main developments envisaged for the future, based on the lessons learned from drills conducted in recent years.

2 | 4

Developments 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 relevant experience in France are the 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, storms in the lower Rhone valley on 2 and 3 December 2003) or abroad (Tokai-Mura accident on 30 September 1999).

2 | 4 | 1

Experience feedback from the storms of 2 and 3 December 2003 in the Rhone valley

On 30 January 2004, the ASN organised an experience feedback meeting about the storms of 2 and 3 December 2003 in the lower Rhone valley. Following this meeting, a "meteorology and hydrology" working group was set up.

The ASN concluded that better use needed to be made of the existing hydrology information channels, by strengthening the ties with the central hydrometeorology and flood forecasting department (SCHAPI) of the Water Directorate at the Ministry for Ecology and Sustainable Development, as well as with any future flood prediction departments.

2 | 4 | 2

Revision of the offsite emergency plans for nuclear sites

Since 1997, collective work coordinated by the DSIN (now the DGSNR) involving the DDSC, DGS, IPSN, OPRI, SGCISN and the BNI operators, has been carried out to revise the design of the nuclear offsite emergency plans (PPI) to take account of experience feedback from the drills. 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 (see II.2.3.2); limitation of PPI initiations in reflex or concerted mode to cases where population protection measures are required.

The Prefects had a period of 2 years, starting from receipt of the circular, to revise their PPIs. Owing to the scale of the revision, most of them were unable to meet this deadline. Today, however, most of the Prefects have completed revision of their PPIs. They thus have at their disposal truly operational plans tailored to the potential hazards involved in the nuclear installations.

This revision of the PPIs was finally a further opportunity for informing the general public and local elected officials, notably through the Local Information Committees.

Note:
Practical information in the event of a nuclear accident is available on the ASN web site www.asn.gouv.fr under the heading "Que faire en cas de crise" (*What to do in an emergency?*).

2 | 4 | 3

Stable iodine preventive distribution

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 distribution of tablets, in the event of an accident, from concentrated stocks, generally stored on or near the nuclear sites. The first accident drill sessions (1995 and 1996), which included the actual distribution of dummy tablets, in an emergency context, soon showed the difficulties involved. Apart from time considerations, this method was intrinsically contradictory: the population was asked to take shelter immediately, while at the same time emergency teams were carrying out urgent door-to-door distribution of tablets. In April 1996, the Sub-Minister for Health announced that it was intended to distribute preventively stable iodine tablets to populations living in the vicinity of nuclear power plants. Once the technical and administrative aspects of this operation had been settled, the Prime Minister confirmed this announcement by the instructions of 10 April 1997.

After completion of the preventive distribution of tablets, the drill sessions revealed the necessity for further improvements in this respect. Moreover, the shelf-life of the tablets distributed in 1997 was 3 years. In this context, another preventive distribution of stable iodine tablets took place in 2000 under the same conditions as in 1997, but with the shelf-life of the tablets extended to 5 years.

At the end of this new distribution campaign, about 50% of those living near the nuclear installations had iodine tablets at home. With a level as low as this, the population protection measure involving sheltering and absorption of iodine is not applicable, which, even in the event of a low release forecast, would require an unjustified emergency evacuation of the population. The objective of the distribution campaign is consequently not achieved.

By a circular of 14 November 2001, the Government consequently decided to supplement the iodine distribution within the radius of the PPIs by asking the Prefects to use more efficient methods, such as door-to-door distribution. In a circular dated 7 October 2003, the DGSNR also began a survey of the prefectures and the DDASS to obtain a more precise assessment of the efficiency of the new iodine distribution campaign within the radius of the PPIs. The replies are currently being studied, but it is already clear that the new distribution methods have brought the iodine coverage of the populations up to over 80% in many cases.

Moreover, given the terrorist context prevailing at the time, the Government also asked the Prefects, in a second part of the circular of 14 November 2001, to prepare for stockpiling to be organised in each department, so as to cover the entire country. To create these stocks, the Ministry for Health ordered 60 million tablets from armed forces central pharmaceutical supplies. Tablet delivery began in 2002 and by the end of 2004 was nearing completion (60 million tablets had been manufactured and 56 million delivered to the departments). A circular dated 23 December 2002 provides the Prefects with a guide for drawing up stable iodine tablet stock management plans. These plans are currently being drawn up by the prefectures.

2 | 4 | 4

Emergency response provisions regarding radioactive material transport accidents

In the event of a transport accident in France, requiring the triggering of a specialised radioactive material transport emergency plan (PSS-TMR), ASN assignments are the same as for a BNI accident. However, in this case, its operator supervision assignment covers the consignor, the carrier of the packages involved and possibly the carriage commission agent.

The organisation of the ASN relies mainly on local bodies: the DRIREs and in particular the DSNRs, whether located in the region or in a neighbouring region.



Radioactive materials transport emergency exercise on 30 September 2004

Together with the DRIREs, the ASN is monitoring the PSS-TMR revision work initiated by circular for Prefects NOR/INT/E/00008/C of 23 January 2004, revising the PSS-TMR. The DGSNR took part in drafting this circular. This aspect is developed further in Chapter 11.

Furthermore, in order to make progress in emergency situation management in the event of a transport accident, a "transport" drill involving the Chinon plant as consignor, COGEMA Logistics as carriage commission agent, SNCF as carrier and all the public authorities, in particular the prefecture of Indre-et-Loire, which was the department concerned, was carried out on 30 September 2004.

2 | 4 | 5

Post-accident management

A nuclear plant accident can have immediate consequences due to significant release levels, requiring fast, efficient response within the framework of the emergency plans. There are also various other post-accident consequences (economic, health-related, social), which have to be dealt with in the medium or even long term, with a view to returning to a situation deemed normal.

Since the "Becquerel" drill carried out in October 1996 around the Saclay site, several interministerial working parties have been set up for the purpose of defining the way in which the various post-accident problems should be dealt with. The DGSNR was represented on three of the working parties, dealing respectively with land reclamation, radioactive contamination measurements and management and monitoring of the population. One of the first lessons learned from this drill led to the setting up of a group responsible for carrying out environmental radioactivity measurements. This group is now systematically activated during drill sessions. The practice of taking measurements during each drill now has to be transcribed into the regulations.

Further to the terrorist attacks on September 11, the Government requested that work on post-accident questions should proceed with a view to rapidly reaching operational conclusions. The "Vrousos" report also identified this topic as one of the areas on which the ASN had to concentrate with respect to radiation protection.

An experimental "post-accident" task force 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 public health; questions of decontamination, clean-up and contamination of the food chain; questions of movements around the area.

National and local working groups were recently set up, in the run-up to the national emergency drill in Belleville, scheduled for 2005. These groups in particular take account of the conclusions of the Aube prefecture task force. Proposals for concrete action presented by the groups will be analysed by the ASN with a view to inclusion in a national post-accident doctrine.

The Cattenom and Pierrelatte drills also dealt with this problem in 2004. The first one tested the beginning of a post-accident phase. Measures to restrict consumption of foodstuffs and a ban on the sale of foodstuffs were simulated on this occasion, as was the deployment of resources to measure contamination in the environment. The second was used to test various recent regulatory texts, either under revision or being drafted, such as the interministerial directive concerning the reaction by the public authorities in the case of an event leading to a radiological emergency, the interministerial directive concerning taking and processing of environmental radioactivity measurements in the event of a radiological emergency and the protocol between the two competent safety authorities on the Pierrelatte site. As the accident was simulated on a secret facility, the DSND was the competent authority during the return to safe condition phase, whereas the DGSNR was the competent authority during the post-accident phase. This drill was an opportunity to go a stage further in managing the beginning of this phase. Apart from the aspects already mentioned in Cattenom, the Prefect simulated measures to clean the potentially contaminated vehicles and land along with population census and health check measures.

2 | 4 | 6

Updating of regulatory texts governing nuclear installations or radioactive material transport 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 to the SGCISN (now replaced by the SGDN), 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;
- the new regulations will apply to clearly defined areas (BNIs, classified BNIs, Ministry of Defence nuclear installations).

These proposals entail considerable interministerial work, under the authority of the SGDN, which should lead to the issue of a directive concerning the organisation of the public authorities in the event of a radiological emergency.

3 OUTLOOK

The ASN is working on creating an emergency response organisation tailored to radiological emergencies outside nuclear installations. Together with the Directorate for Civil Security and Defence, it is drafting a circular specifying the allocation of competence and how the local authorities should respond to such events. The ASN will aim to ensure that this organisation is then tested during drills. It will make sure that this organisation remains consistent with the various plans currently being drawn up for protection against malicious acts.

The ASN will also develop post-accident situation management doctrine by making use of the lessons learned from the various drills which included this particular problem. This doctrine will be required to cover both situations affecting BNIs and radiological emergencies outside nuclear facilities. It will then be tested and modified during BNI drill sessions. Exchanges with other countries will also be an opportunity to compare experience. The Swiss organisation could in particular be examined during a drill simulating the post-accident phase in 2005.

For the BNIs, the ASN will as of 2005 look to renew the drill scenarios in order to test the organisation in unprecedented configurations.

Finally, to take account of experience feedback from drills which show a delay between the availability of the radioactivity measurement results in the field after the release period and the needs of the decision-makers in operational management terms, the ASN will aim to improve the organisation in place, jointly with the interministerial departments concerned. The work in progress concerning revision of the interministerial directive on taking and processing environmental radioactivity measurements in the event of a radiological emergency, coordinated by the SGDN, is an ideal framework for incorporation of the preferred changes.

RADIOLOGICAL AND BIOMEDICAL ACTIVITIES

CHAPTER 9

INTRODUCTION

1 PRESENTATION OF MEDICAL ACTIVITIES USING IONISING RADIATION

1 | 1 Medical and dental radiodiagnosis

1 | 2 Radiotherapy

1 | 3 Nuclear medicine

1 | 4 Blood product irradiators

1 | 5 Medical exposure

2 INSTALLATIONS INVENTORY

2 | 1 Medical and dental radiology installations

2 | 2 Tomography appliances

2 | 3 External radiotherapy installations

2 | 4 Brachytherapy units

2 | 5 Nuclear medicine units

2 | 6 Blood product irradiators

3 REGULATIONS CONCERNING MEDICAL APPLICATIONS OF IONISING RADIATION

3 | 1 Declaration or licensing of radiation sources used for medical purposes

3 | 2 Radioactive source management rules

3 | 3 Declaration or licensing procedures

4 2004 SUMMARY OF DOSSIERS EXAMINED FOR MEDICAL INSTALLATIONS USING IONISING RADIATION

4 | 1 Radiodiagnosis installations

4 | 2 Tomography, radiotherapy, nuclear medicine and blood product irradiation installations

5 PERCEPTION OF RADIATION PROTECTION IN THE MEDICAL SECTOR – THE ASN VIEWPOINT

6 IMPACT OF MEDICAL INSTALLATIONS

7 OUTLOOK

INTRODUCTION

Since ionising radiation was discovered more than a century ago, medical applications have been one of its main uses. Whether for diagnosis or therapy, medicine employs various sources of radiation, produced either by electrical generators or by artificial radionuclides inside sealed or unsealed sources.

In medical applications of ionising radiation, the principle of dose limitation, one of the three fundamental principles of radiation protection, does not apply. Unlike the other types of applications, medical exposure is of direct benefit to the patient exposed, either for diagnostic purposes or for therapeutic reasons. Therefore, it is up to the practitioner to carry out case by case an assessment of the level of exposure to be applied to the patient in order to achieve the specified goal. However, the practitioner shall first of all have followed the principles of justification and optimisation.

Although the benefits and usefulness of medical applications have been established for many years now, they do contribute significantly to exposure of the population. They are the primary source of artificial exposure, behind natural exposure. This is why medical uses of ionising radiation are subject to a wide-ranging regulatory framework and the ASN is in this area developing specific activities, particularly with respect to installation monitoring.

2004 saw continuation of the overhaul of the radiation protection regulations, which began in 2001, with the publication of several orders implementing texts published in 2003 and modifying the Public Health Code (patient protection) and the Labour Code (worker protection).

These new regulations and the increased ASN resources enabled greater supervision of medical installations in 2004, focused as before on nuclear medicine and radiotherapy units. The ASN also devoted efforts for implementing the tools for collecting data about exposure of patients to ionising radiation for diagnostic or therapeutic medical purposes.

The increasing importance of inspection work and its more organised structure, and the efforts made to assess the level of patient exposure, have confirmed the need to continue to strengthen the ASN's resources so that it can perform all of its duties properly.

1 PRESENTATION OF MEDICAL ACTIVITIES USING IONISING RADIATION

1 | 1

Medical and dental radiodiagnosis

Radiodiagnosis is the discipline of medical imaging which comprises all techniques for exploring the human body morphology using the X-rays produced by electrical generators.

Radiology is based on the principle of differential attenuation of X-rays by the organs of the human body. The information is gathered either on radiological film or more and more often on digital media allowing computer processing of the images obtained.

Radiodiagnosis, which is the oldest of the medical uses of radiation, occupies predominent place in medical imaging area, which now comprises various specialisations which have become increasingly independent as time has gone by. Technological change has also led to the development of imaging techniques which meet a wide variety of user needs.

The variety of types of radiological examination available for modern medicine should not however lead the practitioners to forget that they all involve irradiation of the patient. Therefore, the doctor must only prescribe the examination if it is part of a diagnostic strategy that takes account of the pertinence of the information looked for, the benefit to the patient, the irradiation of the patient and the possibilities of other non-irradiating investigative techniques. Paragraph 1.5 of this chapter gives details of the level of patient exposure during certain radiological examinations.

1 | 1 | 1

Medical radiodiagnosis

In the medical field, apart from conventional radiology, more specialised techniques allowing a broader field of investigation are also used.

· Conventional radiology

This uses the principle of conventional radiography and covers the vast majority of radiological examinations carried out. These examinations are primarily of the skeleton, thorax and abdomen and are part of what is called "sophisticated radiodiagnosis", with reference to the performance of the generators used. Conventional radiology can be split into three main families:
• radiodiagnosis performed in fixed installations specifically built for the purpose;
• radiodiagnosis performed occasionally using mobile appliances, particularly at the patient's bedside. This practice should be limited to patients who cannot be moved;
• radiodiagnosis conducted in the operating theatre as a tool to assist the surgeon. In this case, mobile X-ray generators equipped with image intensifiers are used to display real-time pictures on a TV screen (radioscopy), to guide the surgeon's movements.

It should be noted that radioscopy devices without image intensifiers (simple radioscopy) are now prohibited by the order of 17 July 2003.

· Surgical radiology

They are radiological techniques which use radioscopy with image intensification and require special equipment allowing to replace certain surgical operations, in particular in cardiology (dilation of coronary arteries, etc.). They often require long-term exposure of the patients, who then receive high doses which can sometimes lead to radiation deterministic effects (cutaneous lesions, etc.). The surgical staff usually working in the immediate vicinity of the patient are also exposed to higher levels than during other radiological practices. Then, given the risk of external exposure for the operator and the patient, surgical radiology must be justified by clearly determined medical need and its practice must be optimised in order to improve the radiation protection of both operators and patients.



Surgical radiology installation

· Digital angiography

This technique, primarily used to explore the blood vessels, is based on digitisation of the images before and after injecting a contrast medium. Computer processing masks the bone structures around the vessels by subtracting two series of images.

· Mammography

Given the composition of the mammary gland and the degree of detail sought for the diagnostic, high definition and perfect contrast are required for the radiological examination. This can only be achieved by special appliances working with low voltage.

These generators are also used for breast cancer screening campaigns.



Mammographie appliance

· Tomography

Using a closely collimated X-rays beam, emitted by a generating tube rotating around the patient and a computerised image acquisition system, tomography appliances give a three-dimensional picture of the organs with image quality higher than that of conventional equipment, providing a more detailed picture of the organ structure.



Tomography appliance

When first used, this technique revolutionised the world of radiology, in particular in neurological exploration area, but is today being rivalled by magnetic resonance imaging for certain investigations. However, the new generation of appliances (multi-slice scanners) offer an extension of the investigative field of tomography, somewhat offset by the fact that these appliances deliver higher doses of radiation to the patients.

Overall, although tomography examinations only account for a small percentage of the total number of radiological tests, they contribute significantly to the exposure due to radiology.

1 | 1 | 2

Dental radiodiagnosis

Of the radiological installations inventory, dental radiodiagnosis equipment occupies a dominant position, even if only three techniques are employed.

· Intra-oral radiography

Intra-oral type radiography generators are mounted on an articulated arm, to provide localised images of the teeth. They operate with relatively low voltage and current and a very short exposure time, of about a few hundredths of a second. It should be noted that this technique is more and more frequently combined with a system for digital processing of the radiographic image, displayed on a monitor.

· Panoramic dental radiography

Primarily used by dental specialists (orthodontists, stomatologists) and radiologists, panoramic radiography gives a single picture showing both jaws, by rotating the radiation generating tube around the patient's head for about ten seconds.



Panoramic dental radiography appliance

· Cranial tele radiology

These generators are more rarely used by practitioners. They operate with a focus - film length of 4 metres, and are mainly used to take radiographic images for orthodontic diagnosis.

1 | 1 | 3

Installation construction rules

A conventional radiological installation comprises a generator (high-voltage unit, radiation generating tube and control unit) and a stand for moving the tube and an examination table or chair. The general standard NFC 15-160, published by the Union technique de l'électricité (UTE), defines the conditions in which the installations must be fitted out to ensure human safety against the risks resulting from the action of ionising radiation and electrical current. It is supplemented by specific rules applicable to medical radiodiagnosis (NFC 15-161) and dental radiodiagnosis (NFC 15-163). In compliance with these standards, the walls of radiology rooms must be sufficiently opaque to radiation and may require the installation of reinforced lead protection. However, because of radiation protection regulation changes, which have led to lower the exposure limits for both the general public and workers, revision of these standards should be undertaken.

1 | 2

Radiotherapy

With surgery and chemotherapy, radiotherapy is one of the key techniques employed to treat cancerous tumours. It uses ionising radiation to destroy malignant cells. The ionising radiation needed for the treatment is either produced by an electrical generator, or emitted by artificial radionuclides in a sealed source. A distinction is made between external (or transcutaneous) radiotherapy, with the radiation source placed outside the patient, and brachytherapy, in which the source is positioned in direct contact with the patient, inside or very close to the area to be treated.

1 | 2 | 1

External radiotherapy

The irradiation sessions are always preceded by preparation of the treatment plan which, for each patient, details the dose to be delivered, the target volume to be treated, the dosimetry, the irradiation beam ballistics and the duration of each treatment. Preparation of this plan, the aim of which is to set the conditions for achieving a high, uniform dose in the target volume while preserving the healthy tissues, requires close co-operation between the radiotherapist and the radiophysician.

Irradiation is performed either using particle accelerators producing photon or electron beams with an energy of between 4 and 25 MeV and delivering dose rates varying between 2 and 6 Gy/mn, or - albeit now to a lesser extent - telegammatherapy appliances equipped with a cobalt 60 source, the activity of which is about 200 terabecquerels (TBq). In recent years in France, these latter appliances have phased out and replaced by particle accelerators, with superior performance, which offer a wider range of treatments. Given the characteristics of these machines, they must be installed in rooms specially designed to guarantee radiation protection of the personnel, turning them into true bunkers (the ordinary concrete walls can vary from between 1 to 2.5 m thick). A radiotherapy installation comprises a treatment room including a technical area containing the appliance, a control station outside the room and, sometimes, auxiliary technical premises.

The protection of the premises, in particular the treatment room, must be determined in order to respect the annual exposure limits for the workers and/or the public around the premises. A safety case must be produced for each installation by the supplier of the machine, together with the radiophysicist (specialised person in medical radiophysics) and the person with competence for radiation protection (or the appropriate radiation protection department) in the establishment in which the machine is to be installed. This study, which is submitted to the DGSNR for approval, defines the thicknesses and nature of the various protections required, which will be determined according to



Radiotherapy particle accelerator

the conditions of use of the appliance, the characteristics of the radiation beam and the utilisation of the adjacent rooms, including those vertically above and below.

In addition, systems must indicate the machine status (operating or not) or must switch off the beam in an emergency or if the door to the irradiation room is opened.

1 | 2 | 2

Brachytherapy

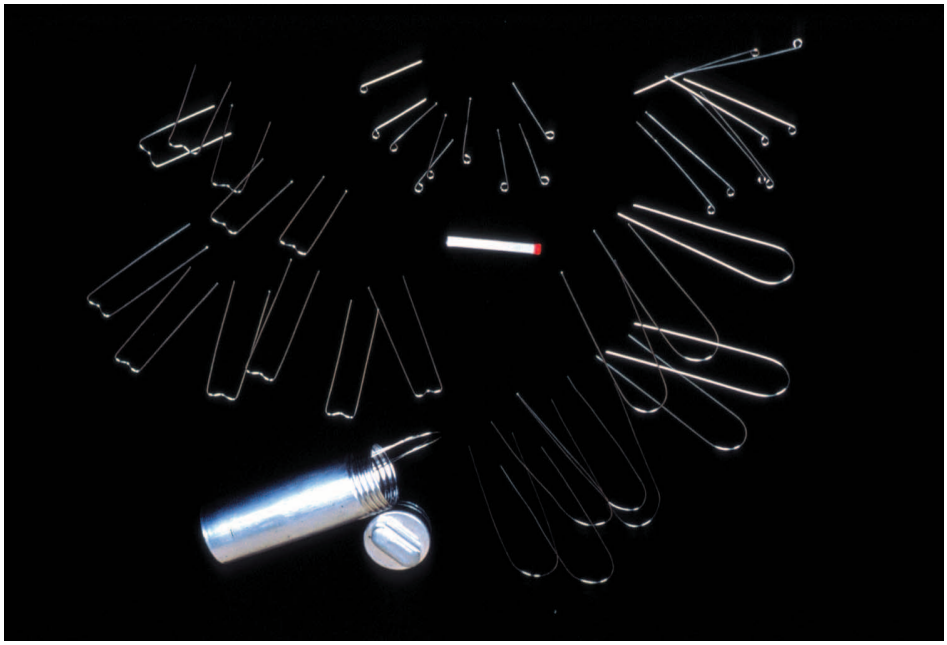
Brachytherapy allows specific or complementary treatment of cancerous tumours, specifically in the ENT field, as well as of the skin, the breast or the genitals.

The main radionuclides used in brachytherapy, in the form of sealed sources, are caesium 137 and iridium 192, which have definitively replaced the radium 226 needles or tubes used in the first half of the 20th century. These two radionuclides have half-lives of 30 years and 74 days respectively.

Brachytherapy techniques involve three types of applications.

Low dose rate brachytherapy, requiring patient hospitalisation for several days, gives dose rates of 0.4 to 2 Gy/h. The iridium 192 sources are used for interstitial applications (inside the tissues). The sources generally come in the form of wires 0.3 to 0.5 mm in diameter, with a maximum length of 14 cm and which linear activity is between 50 and 250 MBq/cm. Endocavity techniques (inside natural cavities) use either iridium 192 wires or caesium 137 sources. In both cases, the sources remain in place in the patient for the duration of hospitalisation.

Sources are implanted in two stages and at two different locations: in the application room, where source catheters are fitted into the patient and their correct positioning is checked by radiological filming, and then in a room specially reinforced for radiation protection reasons, in which the radioactive sources are implanted. With this technique, it is possible to use a source applicator, in particular for the caesium 137 sources, thereby optimising personnel protection.



Iridium 192 source used in low dose rate brachytherapy

Low dose rate brachytherapy requires a room for storage and preparation of the radioactive sources, a room for radiological location and application, and at least 2 protected rooms for hospitalisation of patients implanted with sources.

Room protection must be determined on the basis of a caesium 137 source of 8200 MBq or an iridium 192 source of 5600 MBq, placed in the centre of the patient's bed, which must be fixed in place.

In recent years, low dose rate brachytherapy techniques have been supplemented by the use of sealed sources of iodine 125 (half-life of 60 days) to treat prostate cancers. The iodine 125 sources, just few millimetres long are permanently installed in the patient's prostate. Their unit activity is between 10 and 25 MBq and treatment requires about one hundred grains representing a total activity of 1500 MBq, delivering a prescribed dose of 145 Gy to the prostate.

Medium dose rate pulsed brachytherapy uses dose rates of 2 to 12 Gy/h delivered by iridium 192 sources of small dimensions (a few millimetres), with maximum activity limited to 18.5 GBq. Each source is applied with a specific source applicator. This technique delivers doses identical to those of low dose rate brachytherapy, and over the same period, but given the higher dose rates, irradiation is split up into several sequences (pulses). The patient does not therefore carry the sources permanently, which is more comfortable and enables him to receive visitors. This technique, which is likely to be increasingly used, significantly improves the radiation protection of the personnel, who can now work with the patient without being exposed, once the source has been returned to the applicator's storage container. This technique can only be carried out in units which already carry



Iodine 125 sources used for prostate brachytherapy

out low dose rate brachytherapy; the room(s) set aside for hospitalisation of patients for whom this technique is well suited must have reinforced radiological protection based on an iridium 192 source of 18.5 GBq.

High dose rate brachytherapy uses an iridium 192 source of small dimensions (a few millimetres) and maximum activity of 370 GBq delivering dose rates higher than 12 Gy/h. A source applicator comparable to that employed for pulsed brachytherapy is used. The treatment times are very short (no more than a few minutes), unlike the previous techniques. Irradiation is carried out in a room similar to an external radiotherapy room, with the same safety measures. High dose rate brachytherapy is primarily used to treat cancers of the oesophagus and bronchus.



High dose rate brachytherapy appliance

1 | 3 Nuclear medicine

Nuclear medicine includes all uses of unsealed source radionuclides for diagnostic or therapeutic purposes. Diagnostic uses can be divided into in-vivo techniques, based on administration of radiopharmaceuticals to a patient, and exclusively in-vitro applications. As for radiology, paragraph 1.5 gives additional information on the patient exposure levels during the main nuclear medicine procedures.

1 | 3 | 1 In-vivo diagnosis

This technique consists in examining the metabolism of an organ with a specific radioactive substance - called a radiopharmaceutical - administered to a patient. The nature of the radiopharmaceutical, which has an medical status, depends on the organ being examined. The radionuclide can be used directly, or fixed to a carrier (molecule, hormone, antibody, etc.). For example, table 1 presents some of the main radionuclides used in the various investigations.

Technetium 99m, delivered to nuclear medicine departments in the form of a generator, is by far the most commonly used radionuclide. Moreover, its short radioactive half-life of 6 hours and its limited gamma radiation energy (140 keV) are extremely favourable to the patient from the dosimetry view-

Type of exploration	Type of radionuclide	Type of carrier
Thyroid metabolism	Iodine 123, technetium 99m	
Mycocardial perfusion	Thallium 201	MIBI
Pulmonary perfusion	Technetium 99m	Albumin macroaggregates
Pulmonary ventilation	Xenon 133, krypton 81m, technetium 99m	Solid (carbon) or liquid (DTPA) aerosols
Osteo-articular process	Technetium 99m	Phosphonate

Table 1



Scintillation camera

point. The activity administered to a patient for an examination is a few hundred megabecquerels (MBq).

The radioactive substance administered is located in the organism by a specific detector - a scintillation camera or gamma-camera - which consists of a crystal of sodium iodide coupled with a computer-controlled acquisition and analysis system. This equipment is used to obtain images of how the investigated organs are functioning (scintigraphy). As these images are digitised, the physiological processes can in certain cases be quantified, along with a three-dimensional reconstruction of the organs images, using the same principle as for the X-ray scanner.

Nuclear medicine is used to produce functional images and therefore complements the purely morphological pictures obtained with the other imaging techniques: conventional radiology, X-ray scanner, echography or magnetic resonance imaging (MRI).

1 | 3 | 2

In-vitro diagnosis

This is a medical biology analysis technique - without administration of radionuclides to the patients - for assaying certain compounds contained in the biological fluids, particularly the blood: hormones, drugs, tumour markers, etc. This technique uses assay methods based on immunological reactions (antibody - antigen reactions marked with iodine 125), hence the name RIA (RadioImmunology Assay). The activity levels present in the analysis kits designed for a series of assays do not exceed a few kBq. Currently, radioimmunology is being challenged by techniques which do not use radioactivity such as immunoenzymology.

1 | 3 | 3

Metabolic radiotherapy

Metabolic radiotherapy aims to administer a radiopharmaceutical emitting beta radiation, which delivers a high dose to a target organ for curative or palliative purposes.

Some therapies require limited administration of radionuclides (< 740 MBq). They are for example designed to treat hyperthyroidism by administration of iodine 131, painful bone metastases by strontium 89 or samarium 153, and polyglobulia by phosphorus 32. Joints can also be treated using colloids marked with yttrium 90 or rhenium 186. As a general rule, these treatments do not require hospitalisation of the patient in the nuclear medicine department.

Other therapies require the use of far higher activity levels. This is in particular the case with treatment of certain thyroid cancers after surgery. This is done by administering about 4000 MBq of iodine 131 and the patients have to be hospitalised for several days in a special room in the nuclear medicine ward, until urinary evacuation of most of the radionuclide administered. The radiological protection of these rooms must be appropriate to the type of radiation emitted by the radionuclides. In the case of iodine 131, account must be taken of the gamma radiation from this radionuclide. The protection calculations will be made on the basis of a source of 5550 MBq of iodine 131.

1 | 3 | 4

Nuclear medicine department organisation and operating rules

In the light of the radiation protection constraints inherent to the use of radionuclides in unsealed sources, the nuclear medicine departments must be designed and organised so that they can receive, store, prepare and then administer unsealed radioactive sources to the patients or handle them in a laboratory (for radioimmunology). Provisions must also be made for the collection, storage and disposal of radioactive waste and effluents produced in the installation.

From the radiological viewpoint, the personnel are subjected to an external exposure hazard, in particular on the fingers, owing to handling of sometimes highly active solutions (for example the case with fluorine 18 and iodine 131), along with an internal exposure hazard through accidental intake of radioactive substances. The patients also eliminate radioactivity through their urine, which must be specially treated to minimise releases into the public domain. Finally, as we are here dealing with medical applications, the risk of infection is ever-present.

In these conditions, nuclear medicine departments must comply with specific construction and organisation rules, the main provisions of which - for the in-vivo diagnosis units - are as follows.

I Location and layout of promises

The premises of a nuclear medicine unit must be located away from the general circulation areas, clearly separated from premises intended for ordinary use, grouped so that they form a single unit allowing easy marking out of a controlled area, and categorised in descending order of radioactive activity levels. The controlled area will comprise at least the following:

- a changing area airlock for the staff, separating normal clothing from work clothing;
- examination and measurement rooms and rooms set aside for injected patients waiting for their examination (separate rooms should be provided for mobile patients and patients lying down);
- unsealed radioactive source storage and preparation areas (hot laboratory);
- an injection room adjoining the hot laboratory;
- installation for delivery of radionuclides and storage of radioactive waste and effluents.



Shielded chamber for handling unsealed radioactive sources used in nuclear medicine

II Fitting out the controlled area

The thickness of the hot laboratory and injection room walls must be at least equivalent to 15 cm of ordinary concrete. All coverings on the floors (to be continued up to skirting boards), the walls and the work surfaces will consist of smooth, impermeable, joint-free (no tiling) materials which can be easily decontaminated. The washbasin taps should not be hand-operated. The changing area airlock will have washbasins and a shower and the sanitation facilities reserved for injected patients will be connected to a septic tank, itself connected directly to the establishment's main sewer. The hot laboratory will be fitted with one or more shielded chambers for storing and handling radioactive sources, protecting the personnel against the risks of internal exposure and dispersal of radioactive substances.

III Ventilation of the controlled area

The ventilation system must keep the premises at negative pressure, with air renewed at least five times per hour. It must be independent of the building's general ventilation system and foul air must be extracted with no possibility of recycling. The shielded compartments for storage and handling of radioactive products in the hot laboratory must be connected to independent extraction ducts fitted with filters.

IV Collection and storage of radioactive solid waste and liquid effluents

A room intended solely for storage of radioactive waste pending disposal must be provided. Similarly, liquid radioactive effluents must be sent from a small number of dedicated drainage points to buffer tanks which operate alternately as filling tanks and decay storage tanks. These tanks, of which there must be at least two, will be positioned above a safety leak tank.

1 | 4

Blood product irradiators

Blood products are irradiated in order to eliminate certain cells liable to lead to a fatal illness in patients requiring a blood transfusion. After this treatment, these products can be administered to the patients. This irradiation uses an appliance with built-in lead biological shielding and which, depending on the version, comprises one, two or three sources of caesium 137 with a unit activity level of about 60 TBq each. Depending on the case, the blood bag is irradiated with an average dose of about 20 to 25 grays.

The room housing this type of appliance is generally considered to be a controlled area for radiation protection purposes and must be reserved for this type of application. Regional blood transfusion centres are equipped with this type of appliance.



Blood product irradiators

1 | 5

Medical exposure

Patient exposure to ionising radiation is differentiated from the other types of exposure (population, workers) because it is not subject to any strict limitations. Nonetheless, the jus-

tification and optimisation principles still apply. This is also the only case in which exposure is delivered for the direct benefit of the exposed persons, i.e. the patients.

The situation differs in the diagnostic field (radiology or diagnostic nuclear medicine) and the field of external or internal radiotherapy. In the first case, optimisation is necessary in order to deliver the minimum dose needed to obtain pertinent diagnostic data. In the second, the dose needed to sterilise the tumour must be delivered, while preserving as much of the surrounding healthy tissue as possible.

The dose received by the patient depends on the quality of the equipment used, what fully justifies retiring obsolete equipment and developing a quality control system for the medical appliances used. This concerns not only the irradiating equipment, but also those used for this exposure (if a radiological film viewer is defective, this could lead to increase the radiation doses to produce the films). The dose also depends on the nature of the procedures and the emission of radiation (X-ray tube, particle accelerator, unsealed source of radionuclides, etc.).

It is hard to obtain an accurate picture of overall exposure of medical origin, because the number of examinations conducted (per type) is not well known and the doses delivered for the same examination may vary widely, not only depending on the conditions in which the examination is carried out, but also owing to the morphology of the patients. However, based on currently available data, the number of radiological procedures carried out every year in France is somewhere between 14.5 million conventional radiology procedures, plus 2 million tomography procedures (annual health establishment statistics – SAE 2002) and 25 million radiology procedures (CNAM-TS survey in 2000).

Little valid data is currently available for estimating the doses delivered to the patients, be it overall or per type of examination. However, through its PASEPRI action plan (see Chapter 1, § 3|4) the ASN has initiated a process to gather these data with the support of the IRSN and the INVS.

Worldwide statistics,which need to be updated - (UNSCEAR 2000 report, volume 1) covering 1.530 billion inhabitants (1991-1996 data), indicate an annual effective dose per inhabitant of 1.2 mSv for radiology, 0.01 mSv for odontology and 0.08 mSv for nuclear medicine. In western Europe, the average annual effective dose from diagnostic radiology per inhabitant in France is estimated at 1 mSv, whereas it is 0.33 mSv for the United Kingdom and 1.9 mSv for Germany.

The studies conducted so far generally show a wide variability in the doses delivered for a given examination. The choice of dosimetric parameter is thus very important. The range of doses delivered by medical exposure is fairly wide. For example, in radiology, measurements taken in the same conditions for a given examination performed in three hospitals (report by the Bonnin/Lacronique, OPRI and SFR mission, March 2001) revealed doses (doses at the entry surface on a phantom) varying by a factor of 1 to 3 for a lumbar examination (profile) or a factor of 1 to 10 for a cervical examination (profile).

In nuclear medicine, the activities administered vary widely from one department to another, from one member state to another. Even if the doses are generally lower than in radiology, there are variations that cannot always be justified. For a pulmonary perfusion scintigraphy performed as part of the diagnosis of a pulmonary embolism, the activity administered can vary from 100 MBq (Netherlands) to 300 MBq (France), or an estimated delivered dose variation of 1.2 mGy to 3.75 mGy.

In 2004, in order to improve knowledge of medical exposure and implementation of the optimisation principle, in addition to draft prescription and procedural guides by the health professionals concerned, several regulations (see Chapter 3, § 1|3|1) were issued as regards:

• The diagnostic reference levels (order of 12 February 2004): radiology and tomography units must conduct annual dosimetry assessments of common radiological examinations carried out on “typical” patients, the results of these assessments then being compared with the reference levels. In the case of nuclear medicine, the levels administered to the patients will be recorded and compared with the

activity levels recommended by the radiopharmaceutical's notice of compliance. These levels, which are neither regulatory limits, nor optimum values, will constitute guidelines for implementing the principle of optimisation. They should not be exceeded if there is no technical or medical justification, but compliance with them does not obviate the need for continued optimisation. In order to ensure periodic updating of the reference levels, the IRSN collects the results of these annual assessments.

• Obligation to fit a device on recently installed radiology appliances indicating the quantity of radiation produced during a radiological procedure (decree of 15 June 2004): this device will give the professionals concerned a clearer picture of the doses actually delivered, will make it easier to implement and assess the reference levels and thus help optimise the radiological practices.

• Training and role of persons specialising in medical physics – PSRPM – (order of 19 November 2004): this is the first regulation detailing the training requirements for these specialists and the nature of their duties. This order also requires that all establishments using ionising radiation for diagnostic or therapeutic purposes draw up a plan specifying all of their medical radiophysics resources, in particular taking into account of the medical techniques employed, the resulting constraints and the number of patients treated. Application of this order will clarify the role of the PSRPM and strengthen their actions to obtain a clearer understanding of the doses delivered.

• Training of health professionals in patient radiation protection (order of 18 May 2004): the training programmes are spelt out in this order, in compliance with the requirements of article R. 1333-74 of the Public Health Code. This training is intended for medical and paramedical personnel responsible for carrying out procedures involving ionising radiation.

It must at the same time be pointed out that in 2004 the AFSSAPS made a number of decisions concerning quality control procedures applying to radiotherapy installations which are fully in line with the optimisation principle (see Chapter 3, § 1|3|2).

2 INSTALLATIONS INVENTORY

2|1

Medical and dental radiology installations

In 2004, the inventory of radiological installations grew up by 9.81% over 2003. This reversed the trend observed in previous years, during which there was a regular drop in the installations inventory. The end of the installations approval procedure, which led to a significant rise in the number of dossiers dealt with during 2004 (see § 4|1), may have contributed to this rise. At the end of 2004, the breakdown of declared radiological installations was as follows:

	Medical radiodiagnosis	Dental radiodiagnosis	Total
Private sector	10211	35922	46133
Public and related sector	6543	962	7505
Total	16754	36884	53638

Table 2

The private sector inventory rose by 11.2%, whereas that in the public sector experienced a far more limited rise (1.8 %) (see table 2).

Tables 3 and 4 show the breakdown of radiological installations on 31 December 2004 per category of appliances.

Medical radiodiagnosis

	Private sector	Public and related sector	Totals	% change in relation to 2003
Cat. B and C (simple radiodiagnosis, including osteodensitometers	1507	2531	4038	+ 8 %
Cat. D (sophisticated radiodiagnosis)	6311	3589	9900	+ 6.2 %
Cat. N (mammography)	2393	423	2816	+ 10.95 %
Totals	10211	6543	16754	+ 7.4 %

Table 3

The breakdown per region shows that the most equipped regions are still Ile-de-France, Rhône-Alpes, Provence-Alpes-Côte d'Azur and Nord-Pas-de-Calais with 21, 10, 10 and 5.2 % of the equipment inventory respectively (see table 5).

According to the information collected by the ASN, the radiology installations listed in tables 2, 3 and 5, and the tomography installations mentioned in § 2|2, are divided among 4000 radiology departments in which about 7000 radiologists work with the assistance of more than 22,500 radiology technicians or equivalent.

After several consecutive years of falling numbers, 2004 saw a significant rise in the dental installations inventory in relation to 2003 (+ 10.95%). This rise was as high as 11.2% in the private sector, but only 1.37% in the public sector. 40,000 dentists working in 28,600 establishments, share the use of the 36,884 appliances inventoried above (table 4).

2 | 2

Tomography appliances

In 2004, the French radiological inventory comprises 700 tomography installations, representing a 15% rise compare with 2003. This total includes appliances intended for radiotherapy simulation and that there are almost twice as many appliances in the public sector as in the private.

Dental radiodiagnosis

	Private sector	Public and related sector	Totals	% change in relation to 2003
Cat. E	35922	962	36884	+10.95

Table 4

Region	Medical radiodiagnosis		TOTAL I	Dental radiodiagnosis		TOTAL II	TOTAL I and II
	Public	Private		Public	Private		
Alsace	185	299	484	18	1403	1421	1905
Aquitaine	232	577	809	43	1805	1848	2657
Auvergne	172	200	372	18	768	786	1158
Basse-Normandie	187	160	347	26	575	601	948
Bourgogne	207	221	428	31	780	811	1239
Bretagne	316	428	744	48	1750	1798	2542
Centre	240	345	585	31	1226	1257	1842
Champagne-Ardenne	165	215	380	22	705	727	1107
Corse	24	50	74	1	114	115	189
Franche-Comté	90	152	242	8	659	667	909
Haute-Normandie	166	228	394	24	796	820	1214
Ile-de-France	1382	2058	3440	221	7618	7839	11279
Languedoc-Roussillon	210	450	660	40	1490	1530	2190
Limousin	101	90	191	11	397	408	599
Lorraine	336	274	610	54	1335	1389	1999
Midi-Pyrénées	229	559	788	29	1804	1833	2621
Nord-Pas-de-Calais	392	578	970	38	1770	1808	2778
Overseas	126	161	287	19	449	468	755
Pays de la Loire	290	449	739	38	1751	1789	2528
Picardie	194	250	444	32	730	762	1206
Poitou-Charentes	199	245	444	25	819	844	1288
Provence-Alpes-Côte d'Azur	494	1273	1767	118	3464	3582	5349
Rhône-Alpes	606	949	1555	67	3714	3781	5336
TOTAL	6543	10211	16754	962	35922	36884	53638

Table 5

2 | 3

External radiotherapy installations

As in previous years, the trend already observed continued with a rise in the number of particle accelerators, now standing at 350 units (+ 5.42 % over 2003) and a regular fall in the number of telegammatherapy appliances, now down to 47 (- 23%).

These installations, along with the brachytherapy units mentioned in § 2|4 below, are used by about 600 radiotherapists (350 in the public sector and 250 in the private) who work in 179 radiotherapy centres (source: SFRO).

2 | 4

Brachytherapy units

With a total of 106 brachytherapy units, the fall observed in 2003 continued in 2004. Closure of the small units with limited brachytherapy activities was the reason for this drop. However, the breakdown between public sector (57) and private (49) remained stable.

2 | 5

Nuclear medicine units

With a total of 289 operational nuclear medicine units, overall the situation was stable in 2004 in this sector. However, there was a drop in the number of medical analysis laboratories using unsealed radioactive sources (radioimmunology laboratories). The breakdown between public and private sectors is 222 and 67 respectively. In 2004, 12 new nuclear medicine units acquired positron emission



Telegammatherapy appliance



Position emission tomograph

tomography installations (PETSCAN cameras - PET camera coupled with a tomograph) using fluorine 18 in the form of fluorodeoxyglucose (18FDG).

The demographics of nuclear medicine are not particularly clear, but today it seems that there are about 550 practitioners specialising in this area, to whom should be added 1000 practitioners assisting in the working of nuclear medicine units (interns, cardiologists, endocrinologists, etc.).

2 | 6

Blood product irradiators

No noteworthy change occurred in 2004 and the situation in this area remained stable with about 40 installations in operation in the blood transfusion centres.

3 REGULATIONS CONCERNING MEDICAL APPLICATIONS OF IONISING RADIATION

Chapter 3 of this report presented the current status of radiation protection regulations. Here we will simply recall the provisions concerning medical applications of ionising radiation, in particular the licensing and declaration systems. However, the provisions concerning the protection of persons exposed for medical purposes and already detailed in Chapter 3 will not be explained again.

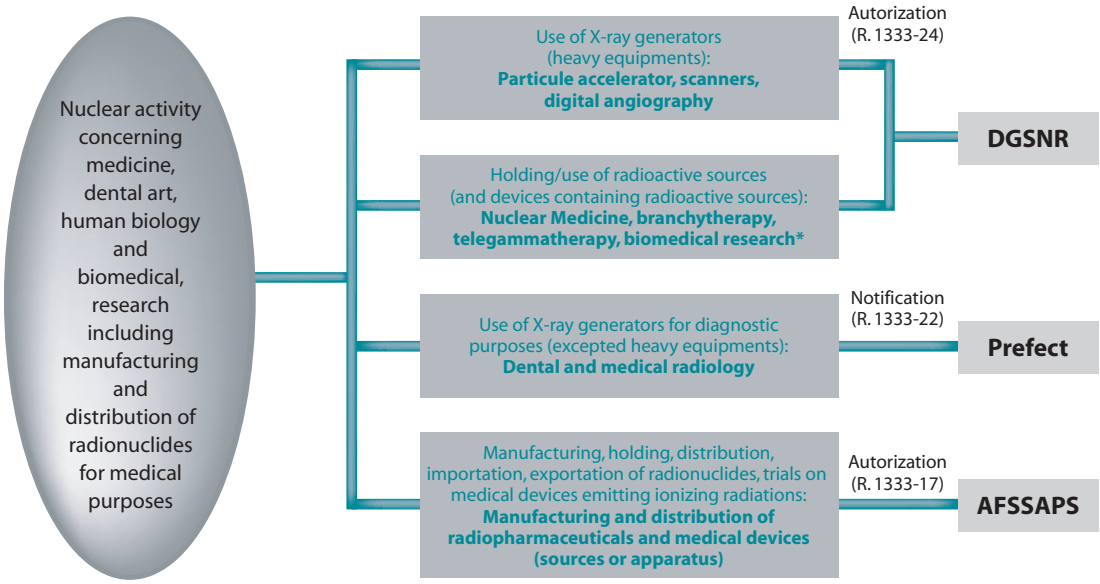
3 | 1

Declaration or licensing of radiation sources used for medical purposes

The Public Health Code (art. R. 1333-17 to R. 1333-44) sets requirements concerning licensing or declaration of all nuclear activities, in particular about medical and biomedical research applications of ionising radiation (sub-sections 1 – art. R. 1333-17 to R. 1333-20 - and 2 - art. R. 1333-21 to R. 1333-25), whether or not the establishments are covered by the regulations applicable to installations classified on environmental protection grounds (see art. L. 1333-4 of the Public Health Code).

The following diagram presents the procedures governing the various medical and biomedical research applications, whenever it is relevant, these procedures do not replace those concerning sophisticated equipment as specified in articles L. 6121-1 to L. 6121-12 of the Public Health Code:

Radiation protection regulation applicable to medical activities



no exemption to notification or authorization procedures

*according to Public health Code § L 1121-1: trials or experimentation organized and performed on human being to develop biomedical or medical knowledges.

Finally, any incident or accident likely to be the cause of over-exposure of an individual must be immediately declared to the Prefect of the department and to the ASN. In this respect, the ASN has an emergency hot-line (toll-free number: 0 800 804 135) available 24 hours a day (see Chapter 7, § 1|1|3) It can also be used for any radiological incident occurring in a medical installation.

In addition, article 2 of decree 2002-460 of 4 April 2002 introduced a modification to article R. 162-53 of the Social Security Code, requiring that: "Practitioners and establishments using appliances generating ionising radiation or comprising the use of radionuclides or products containing them, for therapeutic or diagnostic purposes, may only carry out examinations or give treatment to persons covered by social security insurance if the appliances and installations have been declared or licensed as mentioned in articles R. 1333-22 and R. 1333-24 of the Public Health Code. Only those radiological examinations and radiotherapy treatments carried out using appliances and installations declared or licensed in the conditions laid out in the previous paragraph may be reimbursed or paid for".

Paragraph 33 gives details about the way to compile the declaration and licensing application dossiers required by articles R. 1333-22 and R. 1333-24. The order of 14 May 2004, based on article R. 1333-44, specifies the practicalities for implementation of these procedures.

3 | 2

Radioactive source management rules

These rules, already presented in Chapter 3 § 1|2|4, of course also apply to the medical and biomedical fields, they are about:
- the obligation to have a licence for all transfer, acquisition, possession or use of sources;
- preliminary registration of all source movements to the IRSN;



Cobalt 60 source for telegammatherapy

• book keeping by the beneficiary of the licence of detailed accounts for the sources in his possession, and their movements;

• immediate declaration to the Prefect and the ASN of any loss or theft of radioactive sources;

• return by the user, at its own expense, to its suppliers - who are then obliged to take them - of sealed sources that have expired, are damaged or are no longer needed.

3 | 3

Declaration or licensing procedures

3 | 3 | 1

Declaration dossiers

The procedure for declaration to the Prefect of the department covers use of electrical appliances generating X-rays for medical or dental diagnostic purposes - except for installations requiring licensing as sophisticated equipment (article R.1333-22). Publication of the order of 14 May 2004 about the standard licensing and declaration conditions defined in chapter V.I "Ionising radiation" of the Public Health Code, enables implementation of this declaration procedure which replaces definitively the approvals procedure set up by the order of 23 April 1969 which has been partially abrogated.

The declaration is based on a form which can be downloaded from the ASN web site (www.asn.gouv.fr) or obtained from the nuclear safety and radiation protection division – DSNR. For each establishment possessing and using medical or dental radiology appliances, only a single declaration mentioning all the radiological installations has to be provided. When the dossier is considered to be complete by the DSNR, the Prefect sends back to the declaring party an acknowledgement of declaration of a radiodiagnostic installation, recalling the general conditions to which its operation is subject..

After a five-year period, a further declaration must be submitted. If, prior to expiry of the declaration validity period, modifications have been made to the list of declared installations (change in or addition of an appliance), to their location conditions (transfer or substantial modification of the premises), or if the practitioner in charge has changed, the Prefect of the department must be immediately informed of these modifications.

The declaration dossier must include the reports of the inspections conducted in application of articles R.1333-43. and R. 5212-25 to R. 5212-32 of the Public Health Code and R.231-84 of the Labour Code (protection of workers against the hazards of ionising radiation). If any inadequacies are detected during these inspections, a report describing the remedial measures taken must be submitted along with the declaration dossier.

Installations subject to declaration must be:
• equipped with a generator less than 25 years old (the case of medical appliances) carrying CE labelling guaranteeing conformity with the essential health and safety requirements mentioned in article R.665-12 of the Public Health Code, if they entered service after June 1998;
• fitted out in accordance with standards NFC 15-160, NFC 15-161 (medical radiology) and NFC 15-163 (dental radiology).



AUTORITE DE SURETE NUCLEAIRE

MED/RX/001

SD9

DÉCLARATION D'APPAREILS
DE RADIODIAGNOSTIC MÉDICAL ET DENTAIRE

Je soussigné Nom : ..... Prénom : .....

Titre/Qualité : .....

déclare les appareils de radiodiagnostic désignés dans la liste annexe ci-jointe (nombre de pages : .....).

Si le déclarant est le praticien responsable des appareils, préciser sa spécialité :

☐ Chirurgien ☐ Radiologue ☐ Gastro-entérologue ☐ Gynécologue ☐ Médecin généraliste
☐ Pédiatre ☐ Pneumologue ☐ Rhumatologue ☐ Cardiologue ☐ Chirurgien dentiste
☐ Docteur en chirurgie dentaire ☐ Médecin stomatologue ☐ Orthodontiste ☐ Médecin du travail ☐ Médecin de prévention
☐ Autres (préciser) : .....

1 – MOTIF DE LA DECLARATION

☐ Première déclaration
☐ Renouvellement de la déclaration : ☐ N° de la déclaration antérieure : .....
☐ échéance quinquennale de la déclaration
☐ changement d'appareil ☐ adjonction d'appareil
☐ transfert de local ☐ modification substantielle du local

Examens radiologiques donnant lieu à remboursements par les organismes de Sécurité Sociale : ☐ oui ☐ non

2 – ÉTABLISSEMENT

☐ Secteur public ou assimilé ☐ Secteur privé à but non lucratif ☐ Secteur privé libéral
☐ Clinique ☐ Centre de médecine du travail ou préventive ☐ Centre de santé
☐ Cabinet privé individuel ☐ Cabinet privé collectif
☐ Centre hospitalier universitaire ☐ Centre hospitalier ☐ Centre régional de lutte contre le cancer
☐ Hôpital local ☐ Centre de moyen - long séjour
☐ Autre (préciser) : .....

Utilisation hors établissement d'appareil(s) embarqué(s) sur des véhicules : ☐ oui ☐ non

Nom (ou raison sociale) : .....

Rue : ..... N° : .....

Code Postal : ..... Ville : .....

Tél. : ..... Fax : ..... Mél : .....

Page 1/8

Direction générale de la sûreté nucléaire et de la radioprotection

MINISTÈRE DE L'ÉCONOMIE, DES FINANCES ET DE L'INDUSTRIE
MINISTÈRE DE LA SANTÉ ET DE LA PROTECTION SOCIALE
MINISTÈRE DE L'ÉCOLOGIE ET DU DÉVELOPPEMENT DURABLE

Notification form of medical and dental radiodiagnostic equipments

3 | 3 | 2

Licensing application dossiers

These dossiers concern the following installations:
• X-ray tomography and digitised angiography;
• radiotherapy (particle accelerators, telegammatherapy and brachytherapy appliances);
• nuclear medicine;
• biomedical research on human beings in one of the above-mentioned disciplines, subject to a "Huriet law" biomedical research protocol, which must be licensed by the Minister for Health (art. R. 1333-24), valid for a maximum renewable period of 5 years and issued by the DGSNR to the practitioner in charge.

For each installation mentioned above, the corresponding dossier must be drawn up using a form to be collected from the DGSNR and returned to it accompanied by all the elements required for the dossier.

The license is granted on the basis of criteria concerning necessity (in particular the case with installations governed by the sophisticated equipment procedure), the competence of the practitioner in charge, conformity with the installation technical arrangement and layout rules and the radiation protection organisation.

The appliances mentioned above and which have entered service since June 1998 must carry CE markings showing conformity with the essential health and safety requirements defined in article R.665-12 of the Public Health Code. The appliances may not be used if more than 25 years old (determined the 1st line they came into service).

In the case of nuclear medicine, particular attention will be given to collecting and disposal of radioactive waste and effluents produced in the installations. For instance, the dossier must comprise a waste and effluent management plan for the entire establishment within which the nuclear medicine unit is located.

If biomedical research is performed in one of the above disciplines, the criterion of competence of the practitioners in charge of this research and the technical rules concerning the installations remain applicable.

4 2004 SUMMARY OF DOSSIERS EXAMINED FOR MEDICAL INSTALLATIONS USING IONISING RADIATION

4 | 1

Radiodiagnosis installations

Pending publication of the above-mentioned 14 May 2004 order in the Official Gazette of 20 June 2004, the medical and dental radiology installation dossiers were examined on the basis of the approval system set up by the order of 23 April 1969. In this respect 9,500 radiodiagnosis installation licensing applications were examined. As previously, the vast majority of applications were for dental installations. On 20 June, the declaration procedure came into force and the ASN received 862 dossiers in 2004.

4 | 2

Tomography, radiotherapy, nuclear medicine and blood product irradiation installations

The DGSNR issued 454 notifications as broken down in the following table 6.

Licence	Particle accelerator	Telegamma-therapy	Brachy-therapy	Nuclear medicine	Scanner	Blood product irradiator	Angio-graphy	Contact therapy
Startup (including appliance changes)	34	0	5*	21**	122	3	36	1
Renewal	79	12	32	53	14	5	0	0
Change in person in charge	4	3	1	7	3	2	0	0
Cancellation	9	6	3	1	0	0	0	0
Total	**126**	**21**	**41**	**82**	**139**	**10**	**36**	**1**

Table 6

* This concerns new source applicators used in existing installations.
** 10 of which concern extension of existing licences to the use of fluorine 18 in PET units located in nuclear medicine departments.

5 Perception of radiation protection in the medical sector – the ASN point of view

With the hindsight offered by 3 years of monitoring of medical installations and contacts with professionals in the medical and dental sectors, as well as the suppliers, installers and inspection organisations, the ASN has now sufficient informations to assess the perception of radiation protection by professionals using sources of ionising radiation for medical purposes. The considerable diversity of the installations and medical practices means that radiation protection is dealt with in widely differing ways. The ASN encounters many kinds of situations, ranging from purely administrative radiation protection with the main purpose of declaring the use of a radiology installation or obtaining a license, to the implementation within an establishment of a structured organisation in order to heighten the awareness and make all those concerned by the use of sources more responsible.

In addition, the radiation protection approach varies considerably depending on whether the ionising radiation is used for its therapeutic and functional imaging effects (dose or level administered) or simply to obtain radiological images.

In the first case, corresponding to the fields of radiotherapy or nuclear medicine, overall the radiation protection rules are known and accepted, provided that they do not constitute an obstacle to the development of medical practices and the performance of medical procedures. However, actual implementation of these rules may often be delayed by administrative, financial or technical constraints specific to hospitals.

In the second case, many users still reduce radiation protection under external constraint with administrative (regulatory pressure), technical (obligation to make changes to the installations or reorganise working methods) and financial (costs of modifications, inspections, time spent, etc.) consequences considered to be too burdensome although the risks are not clearly quantified. Therefore this situation leads to delays in applying current radiation protection regulations.

However, these findings can be offset by the increased information available and the work carried out by various learned societies or trade unions which have in recent years contributed to raising the awareness of the parties concerned by radiation protection.

These findings should therefore encourage the ASN to continue its efforts to develop supervision of application of the regulations as well as its training and information programmes with the professionals in the medical world, to ensure a continuous process of radiation protection improvement.



W. Roentgen and the first radiography negative (Mrs Roentgen's hand)

6 IMPACT OF MEDICAL INSTALLATIONS

The ASN currently has little data for assessment of the use of ionising radiation for medical purposes, other than that regarding worker exposure (exposure of patients was described in paragraph 1|5).

According to the existing data collected by the IRSN concerning exposure of personnel employing sources of ionising radiation for medical purposes, about 135,000 people in this sector are subject to dosimetric supervision, or 54% of the total number of exposed workers monitored. 98% of the persons monitored (IRSN 2003 figures) received an effective dose over one year of less than 1 mSv and the future limit of 20 mSv, effective on April 2005, was exceeded 46 times (31 in 2002). As soon as it was aware of this rise in the number of persons exposed above 20 mSv, the ASN asked the IRSN to detail the reasons for this rise. An inquiry is in progress accordingly. The increasingly widespread use of operational dosimetry in the medical field, thereby improving dosimetric monitoring, and the startup of the IRSN'S SISERI centralised dosimetric data collection and analysis system should enable these results to be fine-tuned, giving a clearer identification of the origin of these over-exposures.

Except in special circumstances, there is no specific surveillance of the impact of medical applications on the environment and the population. The available information concerns general surveillance of the environment carried out by the IRSN, in particular measurement of ambient gamma radiation, and overall no significant exposure level above the background radiation variations has been highlighted. However, checks on rivers or sewage plants in large towns occasionally reveal the presence above the measurement thresholds of artificial radionuclides used in nuclear medicine (iodine 131, technetium 99m). The available data on the impact of these discharges show that they are estimated at a few microsieverts per year for the most exposed persons (sewerage network staff) and that these radionuclides have never been measured in water intended for human consumption.

In the case of patients who have undergone a nuclear medicine test or treatment, the 21 January 2004 order requires that nuclear practitioners provide their patients with relevant information to limit exposure of persons in contact with them. Now, it is up to the nuclear practitioners and their representative bodies to draft a guide including all the recommendations to be given to the patients. Regular distribution of this information will help limit unnecessary exposure of those in the patient's entourage.

In addition to this type of measure designed to accompany nuclear medicine procedures, the gradual increase in the number of ASN radiation protection inspections, concurrently with environmental monitoring targeted on certain installations and the use of appropriate computer models, should help set up a clearer picture of the impact of medical uses of sources of ionising radiation. These actions are part of multi-year programmes.

7 OUTLOOK

In 2004, a number of new regulations were published, enabling action to be taken in the radiation protection field of exposed patients. At the same time, as a result of growth in its resources, the ASN was able to expand the scope of its radiation protection supervisory activities in the field of medical applications. The efforts undertaken in recent years will be bolstered in 2005, in particular as a result of the radiation protection situation observed in medical installations, with the implementation of actions about:

- the radiation protection technical inspection bodies, for which approval will now be issued by the ASN, which will require setting up a second-level monitoring of these bodies which are also capable of intervening in medical installations using ionising radiation;
- the requirements applicable to marking out supervised and controlled areas and the health and safety rules. The ASN will use its medical installations inspections to check how all these measures are applied;

• medical radiophysics, with each establishment containing a radiotherapy, nuclear medicine, tomography or surgical radiology unit drafting a plan organising this discipline within the establishment. The ASN will set out to check that these plans exist and that the resources allocated to radiophysics are adequate and operational;
• radiation protection of exposed patients, carrying on the work initiated in 2004 to clarify and experiment with inspection procedures in this area, in particular surgical radiology.

INDUSTRIAL AND RESEARCH ACTIVITIES

CHAPTER 10

INTRODUCTION

1 PRESENTATION OF INDUSTRIAL AND RESEARCH ACTIVITIES USING IONISING RADIATION

1 | 1 Sealed sources

1 | 2 Unsealed sources

1 | 3 Electrical generators of ionising radiation

1 | 4 Particle accelerators

1 | 5 Activities being phased out, unjustified activities, prohibited activities

2 REGULATIONS CONCERNING INDUSTRIAL AND RESEARCH APPLICATIONS

2 | 1 Licensing frameworks for ionising radiation sources used for industrial and research purposes

2 | 2 Radionuclide source management rules

2 | 3 Licensing procedures

3 INSTALLATIONS INVENTORY AND SOURCE MOVEMENTS

3 | 1 Sources of ionising radiation

3 | 2 Radionuclide manufacturers and suppliers

3 | 3 Source users and monitoring

4 2004 SUMMARY OF DOSSIER EXAMINATIONS AND SOURCE MOVEMENTS

4 | 1 The suppliers

4 | 2 The users

5 CHECKS ON RADIATION SOURCES AND INSTALLATIONS

5 | 1 The checks conducted by the ASN

5 | 2 Source retirement

5 | 3 The impact of industrial and research installations

6 INCIDENTS

7 OUTLOOK

INTRODUCTION

For many years, industry and research have been using sources of ionising radiation in a wide variety of applications and locations. The issue for the radiation protection regulations currently in force is to check that, despite this great diversity, the safety of workers, the public and the environment is guaranteed. It is thus important to be able to supervise the conditions of possession, use and disposal of the sources, from fabrication up to disposal. The investigations carried out by the ASN in 2004 confirmed that the means devoted to radiation protection in the industrial and research worlds vary widely. This situation led the ASN to define areas for action, in the light of these existing resources. This year, particular efforts were therefore focused on the manufacturers and suppliers of radionuclide sources, as they have considerable responsibility for the entire life of the radioactive sources, from production up to final disposal. It is important for their situation with respect to radiation protection rules to be unambiguous. At the same time, the ASN continued gradually to acquire the means necessary for discharging all its radiation protection supervision duties.

1 PRESENTATION OF INDUSTRIAL AND RESEARCH ACTIVITIES USING IONISING RADIATION

Industry and research employ radiation produced either by radionuclides - primarily artificial - in sealed or unsealed sources, or by electrical generators. The main applications in these sectors are presented below.

1 | 1

Sealed sources

The main uses of sealed sources include the following.

1 | 1 | 1

Industrial irradiation

This is used for sterilising medical equipment, pharmaceutical or cosmetic products and for conservation of foodstuffs. At low doses, irradiation inhibits germination (potatoes, onions, garlic, ginger), kills insects and parasites in cereals, leguminous plants, fresh and dried fruits, fish and meat, and slows down the decomposition physiological process of fresh fruits and vegetables.

At medium doses, ionisation by irradiation prolongs the shelf-life of fresh fish and strawberries, eliminates deterioration agents and pathogenic micro-organisms in shellfish and meat (fresh or frozen), and technically improves foodstuffs, for example by increasing juice production from grapes or reducing the cooking time of dehydrated vegetables.

At high doses, ionisation offers industrial sterilisation of meat and seafood, of ready-to-eat foods, of hospital meals and decontamination of certain food additives and ingredients such as spices, gums, and enzyme preparations. These consumer product irradiation techniques may be authorised because once the products are treated, they show no signs of added artificial radioactivity. Industrial irradiators use cobalt 60 sources the total activity of which can exceed 250,000 TBq. Some of these installations are classified as basic nuclear installations (BNIs).

1 | 1 | 2

Non-destructive testing

Of the non-destructive testing techniques, gamma radiography in particular uses radioactive sources. It is used to inspect homogeneity defects in metal, particularly in weld beads. It uses iridium 192 sources , with activity not exceeding 4 GBq and cobalt 60, with activity not exceeding about twenty terabecquerels. A gamma radiography appliance mainly comprises:
• a source applicator, used as a storage container when the source is not in use and for transport;
• an ejector tube and remote control designed to move the source between the applicator and the object to be radiographed, while protecting the operator who can remain at a distance from the source;
• a radioactive source inserted into a source-holder.

The gammagraph is usually a mobile device that can be moved from one site to another.



Gammagraphy equipment and its radioactive source

1 | 1 | 3

Checking of parameters

The radionuclides most frequently employed are krypton 85, caesium 137, americium 241, cobalt 60 and prometheum 147. The source activity levels are between a few kBq and a few GBq. These sources are used for the following purposes:
• atmospheric dust measurement; the air is permanently filtered through a tape running at a controlled speed, placed between source and detector. The intensity of radiation received by the detector depends on the amount of dust on the filter, which enables this amount to be determined. The most commonly used sources are carbon 14 (activity 3.5 MBq) or prometheum 147 (activity 9 MBq). These measurements are particularly used for air quality monitoring by checking the dust content of releases from plants;
• basis weight measurement: a beta radiation beam passes through the paper and then is received by a detector. The signal attenuation on this detector allows to know the paper density and thus the basis weight. The sources used are generally krypton 85, prometheum 147 and americium 241 with activity levels lower than 3 GBq;
• liquid level measurement: a beam of gamma radiation passes through the container filled with a liquid. It is received by a detector positioned opposite. The signal attenuation on this detector provides the level of filling of the container and automatic triggering of certain operations (stop/continue filling, alarm, etc.). The radionuclides used depend on the characteristics of the container and the content. As applicable, americium 241 (activity 1.7 GBq), caesium 137 - barium 137m (activity 37 MBq) are generally used;

• density measurement and weighing: the principle is the same as for the above two measurements. The sources used are generally americium 241 (activity 2 GBq), caesium 137-barium 137m (activity 100 MBq) or cobalt 60 (30 GBq);
• soil density and humidity measurement, or gammadensimetry, in particular in agriculture and public works. These devices operate with a pair of americium-beryllium sources and a caesium 137 source;
• logging, which enables the geological properties of the sub-soil to be examined by inserting a measurement probe comprising a source of cobalt 60, caesium 137, americium-beryllium or californium 252.

1 | 1 | 4

Other common applications

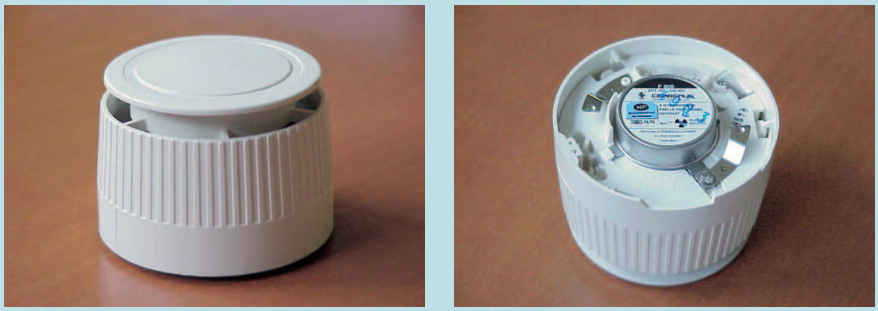
Sealed sources can also be used for:
• eliminating static electricity;
• smoke detection (see box);
• calibration of measuring instruments (radiation metrology);
• practical teaching work concerning radioactivity phenomena;
• chromatography;

Smoke detection

The aim is to signal an outbreak of fire as early as possible, by detecting the smoke produced. The devices used is made of two ionisation chambers, including one reference chamber being tight to the ambient gas, while the other lets combustion gases enter. The intensity of the current passing through the reference chamber is compared with that of the current passing through the measurement chamber. When the difference in intensity is higher than a preset threshold, an alarm is triggered. The gases contained in the reference chamber are ionised by emission of radiation from a sealed source. Although several types of radioelements were used in the past (americium 241, plutonium 238, nickel 63, krypton 85), at present only americium is used, with an activity not in excess of 37 kBq.

Domestic use of smoke detectors employing radioactive sources is prohibited in France. This ban does not apply to the common areas of residential buildings. The licences are issued under a procedure tailored to the constraints arising from use of these appliances.

In recent years, progress in the design of these devices has led to a reduction in the level of activity they need to operate, with some of them using a 10 kBq source. At the same time, the ASN has initiated discussions with the profession so that smoke detectors containing radioactive sources are eventually taken off. The arrangements envisaged are the cessation in 2007 of the sale of new devices, except for appliance replacements for detection system maintenances (maintenance means the replacement of existing devices and/or the addition of detectors on an existing line), followed in 2009 by a total ban on the sale of new devices. From this date, only the reconditioning of old devices would be authorised for two maintenance cycles of a maximum of four years each.



Smoke dectector with radioactive source

Lead detection in paintntures

Saturnism is a disease caused by lead poisoning. This poisoning usually results from ingestion or inhalation of dust from paint containing lead salts. This type of paint is usually encountered in older housing (up until 1948), as lead is currently prohibited as an additive to paint.

A legislative framework aimed at combating social exclusion sets an obligation for action to prevent child saturnism by requiring that the concentration of lead in paint be controlled. The implementation order of 12 July 1999 from the Minister for Health specifies that "lead will preferably be measured by a portable X-ray fluorescence device". This non-destructive analysis method allows instantaneous detection of lead in a coating.

The material to be analysed is excited by an input of energy, to obtain a spectrum in which the presence of the line characteristic of lead can be recognised and quantified. The measurement principle is as follows: the gamma photon emitted by a radionuclide interacts photoelectrically to eject an electron from an atom of the target. De-excitation of the atom to return it to its equilibrium state, leads to emission of an X-ray photon (X-ray fluorescence), the energy of which is characteristic of the element to be analysed (lead). The X-ray photons emitted are counted by a detector and their number is proportional to the number of atoms per unit surface area of the element looked for. Measurement precision is currently 0.058 mg of lead per cm^2 of surface.

The appliances, which are portable, use sources of cadmium 109 (half-life 464 days) or cobalt 57 (half-life 270 days). The activity of these sources is about 400 MBq.

In 2004, a new type of device came onto the market, containing no radioactive source and using an electric generator working on the same principle as the emission of X-ray fluorescence photons.

These various devices are used by a wide variety of organisations, mainly consulting firms, architects, surveyors, solicitors, real estate agents and building managers. The ASN therefore ensures that the appliances offer radiation protection guarantees appropriate to the conditions of use and sets obligations on the users for handling and storage of these appliances, in order to prevent unauthorised loans and theft.



Portable X-fluorescence equipment to detect lead inside paint

• electron capture detectors using sources of nickel 63 or tritium in gaseous phase chromatographs. This technique can be used to detect and dose various elements. These often portable devices are used to dose pesticides or detect explosives, drugs or toxic products;
• X-ray fluorescence detection. This technique is notably used to detect lead in paint (see box).

1 | 2

Unsealed sources

The main radioelements used in unsealed sources are phosphorus 32 or 33, carbon 14, sulphur 35, chromium 51, iodine 125 and tritium. They are used as tracers and for calibration and teaching. Radioactive tracers incorporated into molecules is common practice in biological research. They are thus a powerful investigative tool in cellular and molecular biology. Unsealed sources are also used as tracers for measuring wear, searching for leaks, for friction research, for building hydrodynamic models and in hydrology. The following box describes a particular application of unsealed sources in veterinary medicine.

Use of radionuclides for diagnostic and therapeutic purposes on domestic animal

This entails application to the animal of human nuclear medicine techniques (see chapter 8, § 1.3), both for diagnosis (scintigraph examinations primarily using technetium 99m) and for therapy (metabolic radiotherapy by administration of sources of iodine 131 or yttrium 90). It should be noted that there are also external radiotherapy or brachytherapy irradiation techniques.

Scintigraphy is one of the range of imaging tools which can be used for veterinary medicine (radiology, echography, tomography, magnetic resonance imaging), in particular for supervision of racehorses. As for therapeutic methods, the justification for using them is as yet uncertain, in particular owing to the small number of practitioners who are interested in them. This is based on the only French study on the treatment of feline hyperthyroidism (S. Doliger et P. Devauchelle, in "Pratique médicale et chirurgicale de l'animal de compagnie", 1994 n° 29-5) which considers metabolic radiotherapy to be a safe and effective treatment when compared with surgical excision or the use of anti-thyroidism substances, which are partial alternatives.

The design and fitting out of the installations must take account of radiation protection constraints similar to those used in human nuclear medicine. However, significant differences should be underlined in terms of organisation of work and supervision of the animal, which have consequences for protection of the veterinary staff and the entourage of the animal (handling and restraining the animal, production of waste and effluent, higher risk of contamination of persons and premises). Appropriate safety instructions therefore have to be followed, and must comprise information pertinent to those close to the animal and the radiation protection measures to be taken.

These obligations require that the veterinary surgeon using ionising radiation have experience of the radiobiological and radiotherapeutic aspect of the application, as well as radiation protection constraints. He will therefore have to receive additional training based on that followed by human nuclear medicine practitioners. It would also be best if the products injected were to follow a procedure similar to that applied to drugs: a "veterinary notice of compliance".

To date, two establishments have been licensed to carry out veterinary nuclear medicine.



Veterinary medical imaging by scintigraphy

1 | 3

Electrical generators of ionising radiation

The French inventory of equipment intended for industrial or research activities is today poorly known, insofar as past regulations, based on a simple declaration, were poorly applied. It probably stands at several thousand appliances.

These appliances are mainly intended for non-destructive structural analyses (tomography, diffractometry, etc.), checks on welding bead quality, or materials fatigue inspections (aeronautics).

The customs service and armed forces also use them to check containers of goods or in explosion radiography programmes. There are also more specific uses based on radiography for restoration of musical instruments or paintings, archaeological study of mummies or analysis of fossils.

Industries	Processes	Products
Chemistry Petrochemistry	Cross-linking Depolymerisation Covalent bonding - Polymerisation	Polyethylene, polypropylene, copolymers, lubricants, alcohol
Coatings Adhesives	Vulcanisation Covalent bonding Polymerisation	Adhesive tapes, coated paper products, ply panels, heat shields, wood-plastic and glass-plastic composites
Electricity	Cross-linking Thermal memory Modification of semiconductors	Constructions, instruments, telephone wires, power cables, insulating tape, shielded cable splices, Zener diodes,
Foodstuffs	Disinfection - Pasteurisation Conservation - Sterilisation	Animal feedstuffs, grains, cereals, flour, vegetables, fruit, poultry, meat, fish, shellfish
Health Pharmacy	Sterilisation Modification of polymers	Disposable material, powders, drugs, membranes
Plastics Polymers	Cross-linking Manufacture of foam Thermal memory	Heat-shrink food wrapping, gymnastics apparatus, pipes and ducts, moulded packaging, flexible laminate packaging
Environment	Organic detoxification Fermentation inhibition DeSOx/DeNOx	Sludges for spreading, emission of smoke, gas, solvents, water and various effluents, nutrients from sludge or waste
Paper pulp Textiles	Depolymerisation Covalent bonding	Polyethylene, polypropylene, copolymers, lubricants, alcohol
Rubber	Vulcanisation, strength enhancement Controlled vulcanisation	Adhesive tapes, coated paper products, ply panels, heat shields

Table 1: areas for use of particle accelerators

Unlike equipment used in the medical field, there is no CE marking obligation allowing free circulation of these appliances throughout the European Union.

1 | 4

Particle accelerators

Finally, certain applications require the use of particle accelerators which produce photon or electron beams.

The inventory of particle accelerators, which can be either linear (linacs) or circular (cyclotrons and synchrotrons), stands in France at about 50 installations. They can be used in a wide variety of fields presented in table 1.

1 | 5

Activities being phased out, unjustified activities, prohibited activities

Various activities are tending to disappear, mainly because of technological progress: this is the case with determining the dew point, level measurements and density measurements, for which techniques based on X-rays or ultrasounds are tending to replace those based on radionuclides. This is also the case with measuring snow height or the position of cable cars using a radionuclide source incorporated into the splices of the support cable.



Equipment equipped with caesium 137 source for measuring the depth of snow

The manufacture and sale of lightning arresters containing radionuclides was prohibited in the order of 11 October 1983, in response to the concerns mentioned in article L. 1333-2 of the Public Health Code. This articles states that "certain activities along with certain processes, devices or substances which expose humans to ionising radiation could, owing to the few benefits they offer or to the level of their deleterious effects, be prohibited by regulatory provisions or could be regulated". Similarly, any intentional addition of radionuclides into consumer goods and construction materials is prohibited. In this respect, the manufacture, import and trade in irradiated precious stones, which contain residual activity following activation designed to improve their aesthetic quality and sale value, are not authorised.

The same applies to accessories such as key-rings, hunting equipment (sighting devices) or equipment for river fishing (floats) fitted with sealed tritium sources.

As soon as it became aware of the problem, the ASN asked the General Directorate for Competition Policy, Consumer Affairs and Fraud Control (DGCCRF) to have its departmental service make a distributor of river fishing equipment withdraw from sale this product equipped with tritium ampoules and, through a press release, ask anyone who had acquired such items to return them to their supplier.

Watches marked with tritium

Consideration is being given to the justification for the use of tritium paint applied to the dials and hands of watches in order to make them luminescent. Therefore, the ASN asked the IRSN for a study presenting the advantages and drawbacks of this utilisation, its health impact in various situations and alternative methods. It should however be noted that the health impact of watches marked with tritium is very slight for their wearers (a few µSv/year) in normal conditions of use. Discussions are taking place between the ASN and the DGCCRF to obtain a clearer picture of this market and identify the companies active on it. It should be pointed out that in France, there are no companies still manufacturing tritium paint.

2 Regulations concerning industrial and research applications

The industrial and research application requirements as stated in the Public Health Code (sub-section 3, art. R. 1333-26 to R. 1333-28) are recalled below.

2 | 1

Licensing frameworks for ionising radiation sources used for industrial and research purposes

Table 2 presents the procedures governing the various industrial and research applications, including the veterinary purposes.

Unlike medical applications, industrial and research applications always require licensing, although some of them in certain conditions may be exempted from this licence requirement. The Public Health Code also introduced a licence waiver issued by the Minister for Health for nuclear activities which have already been licensed under the Mining Code, the basic nuclear installations system or that covering installations classified on environmental protection grounds.

The maximum validity of the licences is 5 years renewable. The licence which is issued to the head of an installation is personal and non-transferable. Any modification to the licence concerning either its beneficiary, or the installation, or its operating conditions, must be re-examined under article R. 1333-36 of the Public Health Code. The beneficiary of a licence must make arrangements to protect, inform and provide radiation protection training for all those likely to be exposed to ionising radiation, specified in articles L. 1333-8 and L. 1333-11 of the Public Health Code.

Table 2 presents the procedures governing the various industrial and research applications, including on veterinary purposes.

Finally, any incident or accident likely to be the cause of over-exposure of an individual must be immediately declared to the Prefect of the department and to the ASN. For information, the ASN in

Nature of nuclear activity	Procedure and competent authority	Comments
Manufacture of radioactive sources or devices containing them	Licensed by Minister for Health (DGSNR)(1), unless nuclear activity in ICPE licensed with heading 1700 above declaration threshold: authorisation by the Prefect	
Manufacture of products or devices containing radioactive sources		Exemption possible if criteria set in article R.1333-27 are met(2)
Utilisation of radioactive sources		
Irradiation of products, including food products		
Utilisation of electrical generators, including particle accelerators	Licensed by Minister for Health (DGSNR)	Exemption possible if criteria set in article R.1333-27 are met(2)
Import or export of radioactive sources or devices containing them		
Distribution of radioactive sources or devices containing them		Exemption possible if criteria set in article R.1333-27 are met(2)

Table 2: procedures applicable to industrial or research nuclear activities

(1) The licences issued for nuclear activities covered by the Mining Code or the basic nuclear installations system are equivalent to licensing under the Public Health Code.

(2) The licensing procedures exemption criteria apply:

– to radionuclides, if the total quantities involved, or their concentration per unit mass, are below the thresholds set in the appendix to decree 2002-460 of 4 April 2002 (provided that the masses of substances involved do not exceed one ton);

– to electrical generators of ionising radiation, if of a certified type compliant with the standards and if, in normal operation and at any point 0.1 m from their accessible surface, they do not generate an equivalent dose of more than 1 µSv/h, or if an appliance operating with a potential difference of 30 kV or less in the same dose equivalent rate limit conditions.

2003 set up a telephone hot-line for emergency situations (toll-free number: 0 800 804 135) open round the clock, which can also be used for any radiological incident occurring in any industrial or research installation using ionising radiation sources.

Section 2.3 gives details on the content of the licence application dossiers specified in articles R. 1333-26 and R. 1333-27. An order currently under preparation and based on article R. 1333-44, will detail the modalities for implementation of these procedures.

Particular conditions of use

The CIREA (Interministerial Commission on Artificial Radioelements), which until 2002 was responsible for giving its opinion on issues relating to artificial radioelements had, for activities requiring licensing, set particular conditions of use (CPE) designed to inform the future licensee of the conditions for applying the regulations in its field of activity. Until such time as a text of at least equivalent scope is published, the CPEs are still in force, in accordance with the Public Health Code. Table 3 gives the scope of application of the main CPEs.

The most frequently used of these CPEs will then be incorporated into ministerial orders, with the others remaining in particular technical provisions recalled in the individual licences. In this way, given the scale of the risks involved in the use of gammagraphy, an order was published in March 2004, to update the conditions of use for gammagraphy appliances and supersedes the corresponding CPE.

Particular conditions of use of radiation sources
- licensing of sealed sources: conditions applicable to the recovery and disposal of expired sources or sources which are no longer used (CPA); - extension of the licence to use radioactive sealed sources of artificial radioelements beyond the ten-year period stipulated in the CPAs; - use of natural krypton gas; - use of gaseous phase leak detectors on underground piping; - use in hydrology; - use for measuring air renewal rates; - use of portable devices; - use of adsorbed tritium sources; - use for ionisation of electron tubes and discharges; - use for combustion smoke or gas detectors; - use of sealed sources for reference, calibration and testing; - distribution of laboratory reagents, calibration sources and measuring or analysis instruments; - use of sources which, in nuclear power reactors are employed as start-up sources, or in fixed radiation protection channels for unit control systems, or in boron meters and power range measurement channel control systems as well as in irradiation specimen capsules.

Table 3 : scope of application of the main CPEs for radiation sources

2 | 2

Radionuclide source management rules

These rules, already presented in Chapter 3, § 1|2|4, are of course also applicable to industry and research. It should be remembered that these rules concern:
- the obligation to obtain a licence prior to any transfer or acquisition of sources;
- prior registration with the IRSN of all source movements;
- keeping by the beneficiary of the licence of detailed accounts for the sources in his possession, and their movements;
- immediate declaration to the Prefect and the ASN of any loss or theft of radioactive sources;
- return by the user, at its own expense, to its suppliers - who are then obliged to take them - of sealed sources that have expired, are damaged or are no longer needed.

2 | 3

Licensing procedures

For each nuclear activity mentioned in table 2 above and requiring licensing by the Minister for Health, the corresponding application is examined by the ASN. It must be submitted by the person in charge of the nuclear activity jointly with the head of the establishment or his representative. This dossier should be drawn up on the basis of a form to be collected from the ASN and returned to it, accompanied by all elements requested.

The dossier should establish that radiation protection guarantees are in place and effective and that they were defined taking account of the principles of justification, optimisation and limitation specified in article L. 1333-1 of the Public Health Code. This dossier should therefore comprise elements concerning:
- the justification for the application;
- the conditions of possession and use of the sources;
- the presence of a person with competence in radiation protection;
- the characteristics and performance of appliances containing the sources held and used;

- radiation protection provisions;
- drafting of safety instructions;
- the precautions taken against the risks of theft or fire.

When examining the licensing applications, the ASN may as it sees fit, call on the expertise of the Institute for Radiation Protection and Nuclear Safety (IRSN) and, if necessary, that of organisations whose competence it recognises in the fields of radionuclide source safety and the safety of electrical generators of radiation.

3 INSTALLATIONS INVENTORY AND SOURCE MOVEMENTS

3|1

Sources of ionising radiation

3|1|1

Radionuclides

Tables 4 (below) and 5 (see following page) provide the number of establishments authorised to use sources in the listed applications. They illustrate the diversity of these applications.

A given establishment may carry out several activities and therefore appears in both tables.

Main uses of sealed sources	in 2002	in 2003	in 2004
Gamma radiography	189	192	147
Density measurement and weighing	455	457	337
Thickness measurement	229	221	180
Dust measurement	96	94	79
Thin layer thickness measurement	39	33	23
Weight measurement	261	271	228
Level measurement	467	449	348
Humidity and density measurement	363	339	278
Logging	10	9	14
Elimination of static electricity	26	27	22
Smoke detectors	2	2	2
Use of neutron sources	55	55	44
Analysis	111	113	87
Calibration	846	875	813
Teaching	132	148	137
Research	19	21	19
Chromatography	516	521	477
Electron capture detectors	64	69	56
X-ray fluorescence analysis	1037	1343	1643

Table 4: use of sealed sources

Main uses of unsealed sources	in 2002	in 2003	in 2004
Research	1076	1082	1047
Use of tracers	19	21	16
Calibration	95	103	92
Teaching	25	23	22

Table 5: use of unsealed sources

3 | 1 | 2

Electrical generators of ionising radiation

In the light of changing regulations, the ASN does not yet have sufficiently data linking the number of installations and the nature of the applications. The number of installations using electrical generators of ionising radiation for industrial, research or veterinary purposes is currently estimated at several thousand. However, the obligation to obtain prior licensing for use of this type of appliance, in accordance with the Public Health Code, should in the forthcoming years provide the ASN with this information and thus provide an accurate picture of the inventory of this type of equipment.

3 | 2

Radionuclide manufacturers and suppliers

As regards radioactive source distribution, it is relatively rare for the supplier, who is also very rarely the manufacturer, to deliver an isolated source. Generally, it also distributes a range of appliances containing sealed and unsealed radionuclides. The number of companies involved in the distribution of radioactive sources and appliances has risen since last year, mainly owing to their situation being regularised by the ASN. This process led to users being reclassified as suppliers following verification. Table 6 shows this trend.

Number of suppliers identified per year		
2002	2003	2004
183	202	182

Table 6: supplier licences

3 | 3

Source users and monitoring

In recent years, there has been a rise in the number of licences granted for the possession and utilisation of sealed sources, primarily due to the rise in the number of devices for detecting lead in paint. A given licence may cover simultaneous use of both sealed and unsealed sources. Table 7 shows a slight rise in the users of sealed sources and a significant rise in the users of unsealed sources.

Number of users per type of source used recorded per year					
Sealed sources			Unsealed sources		
2002	2003	2004	2002	2003	2004
3554	3800	4180	758	1165	1138

Table 7: users per type of source

4 2004 SUMMARY OF DOSSIER EXAMINATIONS AND SOURCE MOVEMENTS

4 | 1

The suppliers

In 2004, the ASN carried on with priority action initiated in 2003 about the suppliers of radionuclide sources or appliances containing them and used for industrial or research purposes. These companies have considerable responsibility for the safety of source movements, their traceability, the recovery and the disposal of used or unwanted sources. It is therefore important that their situation with regard to radiation protection rules be transparent and unambiguous and that their activities be duly covered by the licence specified in article R. 1333-27 of the Public Health Code.

During the course of 2004, 34 licences were issued to suppliers and 7 licences being revoked. Several dozen dossiers are also being investigated by the ASN. In this respect, these dossier investigations can last a long time, given the combination of various negative factors, including:

- the identification of key contacts to obtain pertinent data about the sources and appliances;
- the complexity of the radiation protection analyses for appliances and radionuclide sources;
- obtaining specific guarantees to ensure effective recovery of used or unwanted sealed sources.

However, the extensive work currently under way on this type of dossier will ease later examination subsequently when renewing licences or when licence modifications are requested.

4 | 2

The users

Examination by the ASN of about 1500 application dossiers for possession and utilisation of radionuclides led to notify 560 new licences and to revoke 209 licences. About 800 dossiers concerning an industrial or research activity are currently being examined by the ASN. Table 8 presents the trend in the licences issued or revoked over the last three years. The values for 2004 correspond to the licences granted by the ASN and do not take account of those issued by the authorities for installations classified for environmental protection purposes (ICPE) or defence-related installations, owing to the redistribution of the licences between these authorities set up at the beginning of 2004.

Once the licence is obtained, the licensee may procure sources. To do this, it collects supply request forms from the IRSN, enabling the institute to check that the orders are in accordance with the licences of both user and supplier, it being one of the institute's duties to update the inventory of ionising radiation sources. If the order is correct, the movement is then recorded by the IRSN, which

notifies the interested parties that delivery may be done. The ASN is contacted in the event of any difficulty.

Trends in "user" licences			
Year	2002	2003	2004
New licences	407	485	560
Renewals-Updates	1127	1165	707
Revocations	168	200	209

Table 8: "user" licence trends

National movements of sealed sources are illustrated in table 9. The values for 2004 only take account of the sources authorised by the ASN.

Movement of sealed sources			
Sealed sources	2002	2003	2004
Possessed as at 31.12	26018	24508	19478
Distributed in	3195	2243	2067
Recovered during	2365	2682	1534

Table 9: sealed source movements (IRSN data)

In 2004, the number of dossiers dealt with and notifications issued, concerning mainly renewals and updates, has been reduced. In the same time, a continued rise in the new licences linked to the rise in the number of users of devices detecting lead in paint and equipped with sealed sources has been noted.

Periodic checks are carried out on the inventory of sources allocated to a user and on their movements, in particular by comparing them with the data in the reports from the approved organisations leading to on-site checks.

Electrical generators of ionising radiation

The ASN has begun investigation of applications for licences to possess and use electrical generators, it being recalled that in the previous regulations, these installations simply required declaration.

In order to improve efficiency, the ASN initiated an experiment with a number of volunteer DSNRs to decentralise to the regions investigation of these dossiers, which are to be drawn up on the basis of a specific form.

A number of problems were raised during these investigations. In particular, X-ray generators are working equipment according to the Labour Code. Therefore, they have to comply with construction standard NFC 74-100 (construction and tests) setting technical requirements to be met by the generators and which were made mandatory by the order of 2 September 1991, and standards NFC 15-160 (general rules) and NFC 15-164 (rules specific to industrial radiology devices) referred to by the order of 30 August 1991 concerning installation conditions for these appliances. These requirements were not abrogated with the changing regulations, which modified the annual exposure limits for workers and members of the public and which have switched these appliances from the declaration category to that requiring licensing.

The ASN has begun discussions with the Ministry for Labour to ensure that these regulations are modified.

However, in 2004, the ASN granted 118 licences for electric X-ray generator use.

The case of sources of ionising radiation used in BNIs

Article R. 1333-26 of the Public Health Code states that the licence (authorisation decree) issued for a basic nuclear installation (BNI) is equivalent to a licence to possess and use ionising radiation sources, unless these sources are intended for medical applications. This simplification applies to the sources needed for BNI operation, with the other sources being subject to licensing under the terms of the Public Health Code.

In order to implement these measures, the ASN asked the BNI operators to supply it with a list of sources in their possession, differentiating between those needed for operation of the installations from the other sources.

The ASN also continued to press the CEA to regularise its situation with respect to the Public Health Code, by obtaining licences for the possession and utilisation of the sources of ionising radiation it uses in its various establishments, in place of the waiver from which it previously benefited and which gave it a permanent authorisation. This approach led the ASN in 2004 to notify the CEA of a few establishment licences authorising them as both supplier and user of sources.

5 CHECKS ON RADIATION SOURCES AND INSTALLATIONS

5|1

The checks conducted by the ASN

The checks applied to radiation sources depend on the nature of the source and the stage of production and utilisation reached. They are presented in chapter 4, paragraph 2|2|3.

The ASN pays particularly close attention to the use of gamma radiography appliances. On 26 April, it sent out a circular letter to the industrial firms concerned, instructing them to abide by the main regulations in force, following the discovery of numerous inadequacies in application of radiation protection good practices, or even serious breaches of the regulations laid down by the Public Health, Labour and Environment codes. This circular letter was the subject of an information note published on the ASN web site (www.asn.gouv.fr). The ASN inspected establishments using gamma radiography devices, one of its priority inspection topics for 2004. The main inadequacies concern prior evaluation and optimisation of doses, as well as the conditions for carrying out gamma radiography operations on the worksites.

5|2

Source retirement

According to the Public Health Code (articles L. 1333-7 and R. 1333-52), all users are required to have the suppliers recover the sealed sources they supplied, as soon as the user no longer needs them, and in any case no later than ten years following the date the first approval was marked on the source supply request.

The supplier is required to recover the source whenever requested by the user. It must also set up a security deposit to cover the consequences should it default and should another party or the ANDRA be required to step in to take its place. Finally, in accordance with article R. 1333-52, the supplier is required to declare any source not returned to it within the specified time.

The organisation recovering the source is required to send the user a notice of recovery mentioning the characteristics of the source and the references of its possession authorisation form. Presentation of this document is proof that the user no longer has responsibility for utilisation of the source. On the basis of this document, the source is removed from the user's inventory in the data base, but a trace of it is retained in an "archive" file.

When renewal applications are examined, in the event of closure of the company or during occasional periodic inspections, the ASN with the assistance of the IRSN systematically checks the situation and the future disposal of the sealed sources.

In order to strengthen the framework for radionuclide source recovery and make it easier to implement, the suppliers in 1996 created a non-profit association named "Ressources", which set itself a number of objectives:
• to improve the awareness of its members by promoting actions designed to prevent hazards to public health and the environment arising from the possession and utilisation of sealed radioactive sources;
• to set up a guarantee fund, financed from association membership fees. This fund is to be used to reimburse the ANDRA or any other authorised organisation for any expenses incurred in recovery of sources from the user, either through defaulting of the supplier normally responsible for recovering them, or because no competent supplier is available, if the source in question is a stray source.

The sole purpose of this guarantee fund is to meet the cost of recovering, packaging if necessary, transporting, storing and disposing of stray and orphan sources, and in no case to cover the repair of any damage caused by these sources to the environment, property or persons.

Stray sources are defined as being all sealed radionuclide sources for which the members of the association have not met their obligation of recovery. Orphan sources are all sealed radioactive sources for which there is no known or identifiable supplier to meet the obligation of recovery.

With its 60 members, the Ressources association is the main mouthpiece for the profession, in that it covers nearly 95% of the market for this activity.

As part of the national radioactive waste management plan (see Chapter 16), solutions for the used source disposal are being studied because there is still no disposal channel for them. A draft order stipulating the disposal (downgrading) method for sources is being prepared accordingly. The ASN also gave its agreement in principle for disposal in the Aube repository of sources with a half-life equal to or less than that of caesium isotope 137 (or about 30 years).

5 | 3

The impact of industrial and research installations

The ASN currently has little data to enable it to assess the impact of the uses of sources of ionising radiation for industrial and research purposes, except with respect to worker exposure.

According to the existing data collected by the IRSN concerning exposure of industrial and research workers, there are 26,160 and 8,805 exposed individuals respectively in these sectors, who are the subject of dosimetric monitoring. In industry, 80% of those monitored (IRSN 2003 figures) received an effective dose over one year of less than 1 mSv and the annual limit of 20 mSv was found to have been exceeded 40 times, while no overshoot was detected in the research sector where nearly all

(99.8%) of the staff monitored were not exposed to an effective annual dose of more than 1 mSv. It is worth noting a very slight rise in the average dose received by industrial workers, about a tenth of a microsievert, and an increase in the number of industrial workers who received an annual dose of more than 1 mSv (20% above this value in 2003 instead of 14% in 2002).

The impact of non-BNI industrial or research applications on the environment and the general public has not been the subject of any specific monitoring, except special cases. The available information concerns general environmental monitoring as performed by the IRSN, in particular ambient gamma radiation measurement, which on the whole shows no significant level of exposure above variations in background natural radioactivity, except occasionally and momentarily when gamma radiography is detected by the monitoring and alarm system.

The gradual expansion of ASN radiation protection supervision, allied with environmental monitoring targeted on certain installations and the use of appropriate computer models, should provide a more accurate picture of the impact of industrial and research applications. These actions will have to be incorporated into multi-year programmes.

6 INCIDENTS

The declared incidents primarily concern loss or theft of radioactive sources or portable devices containing them (lead detection, etc.), inappropriate use or total or partial accidental destruction of a radionuclide source.

In 2004, there were about ten such incidents, including:
- 5 losses or thefts of sealed sources from their place of use ;
- 3 potential over-exposure incidents.

7 OUTLOOK

In the field of supervision of ionising radiation applications used in industry and for research, the ASN aimed in 2004 to identify working priorities to ensure best use of its current resources. It targeted its efforts on examining the situation of manufacturers and suppliers of radioactive sources or appliances containing them. At the same time, the ASN's manning levels were gradually increased so that in a few years time it will be fully able to discharge all its duties.

With the extra staff already received and those planned for 2005, the action initiated will be continued and indeed added to with:
• continuation of the work to update the licences issued to the manufacturers and suppliers of radioactive sources and the actions undertaken concerning the research sector;
• start-up of the regional inspection programme;
• application of the licensing system to electrical generators of ionising radiation used in industry and research;
• definition of the position and role of the approved organisations in supervision of radiation protection by setting up methodological tools used to establish approval criteria and check compliance with them.

TRANSPORT OF NUCLEAR MATERIALS

1 GENERAL INTRODUCTION

1 | 1 The packages

1 | 2 Annual traffic

1 | 3 Industrial participants

1 | 4 Safety supervision provisions for the transportation of radioactive materials

2 REGULATIONS

2 | 1 International regulations

2 | 2 National regulations

3 ASSESSMENT OF SAFETY DOCUMENTS

3 | 1 Issue of package designs approval certificates

3 | 2 Quality assurance policy

4 INSPECTION AND FIELD SUPERVISION

5 INCIDENTS AND ACCIDENTS

5 | 1 Nonconformity of container or content

5 | 2 Package handling events

5 | 3 Incidents and accidents during actual transport

6 EMERGENCY RESPONSE PROVISIONS

7 OUTLOOK

CHAPTER 11

The Nuclear Safety Authority (ASN) has since 12 June 1997 been responsible for regulations pertaining to the safe transport of radioactive and fissile materials for civil use and for supervision of their application. Its powers in this field were confirmed by decree 2002-255 of 22 February 2002 which created the Directorate General for Nuclear Safety and Radiation Protection.

It should be noted that the radioactive material transport regulations have two separate objectives:

- security, or physical protection, consists in preventing loss, disappearance, theft and misuse of nuclear materials (usable for weapons), for which the Defence High Official, attached to the Minister of the Economy, Finance and Industry, is the responsible authority;

- for its part, safety consists in controlling the irradiation, contamination and criticality hazards involved in radioactive and fissile material transportation, ensuring that man and the environment undergo no ill effects. Monitoring safety is the responsibility of the ASN.

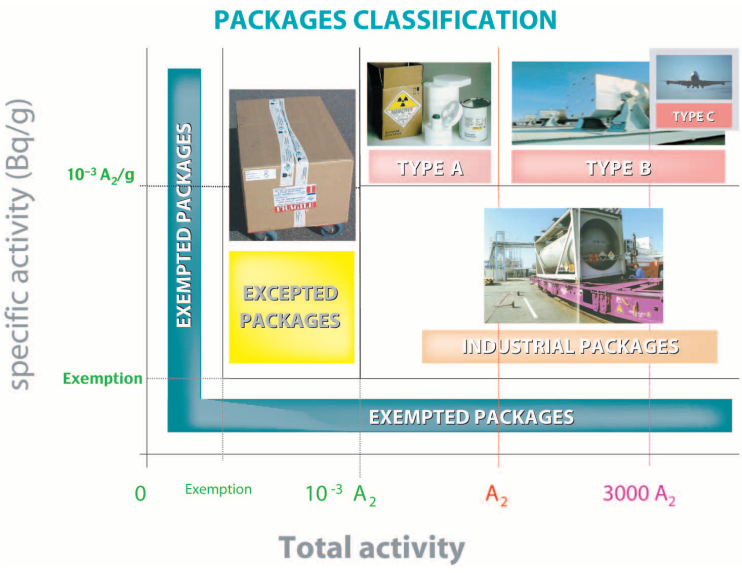
In application of the decree of 5 July 2001, supervision of the transport of radioactive and fissile materials for national security purposes falls to the Delegate for Nuclear Safety and Radiation Protection for activities and installations concerned by National Defence provisions (DSND).

1 GENERAL INTRODUCTION

1 | 1

The packages

The term package designates the container with its radioactive contents ready for transportation. The regulations define several types of package, depending on the characteristics of the substance to be transported, such as its total activity, its specific activity, its physico-chemical form and its fissile character where applicable. For each radionuclide, a reference activity level is defined, where the lowest levels correspond to the most noxious products. This value is called A1 for materials in a special form (guaranteeing no dispersion) and A2 in all other cases. For example, for Pu 239, A1 is equal to 10 TBq and A2 is equal to 10^{-3} TBq.

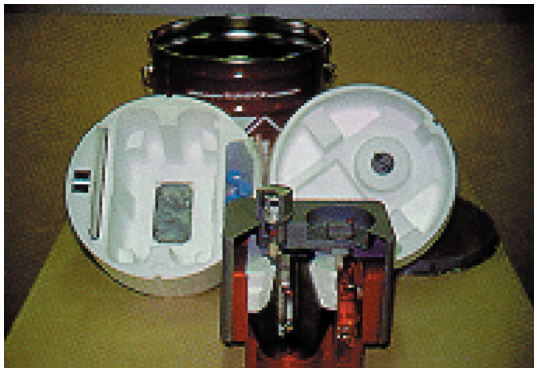


Types of package depending on total and specific activity

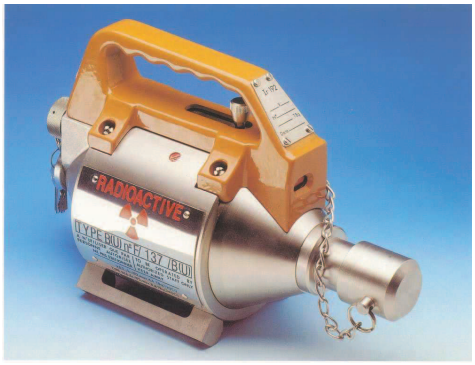
The adjoining diagram shows the different types of package defined by the regulations.

The packages fall into one of the following categories:
- excepted packages: very low activity of contents, below 10^{-3} A1 or 10^{-3} A2;
- industrial packages: low specific activity of contents, below 2.10^{-3} A1/g or 10^{-3} A2;
- type A packages: activity of contents below A1 or A2;
- type B packages: activity of contents above A1 or A2;
- type C packages (air transport): activity of contents above 3000 A1 or 3000 A2.

This package classification only applies to the transportation of material having spe-



Example of a type A packaging – Technetium 99 generator



Example of a type B packaging – Gammagraph containing an iridium source

cific and total activities exceeding the exemption thresholds defined in the relevant transport regulations. Packages where the specific or total activity levels are below the exemption thresholds are considered to be exempted.

Each type of package is governed by specific safety requirements and test criteria confirming the capacity of the package to withstand normal or accident transport conditions (see box below).

Characteristics of the various types of packages

Excepted packages are subjected to no qualification tests. However, they must comply with a number of general specifications such as a maximum dose rate at the surface below 0.005 mSv/h. Non-fissile industrial or type A packages are not designed to withstand accident situations. However, they must withstand certain incidents which could occur during handling or storage operations. They must consequently withstand the following tests:
- exposure to a severe storm (rainfall reaching 5 cm/h for at least 1 hour);
- drop onto a rock target from a height varying according to the weight of the package (maximum 1.20 m);
- compression equivalent to 5 times the weight of the package;
- penetration by dropping a standard bar onto the package from a height of 1 m.

These tests should give rise to no loss of material and radiation shielding deterioration must not exceed 20%.

Fissile or type B packages must be designed so that they continue to ensure their containment, sub-criticality and radiation shielding functions under accidental conditions. These accidents are represented by the following tests:

- a series of 3 consecutive tests:
• a 9 m drop test onto a rock target,
• a 1 m drop onto a spike,
• encircling fire of at least 800 °C for 30 minutes;
- immersion in 15 m deep water for 8 h (200 m water depth for spent fuel).

Type C packages must be designed so that they continue to ensure their containment, sub-criticality and radiation shielding functions under representative air transport accident conditions. These accidents are represented by the following tests:

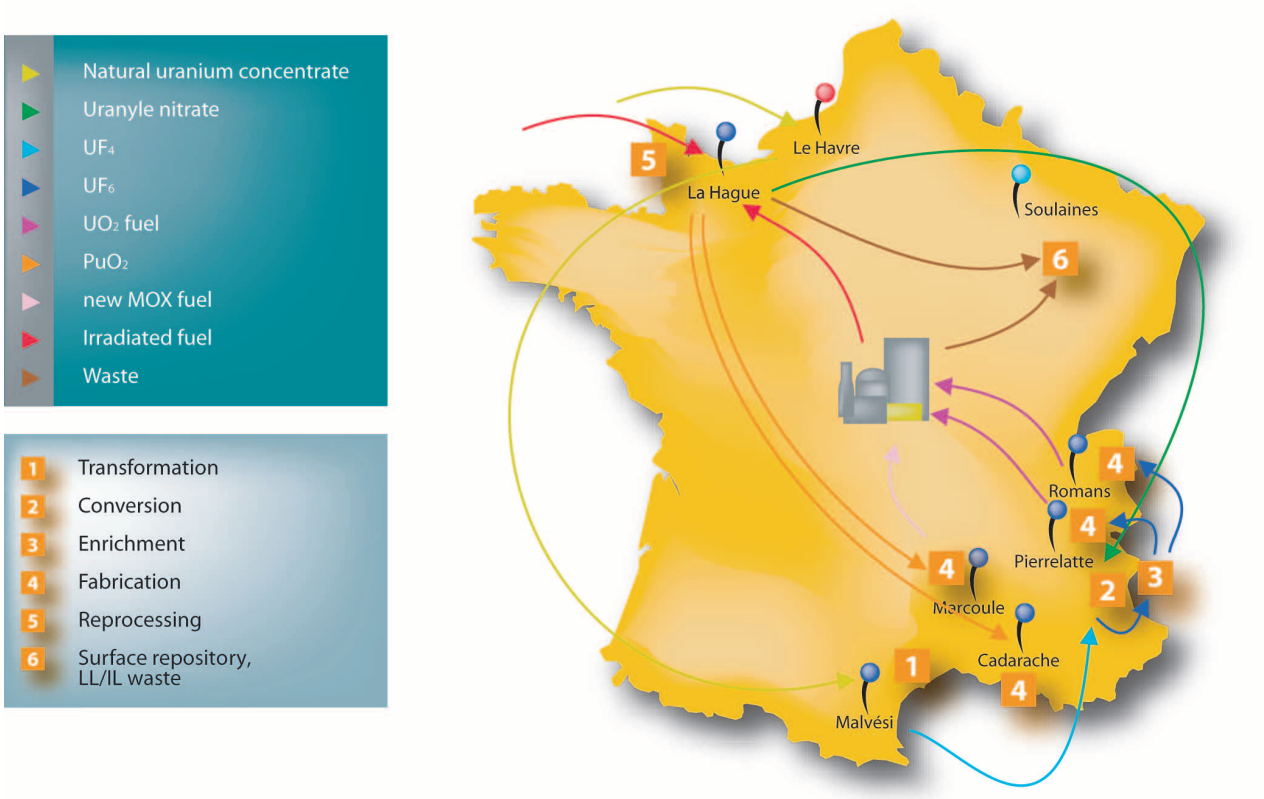
- a series of 3 consecutive tests:
• a 9 m drop test onto a rock target,
• a 3 m drop onto a spike,
• encircling fire of at least 800 °C for 60 minutes;
- 90m/s impact on a rock target;
- immersion in 200 m deep water for 1 h.

1 | 2

Annual traffic

300,000 radioactive material packages are transported in France annually, representing a few percent of the dangerous goods traffic. Most (two-thirds) consist of radioisotopes for medical, pharmaceutical or industrial use. The diversity of these packages is considerable. Their radioactivity varies by more than twelve orders of magnitude, or from a few thousand becquerels (pharmaceutical packages) to millions of billions of becquerels (spent fuel), and their weight from a few kilograms to about a hundred tons.

The nuclear power cycle industry gives rise to the transport of many sorts of radioactive materials: uranium concentrates, uranium tetrafluoride, depleted, natural or enriched uranium hexafluoride, fresh or spent fuel assemblies containing uranium oxide or mixed uranium and plutonium oxide (MOX), plutonium oxide, waste from power plants, reprocessing plants, CEA research centres, etc. (see diagram). The largest consignments concern about 300 shipments per year for fresh fuel, 450 for spent fuel, about 30 for MOX fuel and about 60 for plutonium oxide powder.



Transport traffic: transports related to the fuel cycle in France

Since transport provisions are international, France is also a transit country for some of these shipments, for instance for spent fuel packages from Switzerland or Germany, bound for Sellafield in Great Britain, which are taken on board ship at Dunkirk.

1 | 3

Industrial participants

The main participants in transport arrangements are the consignor and the carrier. The consignor is responsible for package safety and accepts his responsibility by way of the dispatch note accompanying the package remitted to the carrier. Other participants are also involved: the package designer, manufacturer and owner and the carriage commission agent (authorised by the consignor to organise the transport operation).

For a radioactive material shipment to be carried out under good safety conditions, a stringent chain of responsibility has to be set up. So, for major transport operations:
- the consignor as nuclear operator must be fully aware of the characteristics of the material to be transported, so that he can select packaging and specify transport conditions accordingly;
- the corresponding packaging must be designed and sized in accordance with conditions of use and current regulations. In most cases, a prototype is needed to carry out the tests prescribed by the regulations. Following this phase, the safety file is drawn up and submitted to the competent Authority, to back up the authorisation application;
- in cases where existing containers are used, their conformity with approved models has to be confirmed. In this context, the container owner must set up a maintenance system in conformity with that described in the safety file and the authorisation certificate;
- the container is sent to the consignor's site, where it will be loaded with the material for transportation. The consignor must carry out the inspections for which it is responsible (leaktightness, dose rate, temperature, contamination) on the loaded container prior to entry on a public road or railway track;
- the transport operation itself is organised by the carriage commission agent, who is responsible for obtaining requisite permits and complying with advance notice requirements on behalf of the consignor. He also selects the means of transport, the carrier and the itinerary, in compliance with the above-listed requirements;
- the actual transportation is entrusted to specialised firms, having the necessary permits and vehicles. The drivers of road vehicles in particular must be in possession of the training certificate required by the regulations.

1 | 4

Safety supervision provisions for the transportation of radioactive materials

In the context of supervision of the safe transportation of radioactive and fissile materials, the Nuclear Safety Authority (ASN) is responsible for:
- defining technical regulations and monitoring their application;
- accomplishing authorisation procedures (approval of packages and organisations);
- organising and implementing inspection procedures;
- proposing and organising information of the public.

In addition, the ASN acts within the context of emergency plans defined by the authorities to deal with an accident.

In a decision of 1 December 1998, the ministers responsible for nuclear safety set up an Advisory Committee for the transportation of nuclear materials, on similar lines to those which already existed. Depending on the importance of the issue, expert assessment by the Institute for Radiation Protection and Nuclear Safety (IRSN), at the ASN's request, could be supplemented by an Advisory Committee examination.

The TranSAS mission in France

- In 2002, France asked the IAEA to organise a mission to assess its radioactive materials transport organisation and its implementation of international regulations. The TranSAS (Transport Safety Appraisal Service) mission ran from 29 March to 8 April 2004. The mission team comprised fourteen experts from nine different countries (Germany, Canada, Egypt, United States of America, Great Britain, Ireland, Japan, New Zealand and Panama) plus two IAEA experts and a technical writer. Generally speaking, the mission issued three types of comments:
- recommendations for areas in which the Authority needs to make improvements in compliance with the international regulations;
- suggestions for areas in which the Authority could improve its efficiency;
- best practices that could act as a model for other competent Authorities in the field of radioactive materials transport.

The report is available on the ASN's website and in particular contains three recommendations, sixteen suggestions and twelve best practices. The general conclusion is that the international regulations are implemented in accordance with the IAEA's requirements and that improvement is however possible, in particular concerning updating of guides and procedures as well as in formal proof that all the requirements have indeed been met.

The recommendations concern:
- development of an appropriate programme for packages that have not been approved;
- revision of the agreement with the IRSN, developing a specification stipulating the scope and recording of the appraisal work done concerning the package approvals;
- revision of the appraisal procedures in order to formalise proof that all the requirements of the regulations have been met for the approved packages, special arrangements and shipment approvals.

The best practices in particular concern carriage by sea, preparation for emergency situations, inspection and protocols with the other administrations in charge of the various modes of transport.

The ASN is devoting particular attention to implementing the recommendations of this mission. This mainly consists in formalising existing practices in documentary form.

2 REGULATIONS

Unlike the technical safety regulations for plants, which are specific to each State, an international basis has been defined by the International Atomic Energy Agency (IAEA) for transportation safety.

This basis has been used for the definition of the modal safety regulations currently in force: the ADR agreement on road haulage, the RID regulations for transport by rail, the ADNR regulations for inland waterway transport, the IMDG code for sea transport and the technical instructions of the ICAO for air transport. These modal regulations have been fully transposed into French law and have been implemented by interministerial orders. In this context, the ASN has frequent contacts with the government departments dealing with the different modes of transport (Directorate for Inland Transport, Directorate for Maritime Affairs and Seafarers, Directorate-General for Civil Aviation) and has a representative at the Interministerial Committee on the Transport of Dangerous Goods (CITMD).

Transport safety is based on three main factors:
- first and foremost, on the engineered toughness of the packages,
- on transport reliability and certain specially equipped vehicles,
- on an efficient emergency response in the event of an accident.

Regulations are based on IAEA recommendations, which specify package performance criteria. The safety functions to be assured are containment, radiation protection, prevention of thermal hazards and criticality.

The degree of safety of the packages is adapted to the potential harmfulness of the material transported. For each type of package (so-called excepted packages, industrial type packages, type A packages, type B packages, type C packages), the regulations define the associated safety requirements, together with test standards to be reached (see § 11|1|1).

2 | 1

International regulations



IAEA TS-R-1 regulations and maritime (IMDG) and air (ICAO IT) regulations

The ASN aims to intervene as early as possible in the drafting of the regulations, jointly with the IRSN, in particular by taking part in the various international or multinational working groups that exist to deal with the transport of hazardous or radioactive goods.

In this context, the ASN is a member of the IAEA TRANSSC Committee (Transport Safety Standards Committee) and is represented as an expert in many working parties, organised according to transport mode, in cases where radioactive material transport is at issue. In this way, an ASN representative took part in the TRANSSC group meeting held from 22 to 26 March 2004 in Vienna. The ASN also took part in the meeting to review comments by all the member states on the proposals for updating the IAEA recommendations (1996 edition modified in 2000, and then in 2003) which took place from 27 September to 1st October 2004).

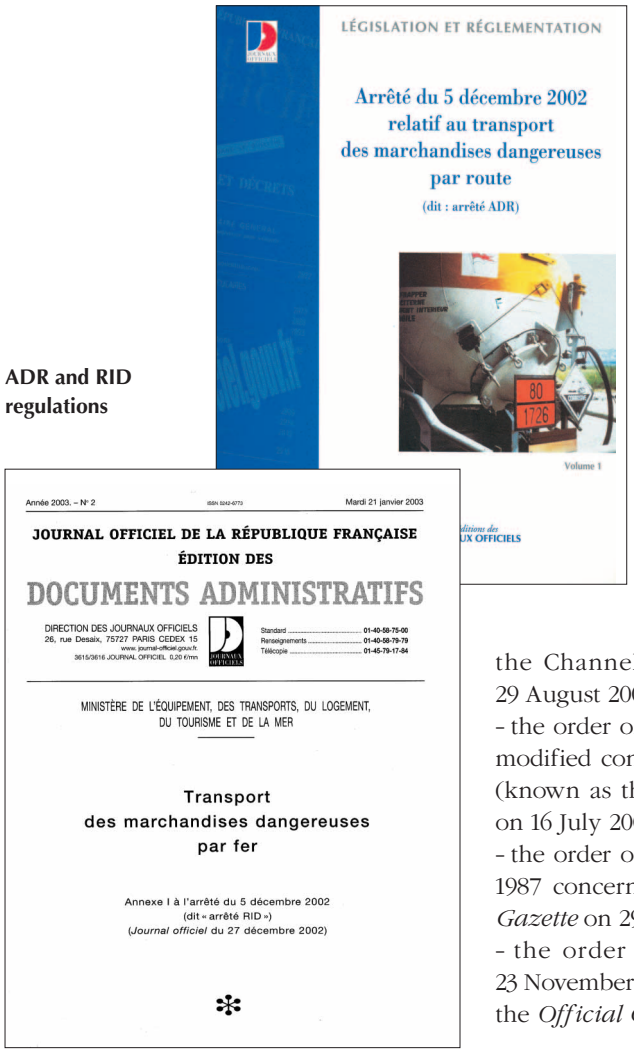
The ASN is also a member of the standing working party on the safety of radioactive material transportation of the DG Energy and Transport of the European Commission. In this capacity, it took part in the 26 April meeting of this working party.

2 | 2
National regulations

The orders applicable to each mode of radioactive material transport are as follows:
- the order of 1 June 2001 as modified concerning the transport of dangerous goods by road (known as the "ADR order");
- the order of 5 June 2001 as modified, concerning the transportation of dangerous goods by rail (known as the "RID order");
- the order of 5 December 2002 concerning the transportation of dangerous goods by inland waterway (known as the "ADNR order");
- the order of 12 May 1997 as modified, concerning the technical conditions for the operation of aircraft by a public air transport operator (OPS1);
- the order of 23 November 1987 as modified, division 411 of the regulations for the safety of ships (RSN);
- the order of 18 July 2000 as modified, regulating the transport and handling of dangerous goods in sea ports.

These orders transpose in full the requirements of the international agreements and regulations in force.

The new orders, which were signed or co-signed by the DGSNR during the course of 2004 are recalled below in chronological order.



ADR and RID regulations

Transports

By delegation of the Minister for the Economy, Finance and Industry and the Minister for Ecology and Sustainable Development, the DGSNR co-signed the following:
- the order of 20 December 2004 modifying the order of 1 June 2001 as modified concerning the transport of dangerous goods by road (known as the "ADR order") published in the *Official Gazette* on 31 December 2004;
- the order of 21 December 2004 modifying the order of 5 June 2001 as modified concerning the transport of dangerous goods by rail (known as the "RID order"), published in the *Official Gazette* on 31 December 2004;
- the order of 16 July 2004 modifying the order of 21 March 1995 as modified concerning the transport of dangerous goods through the Channel tunnel, published in the *Official Gazette* on 29 August 2004;
- the order of 7 July 2004 modifying the order of 1 June 2001 as modified concerning the transport of dangerous goods by road (known as the "ADR order"), published in the *Official Gazette* on 16 July 2004;
- the order of 7 May 2004 modifying the order of 23 November 1987 concerning the safety of ships, published in the *Official Gazette* on 29 May 2004;
- the order of 21 December 2004 modifying the order of 23 November 1987 concerning the safety of ships, published in the *Official Gazette* on 16 February 2005.

Certification of organisations

By delegation of the Minister for the Economy, Finance and Industry and the Minister for Ecology and Sustainable Development, the DGSNR signed the following:
- the order of 6 July 2004 approving the national institute for nuclear sciences and technologies as an organisation authorised to train the drivers of vehicles carrying dangerous goods by road, published in the *Official Gazette* on 21 July 2004;
- the order of 22 October 2004 approving the Bureau Véritas agency for approval of tank-containers and swap tanks intended for the overland transport of class 7 dangerous goods, published in the *Official Gazette* on 11 November.

By delegation of the Minister for the Economy, Finance and Industry and the Minister for Ecology and Sustainable Development, the DGSNR signed the following
- the order of 9 November 2004 approving the Bureau Véritas agency with regard to gas containers, tanks intended for the transport of dangerous goods and hoses, published in the *Official Gazette* on 20 November 2004;
- the order of 9 November 2004 approving the APAVE Group with regard to gas containers, tanks intended for the transport of dangerous goods and hoses, published in the *Official Gazette* on 20 November 2004;
- the order of 9 November 2004 approving the Association of independent inspectors with regard to gas containers, tanks intended for the transport of dangerous goods and hoses, published in the *Official Gazette* on 20 November 2004.

3 Assessment of safety documents

The ASN conducts a critical analysis of the safety documents proposed by the applicants to obtain an approval certificate for their package design.

Certain package designs require the approval of the competent authority before they can be authorised for transport in France:
- radioactive materials in special forms;
- slightly dispersible radioactive materials;
- type B and C packages and all fissile material packages;
- special arrangement shipments (the package fails to comply with all the requisite criteria, but compensatory transport measures have been taken to ensure that transport safety will not be below that of a transport operation involving an approved package).

By delegation from the Ministers and after technical examination of the documents by the IRSN, the ASN approves the package designs complying with the regulations and validates certificates issued by authorities in other countries for inland transport in France.

These certificates are usually issued for a period of a few years. At the present time, about 100 applications for approval are submitted annually by the manufacturers to the ASN (new package design, extension of the term of validity, validation of a certificate issued by a foreign authority, special arrangement, extension of a certificate to cover contents other than those initially defined in the safety documents).

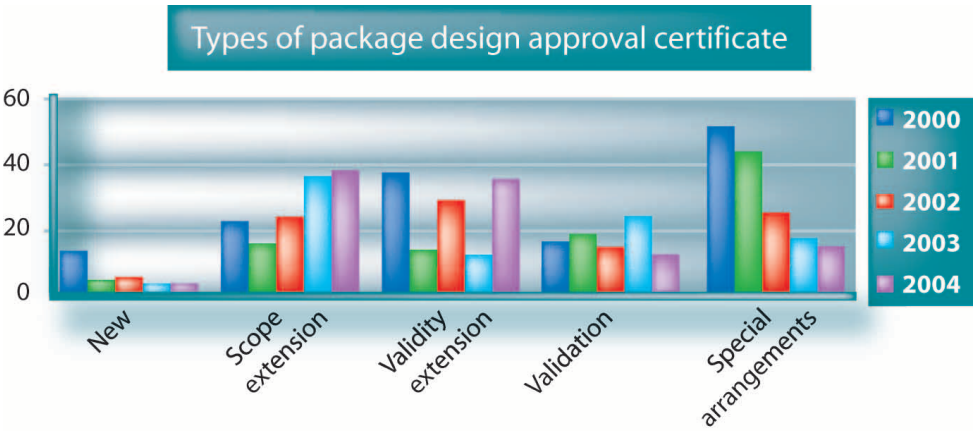
Generally speaking, certificates are issued for package designs and not package by package. However, manufacturing, operating and maintenance conditions are consistently specified.

These certificates are often issued outside the context of specific transport operations, for which no prior notification of the ASN is generally required, but which may be subjected to security checks

(physical protection of materials under the control of the Defence High Official at the Ministry for Industry).

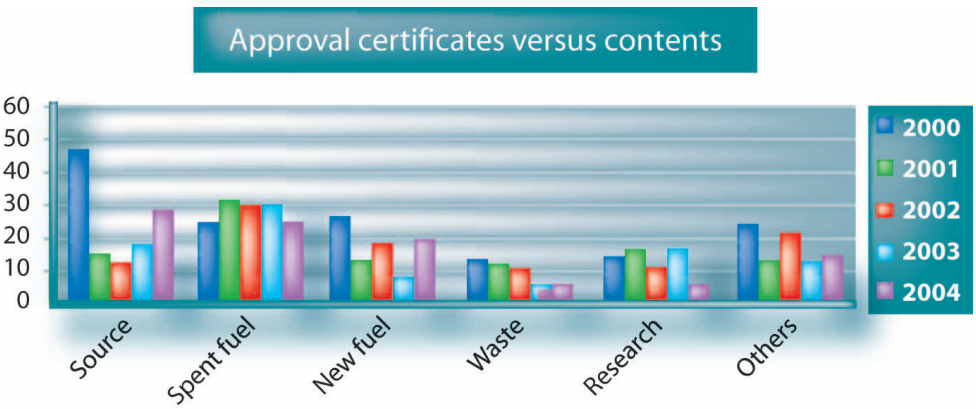
3 | 1 Issue of package designs approval certificates

In 2004, the ASN issued 98 certificates, broken down as follows according to their type:



It is worth noting the significant reduction in special arrangements issued since 1999. This illustrates the effects of ASN actions in this field and the efforts made by the radioactive material transport industry.

The types of transport concerned by these certificates are as follows:



The ROBATEL company has developed a new model of the R68 package for transporting radioactive waste in concrete hulls and the DAHER LHOTELLIER company has developed a waste transport concrete hull overpack model.



Overpack for concrete casks of waste

3 | 2
Quality assurance policy

Within the framework of quality assurance monitoring of transport-related activities, the ASN continued its follow-up work on approved packages. Since 1999, every French owner of type B or fissile packages or packages transported by special arrangement has to update a record sheet for each package concerned, indicating the date of entry into service, modifications undergone, date of last maintenance operation, use to which it has been put, etc. In 2001, these record sheets were modernised: to facilitate their management, a common format was adopted for the form to be filled out and the data base and a copy of the form was sent out to each owner for updating. In 2002, the ASN asked all owners also to declare packages containing 0.1 kg or more of uranium hexafluoride, for which approval has been mandatory since 2001.

The collected package record sheets have provided the ASN with a clearer picture of the overall French package situation. The 2004 figures show that 13,493 packages were declared, 5279 of which were used for transport. The packages can be broken down into 85 package models, instead of 91 in 2003. The most widely used packages are the 48Y cylinders designed to transport natural uranium hexafluoride (6,622 packages, of which 5,342 are the property of a single owner, Eurodif Production). Moreover, more than 80% of the type B package owners reported possession of gamma radiography equipment (GAM 80, GAM 120, GAM 400, GMA 2500 and GR 30-50). These devices are intended for the transport of sources in special forms for gamma radiographic non-destructive tests and were the subject of a priority inspection campaign in 2001, which will be repeated in 2005 to assess change in this area of activity.

In coordination with the DSND, the ASN asked the operators as in 2004 to present an annual summary of the radioactive materials transport activities by the basic nuclear installations. The purpose of this summary is to harmonise the information received by the ASN with that from the other safety authorities. It mainly comprises information concerning transport traffic (internally and on public roads and railways), discrepancies, events, incidents or accidents and dosimetry balances linked to transport activities.

4 INSPECTION AND FIELD SUPERVISION

The ASN has implemented inspection provisions involving the DRIREs at local level, in similar fashion to the procedures already adopted for basic nuclear installations.

These organisational arrangements allow inspections to be carried out on the sites of designers, manufacturers, users, carriers, consignors and their subcontractors and enable package quality to be monitored between two authorisation extensions. In this connection, the 5th sub-directorate of the DGSNR (BCCN) has been entrusted with manufacturing supervision of type B packages since 1998.

Training sessions for "transport" inspectors were renewed in 2004. They will be periodically provided to maintain inspector qualification.

From both the regulatory and practical standpoints, it is important to ensure good cohesion with other supervisory authorities responsible, notably, for the inspection of transport vehicles, for labour inspection in the transport sector or for the protection of nuclear materials. These authorities may have to prohibit transport operations further to observation of regulatory non-conformities.

- Supervision of radioactive material transport is the responsibility of the BNI inspectors. In 2004 as in 2003, it was based around two priority topics: the radiation protection programme (PRP);
- package conformity with approval certificates.

Since 2001, the regulations have required operators to draw up a radiation protection programme applicable to radioactive material transports. The nature and scale of the measures to be implemented in this programme should be proportional to the value and probability of exposure to radiation. Radiological protection and safety must be optimised so that the individual doses, the number of people exposed and the probability of being exposed are kept as low as is reasonably achievable (ALARA approach).

With regard to the second priority topic, radioactive material transport regulations stipulate that for each package approved by the competent authority (DGSNR for France), the consignor must check that all the requirements of the approval certificates are followed. The consignor must therefore be in possession of a copy of the approval certificates issued by the DGSNR.

Checks were therefore carried out in particular on the consignors and carriers. At a more general level, inspections also took place at the manufacturers and on the maintenance sites.





Inspection at Roissy airport

A total of 65 inspections was carried out in 2004 in the field of radioactive material transport.

Progress has been made in drafting the radiation protection programmes, but the situation is still not satisfactory. The documentation is on the whole available in the nuclear industry but there is still place for improvement with respect to evaluating doses and optimising radiation protection. The inspections conducted outside the nuclear industry in particular show - as in 2003 - a fairly widespread lack of any radiation protection programmes in companies which had not previously been inspected on this point. The ASN decided to maintain particular vigilance in this area.

Elsewhere, airport supervision was reinforced in 2004, with inspections conducted at Roissy, Bordeaux and Marseille airports. These inspections were devoted to checking the requirements applicable to companies working in the cargo area. Generally speaking, the volume of radioactive material packages passing through the provincial airports is relatively small, no more than a few dozen packages per year, while the majority of the traffic passes through Roissy and Orly (about 50,000 packages per year). Progress has been achieved by those companies that had previously been inspected, particularly with respect to the radiation protection programmes. Those companies being inspected for the first time do however demonstrate poor knowledge of the regulations applicable to the transport of radioactive materials. Surveillance of the Paris airports will be maintained.

The approval certificate conformity inspections produced few results as corrective action had been taken by most consignors further to the inspections conducted in 2003.

Among the observations or findings formulated further to the inspections, the most frequent concern quality assurance, documentation, the responsibilities of the various parties involved, or compliance with procedures and established practice as indicated in the approval certificates, safety files or, more generally, regulatory texts.

As regards quality assurance, the observations most frequently encountered concern the following:

- organisation;
- quality plan, procedures, established practice;
- traceability of checking operations;
- handling of deviations;
- supplier audits.

With regard to the other fields, the observations mainly concern:

- the training programme for all those involved in transport operations;
- the duties of the security adviser;
- the annual report from the security adviser;
- justification of the conformity of non-approved packages (type A and industrial type packages);
- lack of inspection;
- procedures for declaring events and incidents.

Within the framework of its special assignment, the 5th sub-directorate of the DGSNR carried out a visit to suppliers chosen by the Framatome company to manufacture the FCC containers designed to transport new fuel for power reactors. The purpose of this visit was to examine the extent to which the requests and observations made during the previous inspection in 2003 had been taken into account on the manufacturing stations (straightening and resin pouring), and to check the conformity of the packages manufactured in 2004 with the manufacturing reference framework. An inspection was also conducted at DAHER LHOTELLIER, concerning the manufacture of the concrete hulls for waste transport.

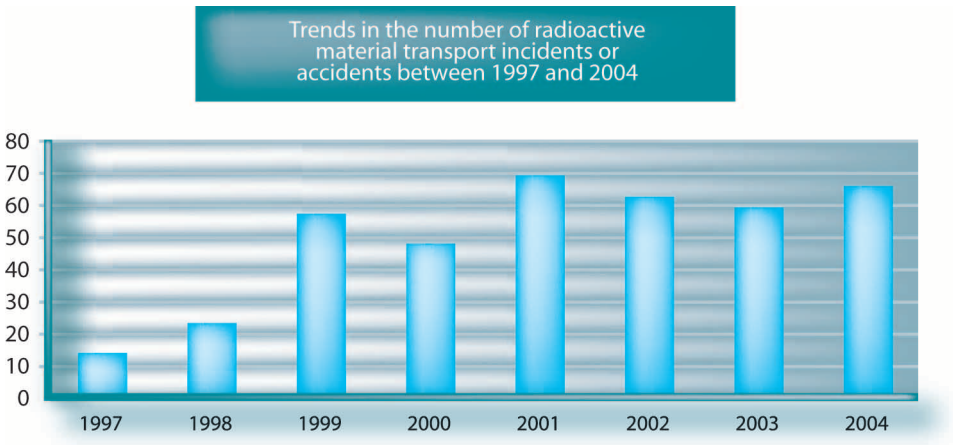
5 INCIDENTS AND ACCIDENTS

The circular letter of 28 August 2003, sent out by the ASN to all consignors and carriers, redefines the incident and accident declaration criteria initially sent out in the circular of 7 May 1999. It also reuses the incident report model proposed in the ADR and RID orders.

All transport discrepancies are thus to be declared to the ASN. Apart from this declaration, a detailed incident report must be sent to the Authority within two months. Events concerning regulatory nonconformities but which do not impair the safety function are not concerned by this report. In the case of contamination, an analysis report is to be sent to the ASN within two months.

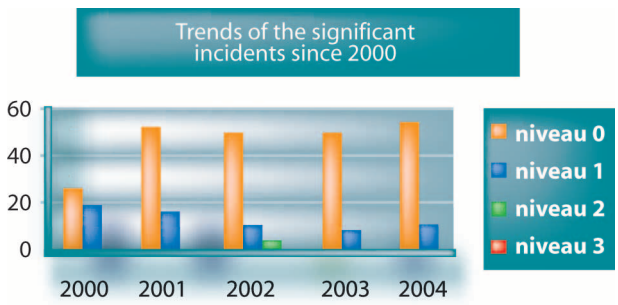
The main events that occurred this year are detailed below according to category. These events may be of several types:
- nonconformity with the requirements of the orders specific to each mode and of the package model approval certificates;
- package handling event;
- incident or accident during actual transport, particularly a stowage fault.

The trend in the number of incidents/accidents reported during the last eight years is illustrated below:



The above graph shows a rise in the number of incidents notified, reflecting the creation of the declaration system, followed by a phase of relative stability. The incidents or accidents reported since 1 October 1999 were classified on the INES scale, which the ASN has decided to apply to transport operations. A new version of the INES scale, applicable to transport, has been produced by the IAEA and a circular letter was sent out to all consignors and carriers to ask them to apply it and to inform them that the French translation was available on the ASN's website.

In 2004, 55 incidents were classified level 0 and 11 were classified level 1. The following graph shows the trends since 2000.

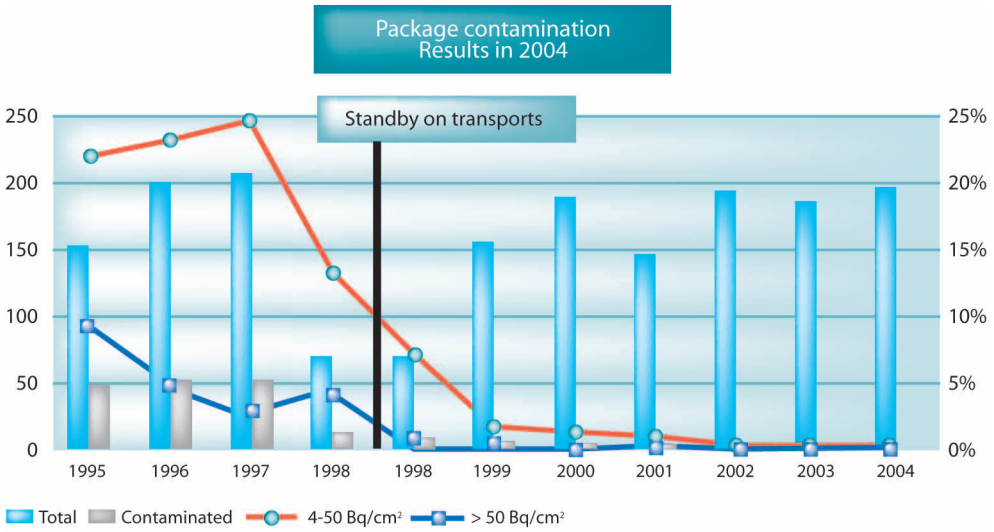


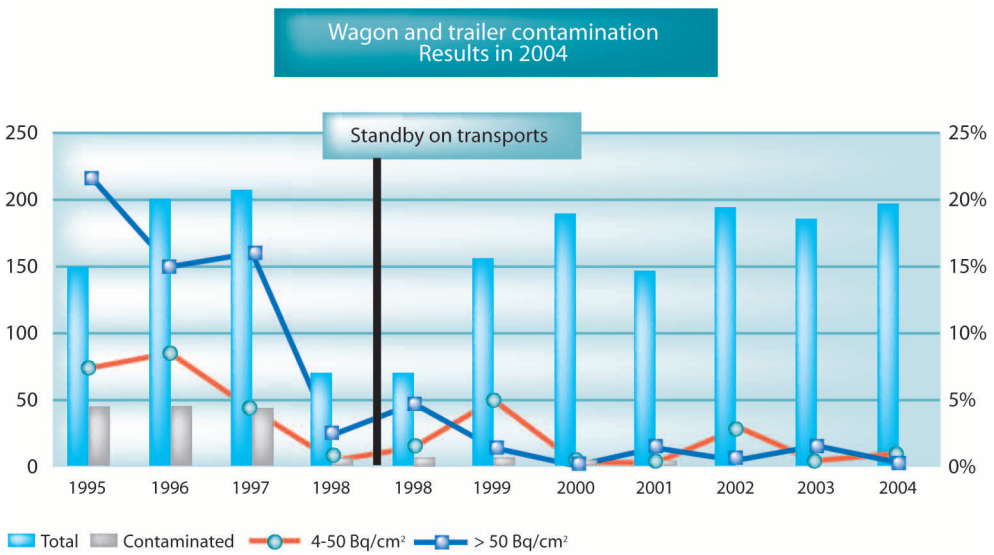
5 | 1

Nonconformity of container or content

Contamination of spent fuel convoys

Transport of spent fuel from the EDF sites to the COGEMA La Hague plant continued with no significant incident. The contamination problems experienced in the past have been solved thanks to the efforts made by the EDF sites and to ASN supervision. The ASN remains vigilant and continues to closely monitor the conditions in which these transports take place.





The following two graphs show the trend since 1995 in the contamination levels on the packages and the means of transport used to carry spent fuel from the EDF plants to the La Hague reprocessing plant.

Spent fuel is continuing to be transported normally from foreign countries to La Hague and to Sellafield (Great Britain).

5 | 2 Package handling events

Airport handling incidents

Handling incidents at airports, involving radioactive material packages, are considered to be transport incidents. Transport in fact comprises all operations and conditions associated with the movement of radioactive materials, especially loading, routing, including interim storage, and unloading.

In 2004, 26 incidents of this type were recorded at Roissy-Charles-de-Gaulle and Orly airports. These incidents concerned type 1 or excepted packages, which were damaged to varying extents.

Jointly with the DGAC (civil aviation authority) and the air transport police the ASN carried out a number of air cargo inspections. The carriers were reminded of the need to implement a radiation protection programme appropriate to the transport activities, to correctly secure the packages and make the personnel aware of the hazard of ionising radiation.

On 11 November 2004, an incident occurred when a package was being loaded on the runway at Orly airport. A type A package containing radioactive materials fell and was crushed. The cardboard box and crimped metal canister were damaged, but the content, a capsule of iodine 131 was undamaged in its canister.

The design of this canister had been modified following the 17 August 2002 incident at Roissy airport. The company responsible for loading onto the aircraft did not apply the procedure specified for this situation. The package was consequently only found at Orly the following day in a waste container by another company, Air France. Air France immediately notified the airport's fire service and the consignor.

Radiological measurements confirmed that there was no contamination. The package was reconditioned and returned to the consignor. The ASN classified the incident level 1 on the INES scale owing to its potential consequences and the lack of safety culture on the part of the company responsible for loading the aircraft.

5 | 3 Incidents and accidents during actual transport

The following incident is a good example of those which occur during actual transport.

Road accident during transport of new fuel

On 5 October 2004, the ASN was informed of a road traffic accident, near Orleans, involving a lorry transporting radioactive materials. The lorry trailer was carrying 5 packages of new fuel (or 10 uranium fuel assemblies) from Lingen (Germany) and intended for the Le Blayais nuclear power plant.

The fuel transport trailer was rear-impacted, damaging the underride guard, the tail lights and the canopy support rod. The tarpaulin was also locally torn.

The packages were undamaged and remained on their cradles. Radiological inspection revealed no sign of contamination.

An assessment on the morning of 6 October 2004 led to the shipment being transferred to a new trailer. The packages were then taken to their destination.

Given the lack of damage to the packages, the ASN confirmed classification of this incident at level 0 on the INES scale applied to transport.



Damaged truck during transport of fresh fuel

Stowing

On 10 September 2003, the ASN sent all consignors and carriers a circular letter concerning the importance of chocking and stowing the packages during all stages of transport.

Only half of those mailed replied on time. The ASN sent out a reminder letter on 3 June 2004 to those consignors and carriers who had failed to reply to the first letter. The ASN has now received all the replies.

Analysis of the replies shows that the vast majority of companies have added a new stowage verification inspection to their procedures and pre-departure check-lists. For the more voluminous packages, a check on the anchor points was also generally carried out.

6 EMERGENCY RESPONSE PROVISIONS

Nuclear safety is not only directed towards preventing accidents, but also towards limiting their consequences. To this end, in conformity with the defence in depth principle, the necessary provisions must be made to bring even an improbable accident situation under control. These "ultimate" lines of defence comprise specific organisational structures and emergency plans, involving both the consignor and the authorities.

The details of emergency assistance in the event of an accident are defined in special emergency response plans for radioactive material transport accidents, in accordance with decree 88-622 of 6 May 1988, implementing law 87-565 of 22 July 1987. These actions are supervised by the Directorate for Civil Defence and Security at the Ministry for the Interior, which the ASN assists.

The ASN took part in the work of the interministerial committee entrusted with preparing a guidance circular to assist the Prefects in drafting the PSS-TMR (specialised emergency plan for the transport of radioactive materials).



COGEMA Logistics equipment for heavy package recovery

Both operational and practical, the PSS-TMR is an emergency plan which should be drafted and updated by the prefects. Its aim is to protect the response personnel, the local residents and the environment against the consequences of a radioactive material transport accident.

In 2004, the emergency response provisions put in place by the ASN, those of the Indre and Loire prefecture and those of the other national organisations, particularly the DDSC, were tested during an emergency exercise in the Indre-et-Loire department. This exercise concerned a rail transport accident involving spent fuel from the Chinon NPP. The consignor was EDF, the carriage commission agent COGEMA Logistics and the carrier SNCF. The CEA also provided a first level emergency response team. A further exercise will be organised in 2005.





2004 emergency drill

7 OUTLOOK

In 2004, the ASN continued to strengthen the radioactive material transport inspections that has been carrying out since 1997. It continued the inspections conducted of the radioactive material packaging designers, manufacturers, carriers and consignors; it once again tested its emergency response procedures to an accident involving the transport of radioactive materials.

The inspections carried out in 2004 show that progress has been made, in particular in drafting the radiation protection programmes that have been mandatory since 2001, but that there is still place for improvement. They also show poor knowledge of the radioactive materials transport regulations by those companies which had not yet been inspected. The ASN will be continuing its work in these areas.

The ASN also continued the technical background work prior to issue certificates approval: periodic safety reviews of existing package models and the approval of new models incorporating innovative design features contribute to the overall upgrading of transport safety. This work in particular led to a highly significant drop in the number of special arrangements delivered (about fifty in 2000, less than ten in 2004).

Finally, following the IAEA's publication of a new guide applying the INES scale to transport, the ASN updated the communication tools used to inform the public of the seriousness of an accident involving a radioactive materials shipment.

All these actions taken together have led to improvement in and reinforcement of the safety culture among the transport operators.

The results of the TranSAS mission, which audited the ASN in 2004, are highly satisfactory. Based on the identified areas for progress, the current situation will be improved still further in the next few years.

CHAPTER 11
TRANSPORT OF NUCLEAR MATERIALS

CHAPTER 12

1 GENERAL INFORMATION ON EDF NUCLEAR POWER PLANTS

1|1 Description of a nuclear power plant
1|1|1 General presentation of a pressurised water reactor
1|1|2 Core, fuel and fuel management
1|1|3 Primary and secondary systems
1|1|4 Reactor containment building
1|1|5 The main auxiliary and safeguard systems
1|1|6 Other systems

1|2 Operation of a nuclear power plant
1|2|1 EDF organisational structures
1|2|2 Operating documents
1|2|3 Plant unit outages

2 THE NUCLEAR SAFETY AND RADIATION PROTECTION IMPROVEMENT POLICY

2|1 Organisations, safety, competitiveness
2|1|1 Supervision of organisational and human factors
2|1|2 Training and skills
2|1|3 Monitoring the quality of subcontracted operations
2|1|4 Safety and competitiveness
2|1|5 Internal authorisations

2|2 Continuous safety improvements
2|2|1 Anomaly correction
2|2|2 Safety reviews
2|2|3 Modifications made to the equipment and to the operating rules

2|3 Nuclear power plant ageing
2|3|1 A relatively young fleet of nuclear power plants
2|3|2 The main factors in ageing
2|3|3 Strategy to deal with equipment ageing
2|3|4 ASN policy

2|4 The EPR project
2|4|1 The Government's position on the project safety options
2|4|2 Examination of the detailed design studies
2|4|3 Examination of the nuclear steam supply system construction options
2|4|4 Cooperation with the Finnish nuclear safety authority

2|5 Research into pressurised water reactor nuclear safety and radiation protection

3 PLANT SAFETY

3|1 Construction supervision

3|2 Operation and control
3|2|1 Normal operating conditions
3|2|2 Incident and accident operation

3|3 Maintenance and tests
3|3|1 Maintenance practices
3|3|2 Industrial code changes
3|3|3 Qualification of inspection methods
3|3|4 Periodic tests

3|4 Fuel
3|4|1 In-pile fuel management trends
3|4|2 Fuel assembly modifications
3|4|3 Fuel handling operations

3 | 5 The primary and secondary systems
3 | 5 | 1 The system reference files
3 | 5 | 2 The use of nickel-based alloys
3 | 5 | 3 Reactor vessels
3 | 5 | 4 Steam generators
3 | 5 | 5 Steam isolation valves
3 | 6 Containment
3 | 7 Protection against exertnal hazards
3 | 7 | 1 Earthquakes
3 | 7 | 2 Climatic hazards
3 | 7 | 3 The fire and explosion risks
3 | 7 | 4 Other hazards
3 | 8 Other subjects
3 | 8 | 1 Pressurised equipment
3 | 8 | 2 Risks in the workplace

4 RADIATION PROTECTION AND ENVIRONMENTAL PROTECTION
4 | 1 Radiation protection of persons working in nuclear power plants
4 | 2 Releases from nuclear power plants
4 | 2 | 1 Revision of the discharge licences
4 | 2 | 2 Procedures carried out in 2004
4 | 2 | 3 Radioactive discharge values
4 | 3 Technological waste management
4 | 4 Protection against other risks and nuisances
4 | 4 | 1 The microbiological risk
4 | 4 | 2 Prevention of water pollution
4 | 4 | 3 Noise

5 SUMMARIES
5 | 1 Summary of incidents
5 | 1 | 1 Summary of incidents in 2004
5 | 1 | 2 Statistical analysis of the incidents in 2004
5 | 2 Significant events site by site

6 ASSESSMENT AND OUTLOOK
6 | 1 ASN assessment of the past year
6 | 2 Outlook

CHAPITRE 8

LES RÉACTEURS À EAU SOUS PRESSION

This chapter is devoted to pressurised water reactors (PWRs). These reactors produce electricity and lie at the heart of the nuclear industry in France. Many other installations described in the other chapters produce the fuel intended for these plants or reprocess it, store the waste produced by them or examine the physical phenomena related to reactor operation and safety. These reactors are operated by Electricité de France (EDF). One particularity in France is standardisation of the plant fleet, with a large number of technically similar reactors, justifying a "generic" presentation in this chapter. However, a table at the end of the chapter gives the significant events on each site. Additional information can be obtained from the DRIRE for each individual site.

1 GENERAL INFORMATION ON EDF NUCLEAR POWER PLANTS

Overall, the 19 French nuclear power plants are similar. They each comprise from 2 to 6 PWRs, which all together comes to 58 reactors. For each of them, the nuclear part was designed and built by Framatome, with EDF acting as industrial architect.

The thirty-four 900 MWe reactors can be split into:

• the CP0 plant series, comprising the 2 Fessenheim reactors and 4 Bugey reactors (reactors 2 to 5),

• the CPY series, comprising the other 900 MWe reactors, subdivided into CP1 (18 reactors at Dampierre, Gravelines, le Blayais and Tricastin) and CP2 (10 reactors at Chinon, Cruas and Saint-Laurent-des-Eaux).

The twenty 1300 MWe reactors comprise:

• the P4 series, comprising the eight reactors at Paluel, Flamanville and Saint-Alban,

• the P'4 series, comprising the twelve most recent 1300 MWe reactors at Belleville, Cattenom, Golfech, Nogent-sur-Seine and Penly.

Finally, the N4 series comprises 4 1450 MWe reactors, 2 at the Chooz site and two at the Civaux site.

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

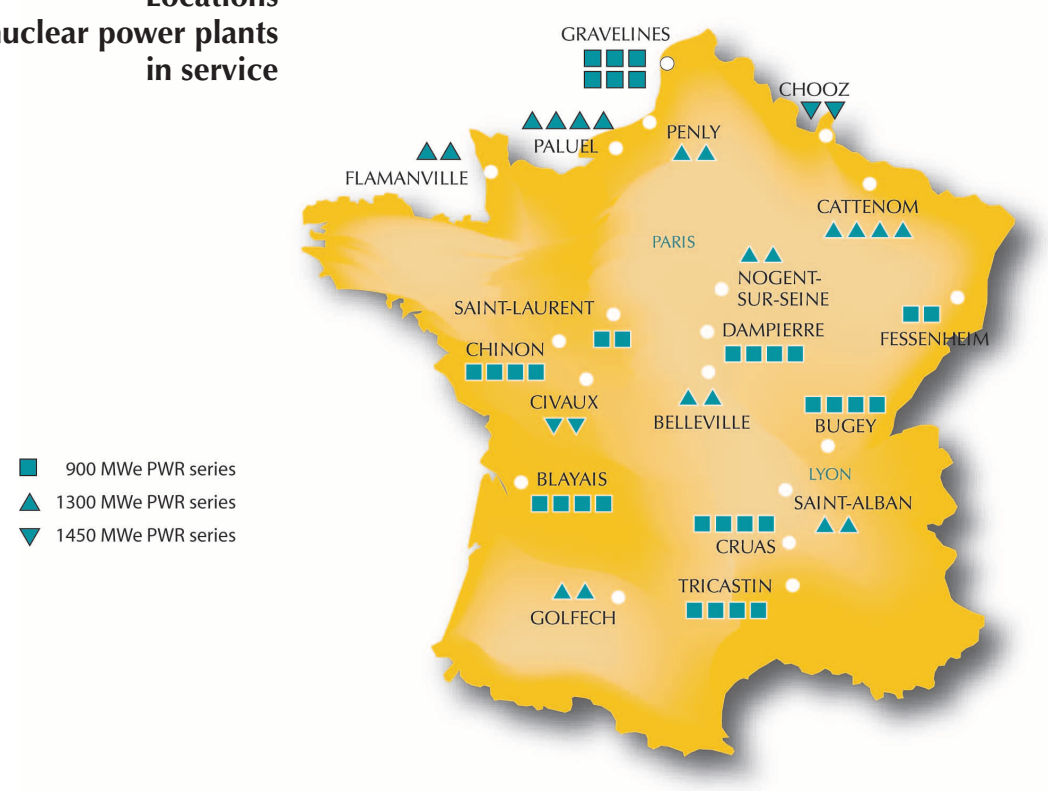
The CPY series differs from the Bugey and Fessenheim reactors in building design and the addition of an intermediate cooling system between that used for containment spraying in the event of an accident and that containing river water. It also provides for more flexible reactor control.

The design of the 1300 MWe reactor primary and secondary loops, core protection devices and plant buildings differs considerably from CPY series provisions. The increased power means a primary system with 4 steam generators, offering a higher cooling capacity than the 900 MWe reactors equipped with 3 steam generators. Moreover, the reactor containment consists of a double concrete-walled structure, instead of the single wall with steel liner design adopted for the 900 MWe series.

The P'4 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 reactors in the design of more compact steam generators and of the primary pumps and in the computerised instrumentation and control system.

Locations of nuclear power plants in service



1 | 1

Description of a nuclear power plant

1 | 1 | 1

General presentation of a pressurised water reactor

In passing heat from a "hot source" to a "heat sink", all thermal electric power plants produce mechanical energy, that they then transform into electricity. Conventional plants use the heat given off by the combustion of fossil fuels (fuel oil, coal, gas) and nuclear plants that resulting from the fission of uranium or plutonium atoms. The heat produces steam. This latter is then expanded in a turbine which drives a generator producing 3-phase electric current with a voltage of 400,000 V. After pressure reduction, the steam then flows into a condenser where it cools in contact with tubes containing circulating cold water from the sea, a river or a cooling tower.

Each reactor comprises a nuclear island, a conventional island, water intake and discharge infrastructures and possibly a cooling tower.

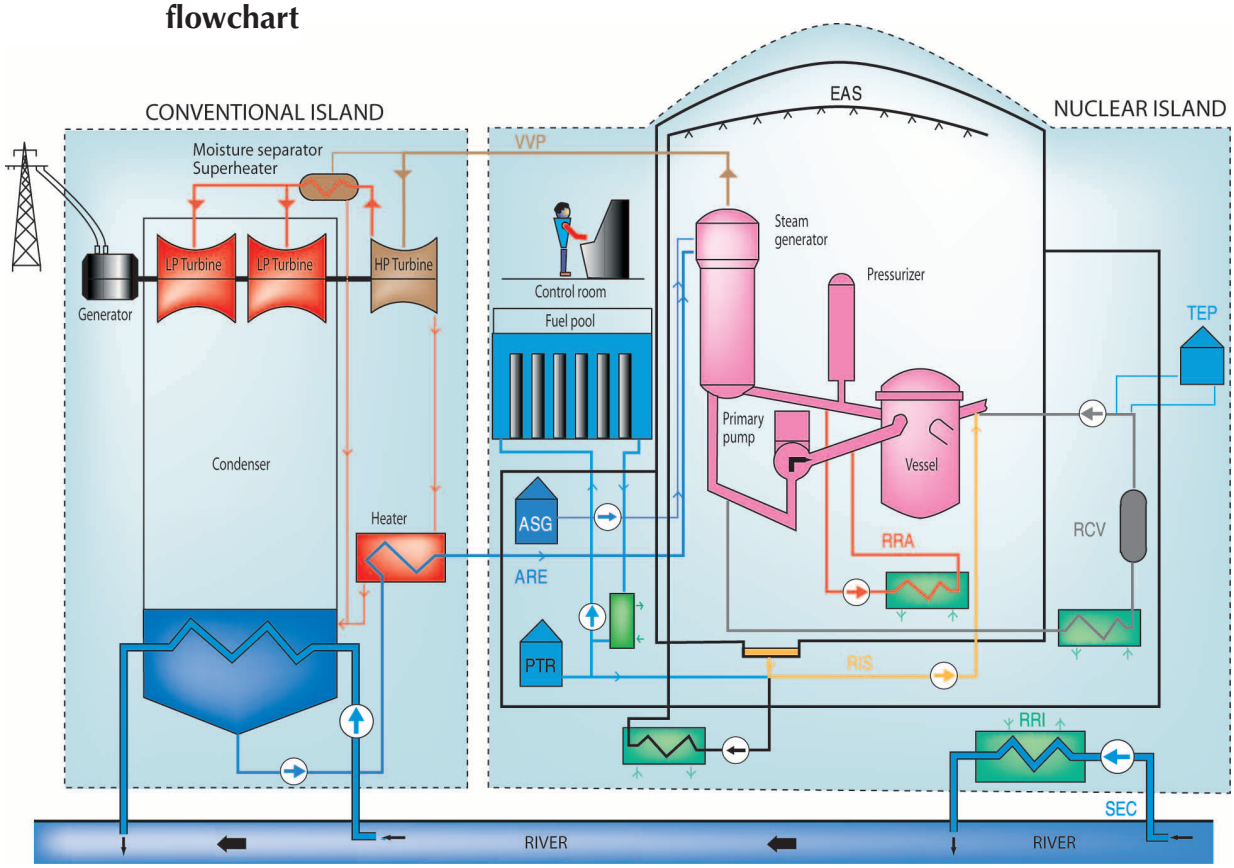
The nuclear island mainly consists of the nuclear steam supply system comprising the primary system and the systems responsible for reactor operation and safety: the chemical and volume control, residual heat removal, safety injection, containment sprinkling, steam generators feedwater, electrical, I&C and reactor protection systems. Various "support" function systems are also associated with the nuclear steam supply system: primary waste treatment, boron recovery, feedwater, ventilation and air-conditioning, backup electrical power (diesel generating sets). The nuclear island also comprises

the systems removing steam to the conventional island as well as the building housing the spent fuel interim storage pit.

The conventional island comprises among others the turbine, the AC generator and the condenser. Some of this equipment contributes to reactor safety.

The secondary systems belong partly to the nuclear island and partly to the conventional island.

PWR flowchart



ABBREVIATIONS USED IN THE PWR BLOCK DIAGRAM

ARE	feedwater flow control system
ASG	steam generator auxiliary feedwater system
EAS	containment spray system
PTR	spent fuel pit cooling and treatment system
RCV	chemical and volume control system
RIS	safety injection system
RRA	residual heat removal system
RRI	component cooling system
SEC	essential service water system
TEP	boron recycling system
VVP	main steam system
LP Turbine	low-pressure turbine
HP Turbine	high-pressure turbine

1 | 1 | 2

Core, fuel and fuel management

The reactor core consists of rods containing uranium oxide pellets or a mixture or uranium and plutonium oxides ("MOX" fuel) placed in fuel assemblies, themselves placed in a steel vessel. When fissioned, the uranium or plutonium nuclei emit neutrons which, in turn, produce further fissions: this is known as the chain reaction. These nuclear fissions release a large amount of energy in the form of heat. The primary water enters the core from below at a temperature of about 285 °C, flows up along the fuel rods and exits through the top at a temperature of about 320 °C. It remains liquid under a pressure of 155 bar.

At the beginning of an operating cycle, the core represents a considerable reserve of energy, which gradually decreases during the cycle as the fissile nuclei disappear. The chain reaction, and hence the reactor power, is controlled by:
• the rod control cluster assemblies which penetrate the core and contain elements capturing the neutrons. These enable the reactor to be started and stopped and its power level to be adjusted to the quantity of electricity to be produced. Their gravity dropping into the core trips the reactor;
• varying the boric acid content of the primary system water. Through its ability to absorb neutrons, boron dissolved in the primary system water compensates for the initial high reactivity. The boron concentration is adjusted through the cycle according to the gradual depletion of the fissile material in the fuel.

The operating cycle ends when the boron concentration approaches zero. An extension is however possible, if the temperature and possibly the power level are brought below their nominal values. At the end of the campaign, the reactor core is unloaded for renewal of part of the fuel.

EDF uses 2 types of fuel in its PWRs:
• a U-235 enriched uranium oxide (UO_2) fuel. This fuel is primarily manufactured by the FBFC company, belonging to the AREVA Group. However, with a view to diversify its supplies EDF has, since 1980, been obtaining fuel from several foreign fuel manufacturers. Initial U-235 uranium enrichment for UO_2 fuel using natural uranium is limited to 4.2%;
• mixed uranium and plutonium oxide (MOX) fuel. MOX fuel is produced by the COGEMA MELOX plant at Marcoule. An initial plutonium content, limited to an average of 7.08% per fuel assembly, provides an energy equivalence with 3.25% U-235 enriched UO_2. This fuel can be used in the CP1 and CP2 series 900 MWe reactors where provision is made in the authorisation decrees for MOX fuelling. Twenty reactors out of twenty-eight are concerned.

Fuel management in the reactor differs according to the plant series. It can in particular be characterised by:
• the nature of the fuel used and its initial fissile content;
• the maximum degree of fuel depletion at removal from the reactor, characterising the quantity of energy extracted per ton of material (expressed in GWd/t);
• the length of the burnup cycle (generally given in months);
• the number of new fuel assemblies loaded at each reactor refuelling outage (1/3 or 1/4 of the assembly total number);
• the reactor operating mode, with or without major power variation, characterising the stresses to which the fuel is subjected.

1 | 1 | 3

Primary and secondary systems

The primary and secondary systems are used to transport the heat released in the core to the turbine, which produces electricity, without any of the water in contact with the core leaving the containment.

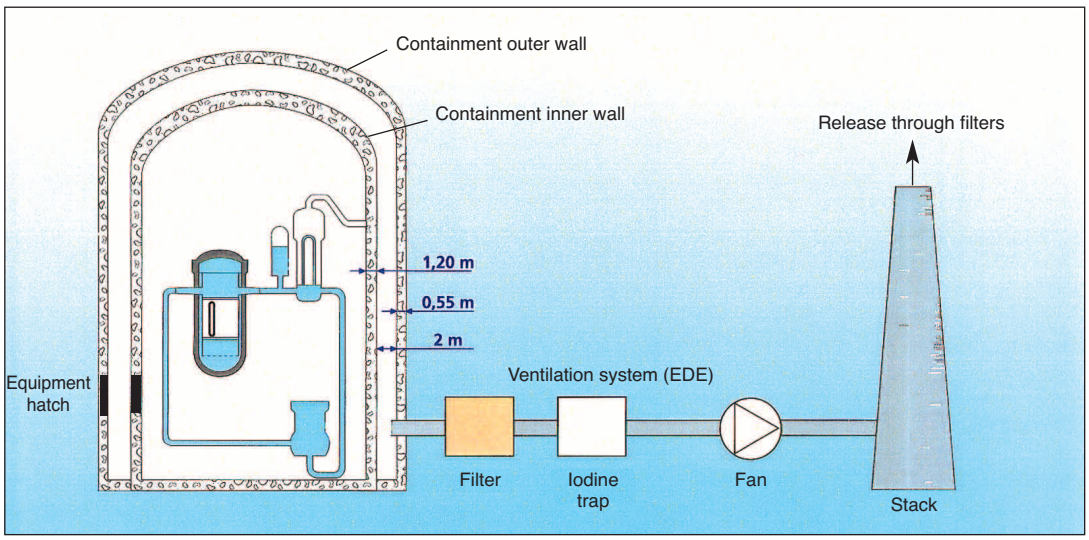
The primary system extracts the heat released in the core by circulating pressurised water, known as the primary water, in the cooling loops (3 loops for a 900 MWe reactor, 4 loops for a 1300 MWe or 1450 MWe reactor). Each loop, connected to the reactor vessel containing the core, comprises a circulating, or primary pump, and a steam generator. The primary water, heated to more than 300 °C, is kept at a pressure of 155 bar by the pressuriser, to prevent it boiling. The entire primary system is located inside the containment.

The water in the primary system transfers the heat produced by the reactor core to the water in a secondary system, but without entering into contact with it, in the steam generators. The steam generators contain thousands of tubes through which the primary water circulates. These tubes are immersed in the water of the secondary system and boil it. Each secondary system primarily consists of a closed loop through which water runs in liquid form in one part and as steam in another part. The steam produced in the steam generators is partly expanded in a high-pressure turbine and then passes through superheater separators before final expansion in the low-pressure turbines, from which it is then routed to the condenser. The condensed water is sent back to the steam generators by the extraction pumps relayed by feed pumps through low and high pressure reheaters.

1 | 1 | 4 Reactor containment building

The PWR containment building has 2 functions:
• protection of the reactor against external hazards;
• confinement, thereby protecting the public and the environment against radioactive products likely to be dispersed inside the containment in the event of an accident. The containments are therefore designed to withstand the pressure and temperature that could be reached in an accident situation, and offer satisfactory leaktightness in such conditions.

There are two types of PWR containments:
• 900 MWe type containments, which consist of a single pre-stressed concrete wall. This wall provides mechanical resistance to the most severe design accident pressure and structural integrity against an external threat. Leaktightness is assured by a thin metal liner on the inside of the concrete wall,
• the 1300 MWe and 1450 MWe PWR containments, comprising two walls, an inner wall made of pre-stressed concrete and an outer wall made of reinforced concrete. Leaktightness is provided by the inner wall and the ventilation system (EDE) which, in the annular space between the walls, collects any leakage from inside the containment. Resistance to external threats is mainly provided by the outer wall.



Block diagram of a 1300 MWe PWR containement building

1 | 1 | 5

The main auxiliary and safeguard systems

The residual heat removal system (RRA) functions during normal outages to remove the heat from the primary system and the after-power from the fuel and then to keep the primary system water at a low temperature as long as there is fuel in the core. Once the chain reaction stops, the reactor core in fact continues to produce heat. This after-power has to be removed as it could otherwise damage or even melt the fuel, releasing a large quantity of radioactive products. The RRA system is also used to drain the reactor cavity after refuelling.

The chemical and volume control system (RCV) is used during reactor operation:
• to adjust the mass of primary water according to temperature fluctuations;
• to maintain primary water quality, by reducing the corrosion and fission product content and injecting chemical products (corrosion inhibitors for example);
• to collect and compensate for normal leakage from the primary pump seals;
• to regulate the boric acid concentration.

The purpose of the safeguard systems is to control incidents and accidents and mitigate their consequences. This primarily concerns the safety injection systems (RIS), the reactor building containment spray system (EAS) and the steam generator auxiliary feedwater system (ASG).

The RIS systems inject borated water into the reactor core in the event of an accident in order to smother the nuclear reaction and remove the after-power. They comprise passive pressurised accumulators and pumps with varying flow rates and release pressures for different types of accident situations. These pumps start by taking in water from a tank of about 2000 m^3, the PTR tank. When this tank is empty, they are connected to the reactor building sumps which collect the water sprayed by the EAS system, as well as the water escaping from the primary system through any leak on this system.

In the event of a primary pipe or steam line break inside the containment, the EAS system sprays the containment with water with added sodium hydroxide to reduce the pressure inside it and tamp down on the ground any scattered radioactive aerosols.

The ASG system is used to maintain the secondary water level in the steam generators and thereby cool the primary system water in the event of failure of the normal feedwater system (ARE). It is also used in normal operation and during reactor shutdown and restart phases.

1 | 1 | 6

Other systems

In addition to the many systems necessary for reactor operation and important to its safety, these include:
• the ventilation systems, which play a vital role in containing radioactive substances by depressurising the premises and filtering all releases;
• the fire-fighting water systems;
• the reactor cavity and spent fuel pit cooling and treatment system (PTR), used notably to remove after-power from irradiated fuel elements stored in the spent fuel pit;
• the component cooling system (RRI), which cools several nuclear equipment items and operates in a closed loop between the systems containing water which has been in contact with the reactor core and the systems carrying water pumped from the river or the sea;
• the essential service water system (SEC), which uses the heat sink (sea or river) to cool the RRI system.

1 | 2
Operation of a nuclear power plant

1 | 2 | 1
EDF organisational structures

Within the EDF Engineering and Production Branch, created in 2004, a difference is made between the function of operator and that of investing owner. Whereas the owner is responsible for the development and long-term exploitation of its asset as well as for its dismantling once operations are completed, the operator is in charge of the short and medium term performance of the production plants and of safety, radiation protection and environmental issues on daily basis.

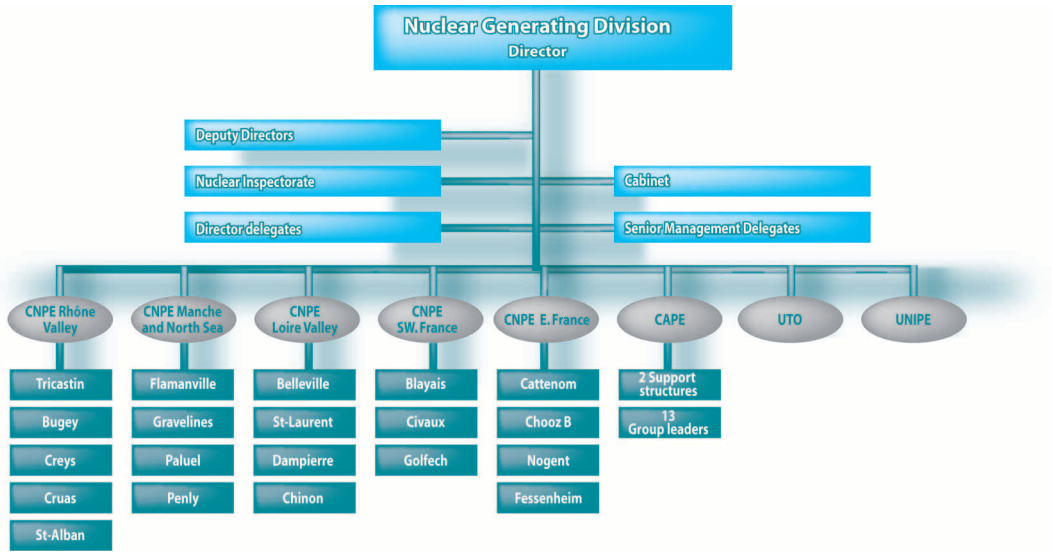
The responsibility of operator is assumed by the Nuclear Generating Division (DPN). Day to day operation of the nuclear power plants, including safety, radiation protection and security, along with availability and costs, are its duties. The Director of the DPN has authority over the nuclear power plant directors and also has at his disposal Head Office departments, comprising expert assessment and technical support services responsible for defining DPN policy and participating in the improvement of plant operation.

Within the DPN, the operating plant support centre (CAPE) is required to provide the plants with help in attaining their safety and performance targets and to help the DPN with fleet oversight and monitoring implementation of technical decisions. This unit offers expertise in the nuclear energy production trades, including safety, the environment, maintenance, process engineering, risk prevention and radiation protection. The national engineering unit for operating plants (UNIPE) performs national engineering tasks concerning technical and documentary upgrades, reactor fuel management, and the national emergency response procedures. In particular, its duties are to implement modifications to the installations decided on at a national level and to produce generic operating, control and maintenance documents. For the entire fleet, the Operational Technical Unit (UTO) works on generic maintenance, subcontracting policy and buying policy. Finally, the IN (Nuclear Inspection) teams, on behalf of the DPN authorities, carry out verification assignments on the entire division.

Within the nuclear power plants, the departments are organised according to professional fields, for performance of safety and radiation protection, production and maintenance functions. Cross-functional project teams are set up for specific activities such as unit outages. The production and maintenance activities can also call on an engineering department.

The roles of owner and designer lie with the Nuclear Engineering Division (DIN). In this respect, the DIN is responsible for the facilities design reference framework. It performs engineering activities about the future issues, in other words, studies, draft projects and long-term upgrade projects for the facilities which go beyond the natural scope of the operator's work. Finally it has oversight for projects designed to maintain the assets, primarily concerning design aspects, in particular the periodic safety reviews.

Among the DIN's engineering centres, the design department for thermal and nuclear projects (SEPTEN) is responsible for upstream studies and draft projects. The National Centre for Nuclear Equipment (CNEN) is more particularly responsible for equipment design and modification in the nuclear island of the N4 plant series and the EPR (European Pressurized water Reactor) project. The Engineering Centre for Operating Plants (CIPN) works on the nuclear islands for the 900 and 1300 MWe plant series. The National Centre for Electricity Production Equipment (CNEPE) deals with the conventional islands across the fleet. The dismantling and waste management activities are handled by the Engineering Centre for Dismantling and related Environmental Issues (CIDEN). Finally,



EDF's Nuclear Production Division's organization

the Production and Operation appraisal and inspection centre (CEIDRE) is particularly responsible for in-service inspection of equipment and for conducting appraisals.

Within the framework of its supervisory activities at the national level, the Nuclear Safety Authority (ASN) deals mainly with the DPN. The ASN's contacts are the head office departments with regard to generic matters, in other words those that concern some or all of the reactors in the fleet; the ASN deals directly with the plant management for questions specifically concerning their own particular reactors. As regards equipment design and study documents, they are discussed in the first place with the DIN. Those concerning fuel and fuel management are also discussed with a third division which has more specific responsibility for these questions; the Nuclear Fuel Division.

1 | 2 | 2

Operating documents

Day to day operation of the nuclear power plants relies on a set of documents, among which the ASN pays particularly close attention to those related to safety.

First among these documents are the general operating rules (RGE) which present the provisions implemented during operation of the reactors. They supplement the safety report which mainly deals with the steps taken at the design of the reactor, and translate the conclusions of the safety studies into operating rules.

The RGE comprises several chapters, among which those having particular safety implications are carefully examined by the ASN.

Chapter 3 describes the "Technical Operating Specifications" (STE), which specify the reactor's normal operating range and in particular the allowable range for the operating parameters (pressure, temperature, neutron flux, etc.). The STE specify the operating steps to be taken if these limits are exceeded. The STE also define the equipment required according to the status of the reactor and state what to do in the event of a malfunction or failure of one of these equipment items.

Chapter 6 contains the operating rules to maintain or recover safety functions (reactivity control, core cooling, radioactive product containment) under incident or accident conditions and revert to a safe reactor configuration.

Chapter 9 defines the routine test and inspection programme for safety-related equipment. In order to check the availability of this equipment, and notably the safeguard equipment to be used in the event of an accident, tests are periodically carried out to ensure that these systems are working properly. In the event of an unsatisfactory result, the course of action to be followed is stipulated in the technical operating specifications. This type of situation may sometimes require the operator to shut down the reactor in order to repair the faulty equipment.

Finally, Chapter 10 defines the physical test programme for reactor core loads. It contains the rules defining the programme for core requalification during reactor restart and for core monitoring during reactor operations.

Secondly, there are documents describing the in-service monitoring and maintenance actions required on the equipment. On the basis of the manufacturer's recommendations, EDF defined periodic inspection programmes for the components (or preventive maintenance programmes), based on the knowledge of the potential degradation that could be suffered by the equipment.

In particular for pressurised equipment, this may entail non-destructive testing methods (radiography, ultrasounds, eddy current, dye penetrant, etc.) which are entrusted to specially qualified staff.

1 | 2 | 3

Plant unit outages

The nuclear power plants operated in France undergo periodic shutdown for replacement of the spent fuel and inspection and maintenance of parts of the installation which are not normally accessible during operation. This is known as a unit outage.

There are different types of outages:
• simple refuelling outage: this is generally short, lasting about 4 to 5 weeks, and devoted to renewing part of the fuel and conducting a limited scope programme of verification and maintenance;
• partial inspection outage: this is a longer shutdown, lasting 1 to 2 months, during which verifications and maintenance are carried out. An outage such as this entails about 3000 activities in the "controlled" area and involves about 1000 people;
• ten-yearly outage: this outage lasts 4 to 5 months, and entails a wide-ranging verification and maintenance programme. This type of outage, which occurs every 10 years, is an opportunity for the operator to carry out major operations, in particular on the pressurised systems or the reactor building containment. It is also actually during this type of outage that any design changes decided on during the periodic safety reviews are applied to the reactor.

EDF currently alternates between simple refuelling outages and partial inspection outages. These outages are scheduled and prepared by the operator several months before their scheduled start date, in particular in order to optimise the large number of tasks involved. The ASN checks the safety precautions taken by the operator, from preparation of the outage to implementation of measures planned after the outage.

In terms of the inspection conducted by the ASN, the key phases in a unit outage are as follows:
• the outage preparation phase: this comprises presentation of the unit outage programme to the ASN, and statement of the ASN's position concerning this programme;
• the outage monitoring phase: this comprises regular information of the ASN by the operator concerning the actual running of the outage, monitoring by the ASN of handling of anomalies and incidents, and scheduled, unannounced or reactive inspections carried out by the ASN;

• the reactor restart phase: this includes presentation of the unit outage summary by the operator to the ASN, a check on reactivation of the NSSS and criticality authorisation issued by the ASN;
• the end of outage phase: this comprises presentation to the ASN of the results of all the tests and transmission to the ASN of the end of unit outage file.

2 THE NUCLEAR SAFETY AND RADIATION PROTECTION IMPROVEMENT POLICY

The ASN's policy is to ensure that nuclear safety and radiation protection progress and not simply to maintain them at existing levels. This means that the ASN requires that the operator permanently look for potential areas for improvement and implement these improvements.

This progress can be achieved in two main areas:
• the reactor material status: barring exceptions, the safety improvements affecting equipment are examined and implemented during the ten-yearly periodic safety reviews rather than as and when they are conceived, to ensure that the facility is not constantly under modification, which could only be prejudicial to safety;
• the working of the organisations involved in the design, construction or operation of the reactor: they can be the subject of a more continual improvement process.

This policy implies the coexistence of facilities with differing levels of safety, with the safety of the older units being upgraded to keep pace with the more recent ones.

Research is also one source of progress in nuclear safety and radiation protection area.

2 | 1 Organisations, safety, competitiveness

2 | 1 | 1 Supervision of organisational and human factors

Man is an essential link in the safety chain, primarily through his ability to adapt, question and react to unexpected situations. His role in running, supervising and maintaining the facilities is vital.

A number of factors determine human performance and thus the ability of the staff to perform their functions efficiently and safely: characteristics linked to human capabilities and limits, skills, working of the groups and the organisations, operating procedures and instructions, quality of the man-machine interface on the technical equipment in the facility and the working tools, constraints inherent in the working environment.

Including "human factors" (HF) in safety therefore requires consistent action in a number of areas, such as the training and skills of the staff working in the facilities, the ergonomics of the facilities and the operating documentation, individual and group working methods, organisation and management.

ASN action is based on the following general principles:
• the operator's responsibility: in terms of the general safety objectives, it is up to the operator to define the organisation and modify it whenever necessary, to take the action necessary to include human factors in the design and operation of the facilities, and to ensure correct training of its personnel. The ASN where appropriate analyses and approves certain provisions but prescribes no standardised organisational arrangements for nuclear operators. Similarly, it is up to the operator to train its staff and assess their ability to perform their duties;

• monitoring; the inspections are frequently an opportunity to examine how the organisations work and enable the extent to which human and organisational aspects are taken into account in nuclear facilities to be assessed;
• experience feedback: incident analysis should enable the operator to improve how the working groups function, in other words those groups of staff involved in the performance of a task, such as an operating team. The unsolicited transmission of information should be aimed more at improving safety than looking for a culprit;
• defence in depth: to enable staff to play a significant safety role, organisational lines of defence must be set up. These notably consist in definition of systematic technical supervision for sensitive operations, the provision of tactical support for those directly concerned, the detection and treatment of deviations.

On these questions, the ASN is a participant in international deliberative bodies, in particular those under the aegis of the OECD's nuclear energy agency.

The observations made during the various inspections conducted by the ASN highlight EDF's efforts to improve the extent to which human factors are taken into account. The same applies to the steps taken by EDF in the facility design and modification projects to incorporate human factors into systems engineering, as described further below. This also applies within the operating plants where deployment of an "HF Policy" has over the years led to improvements in safety management, particularly on the plant sites.

However, there is still room for improvement in certain areas, notably operational stringency, hierarchical supervision, workforce management, working conditions and relations. All these areas require particularly close attention. These observations are of particular pertinence with regard to maintenance and radiation protection of maintenance staff, where the "human factors consultants" have to be more closely involved in carrying out studies on those jobs and sites entailing a higher dosimetry risk. The ASN expects to see improvements on these points.

Taking account of human factors in the design and modification of facilities

Taking account of human factors in the design or modification of a facility presupposes an analysis of the influence of the various human performance factor on the expected performance of the system and deduction of the needs and requirements in designing the facility or carrying out the modification. To do this, ergonomics propose a series of concepts, methodological tools, data collection and analysis tools which have proven themselves in many industrial projects.

During the design of a new facility, the organisational and human issues must be considered in sufficient depth and as soon as possible in the design process, to enable the staff to understand and control the facility in all situations in which they are likely to be required to intervene.

For example, the data collected during observation of various maintenance programmes on existing facilities and interviews with the future maintenance staff can be used to define the needs and requirements to be included in the physical architecture of the new facility and the arrangement of the equipment within the premises. In terms of operation, the use of mock-ups and simulators can bring the future users into the loop from the beginning of the project in order to improve and validate incorporation of requirements linked to the use of the operating system in the control room.

In 2004, the ASN examined the programme to engineer human factors into the design of the EPR reactor project, and more particularly the computerised control system. The ASN believes that the proposed guidelines are satisfactory and should lead to optimum use of the potential offered by data processing in providing the operators with effective assistance in running the facility, while leaving them sufficient independence in performing their duties. The use of mock-ups to include the operators in validating the computerised control design process also proved positive.

The modifications implemented during operation of the existing facilities often have repercussions on operation and maintenance. If highlighted sufficiently early on in the modification project, for



N4 reactor control room

example a partial renovation of the I&C system, they can be an opportunity to improve the operating conditions of this system by involving the future users in the various stages of the design process: analysis of requirements, presentation of the product by the manufacturer in order to fine-tune user needs and identify impacts, in particular those affecting the organisation of the work, mock-up on the site, validation at the manufacturer's and then on the site in real operating conditions. This enables the system's man-machine interface to be adjusted in order to obtain a final system easier to use by the operator, thus contributing to enhance safety.

In 2004, at the request of the ASN, the Advisory Committee for nuclear reactors, along with organisational and human factors experts, examined the methodology employed by EDF to take account of human and organisational factors in implementing technical and documentary modifications with an impact on nuclear reactor operation or maintenance. This methodology is chiefly based on an analysis of the socio-organisational and human aspects during impact assessments carried out upstream of the projects.

The examination relied on a number of modification project case studies, for example a new alarms arrangement in the control room.

This examination led the ASN to ask EDF to explain its strategy for incorporating human factors into modification projects, to expand its approach to each phase in the design process, relying on existing best practices in the area, and to reinforce measures to develop skills and organisational procedures contributing to implementation and assessment of its approach.

2 | 1 | 2

Training and skills

With regard to staff training and qualification, in other words recognition of competence to carry out a specific task, current EDF policy is based on decentralising training to the plants and on the notion of skill. This policy gives the nuclear power plants (NPPs) greater freedom of organisation and action and should lead to greater involvement by the local hierarchy in manageing skills, in particular through need identification and skill assessment.

As increasing numbers of staff retire, with the corresponding high influx of new personnel, the DPN in 2003 set up a human resources policy giving it a multi-year view of jobs and skills, with a view to ensuring that the necessary resources are available.

The provisions concerning personnel qualification are reinforced by adding an assessment of what has been learned during the national training courses organised for the more sensitive professional

sectors. This is already underway for the classroom courses and is gradually being implemented on the simulator courses.

The programme to deploy a simulator in each NPP is nearing completion. At the end of 2004, the simulators in the 900 MWe and 1300 MWe plant series had been delivered and were operational. For the N4 plant series, a new simulator was delivered to Civaux in October 2004. The simulator for the Chooz B plant will be overhauled in 2005 in order to incorporate the technical modifications made on the plant. The ASN is paying particularly close attention to this plant equipment programme, the effect of which should be to increase simulator availability for the operating teams, as well as to offer simulator access for the staff in charge of maintenance or testing.

Overall, the observations made during the various inspections by the ASN in this area show a plant situation that is satisfactory. However, efforts are still required to adapt radiation protection training to the staff is actual duties and to set up a process for skills assessment on this subject.

The ASN asked the Advisory Committee for nuclear reactors to carry out an assessment in 2005 about the skills management and staff qualification process used by EDF in its nuclear facilities.

2 | 1 | 3 Monitoring the quality of subcontracted operations

Maintenance of the reactors in the French nuclear power plant fleet is to a large extent subcontracted by EDF to outside companies. This activity, which is highly dependent on the scheduling of nuclear reactor outages, concerns about 20,000 people.

Implementing an industrial policy such as this is left to the initiative of the operator. The ASN is responsible for ensuring that EDF, under application of the ministerial order of 10 August 1984, assumes its responsibility for the safety of the facilities by applying a quality procedure, in particular involving supervision of the subcontracting conditions.

The ASN supervises the following aspects. The "Progress and sustainable development" charter signed in 2004 by EDF and its main contractors, is also based on these aspects.

Selection of the subcontractors and supervision of the quality of the subcontracted operations

In order to comply with the requirements of the ministerial order of 10 August 1984, EDF implemented a system for qualifying its contractors, based on an assessment of their technical competences and their quality organisation. In addition, EDF is required to monitor its contractors or have them monitored and use experience feedback for a continuous assessment of their qualification.

In 2004, the ASN examined EDF's way to adapt its subcontractor qualification system to the increasingly widespread use of "integrated maintenance services".

With regard to monitoring the quality of the subcontracted operations, the ASN believes that once again this year EDF must make significant progress, both in the preparation and the monitoring of the work and in the level of supervision in the field. Second level subcontracting supervision also has to be improved.

Maintenance conditions

With regard to the conditions of maintenance work and maintenance preparation, the ASN once again this year confirmed the improvement in early service ordering by EDF and the greater visibility of their workload afforded to the subcontractors, although EDF's target of 100% of orders placed 4 months before the beginning of outage has not yet been met.

Radiation protection and working conditions

In terms of maintenance worker radiation protection, the ASN focused its attentions on enforcing the Labour Code through inspections conducted during the reactor outages. It was in particular able to check that monitoring of worker exposure to ionising radiation was conducted with an equivalent quality level, regardless of whether the person concerned was employed by a subcontractor or by the operator.

The service company market

The decision made by EDF to outsource most of its reactor maintenance work must not create a situation of dependency in which it relinquishes control over the planning or quality of the work done. EDF is responsible for ensuring that this is not the case and, to do so, it has set up a structure to oversee its subcontractors market and monitor the available resources. As far as it is concerned, the ASN is keeping a close watch on the subject through its programme of inspections.

2 | 1 | 4

Safety and competitiveness

The law of 10 February 2000 regarding 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 electricity market, in particular places EDF in competition for the production and supply of energy to the main customers.

Cost control concerns are now more clearly apparent in the operator's dialogue with the ASN. Technical discussions with EDF have become tougher with regard to economic feasibility aspects, or to the justification for certain requests or certain deadlines, and in the handling of very short term subjects during unit outages.

A broader discussion has begun and is continuing on the potential safety impact of electricity market trends and the new practices implemented or foreseen by the operator, and on the actions that could be taken by the ASN in this field. The ASN has already initiated work in several areas.

The first area of work is to develop inspection and monitoring tools to provide early warning of any drift: the economic situation, spending trends, workforce management and operator organisational changes are all the subject of closer scrutiny. The ASN has thus questioned EDF about its 2004 budget and asked for a periodic safety and radiation protection summary of certain steps taken to improve the economic performance of the nuclear fleet, such as cycle extensions, or reliability centered maintenance. Spending trends show regular investment in maintaining the fleet and a more or less constant R&D effort over the period 2002-2004. Overall, the 2004 examination showed no worrying drift. However in the future, the ASN will be keeping a close watch on the consequences of any reorganisation within EDF designed to attain its economic performance targets.

The second area of work is to set up a more open and responsible dialogue with the operator about economic issues. One instrument used in this dialogue is the system of analyses offsetting the cost against the safety benefits, so that for a given financial resource level the actions offering the highest safety gains can be chosen. At the end of 2004, EDF presented these analyses to the ASN to provide a ranking of the modifications currently being defined as part of the periodic safety review for the third ten-yearly outages on the 900 MWe reactors. These analyses will be discussed during the course of 2005.

The third area of work is to implement a clearer, stronger legal framework. The nuclear safety and transparency bill proposes making improvements to these aspects. Work has begun into the general technical regulations, with the ASN issuing decisions and formal notices and with draft regulations concerning nuclear fuel and general operating rules for power reactors.

The fourth area of work is to develop international exchanges between nuclear safety authorities, in order to move towards harmonised requirements in the light of operator internationalisation and the setting-up interconnected electricity market. The work done within the WENRA association, in which the ASN plays an active role, contributes to this.

2 | 1 | 5

Internal authorisations

At present, some of the operations performed on the reactors requires prior authorisation by the ASN. Generally, the ASN considers that the prior authorisation system must remain limited to the cases which specifically require it, either because stipulated in the regulations or because of the safety, radiation protection or environmental protection issues. Actually, a such system could encourage the operator to shift the burden of validating its operations or documents onto the ASN and thereby pay less attention to their quality, which runs contrary to the principle of the operator's prime responsibility for nuclear safety.

In certain cases, prior authorisations were imposed on the operator following significant incidents. In particular, authorisation to restart after reactor shutdown followed a series of incidents in the early 1990s due to poor supervision of maintenance. Similarly, operations involving lowering the water level in the primary system to the "low operating range" of the residual heat removal system (RRA) with core loaded, which in particular enables fuel handling and steam generator maintenance operations to be carried out at the same time, can lead to a loss of cooling risk and requires prior authorisation from the ASN further to the incidents which occurred in 1990.

According to experience feedback in recent years, the ASN reckons that some of the prior authorisation requirements could be lifted, provided that EDF reinforces monitoring of the activities and implement an appropriate supervisory organisation.

In this respect, EDF submitted a proposal to the ASN for an "internal authorisation system" so that the following operations would no longer require prior authorisation from the ASN:
- lowering the primary system water level to the "low operating range" of the RRA system with core loaded,
- reactor restart after outages without significant maintenance,
- modification of an NPP's on-site emergency plan further to national reference framework changes.

After examination, the ASN gave EDF its approval for implementing the first two points. The authorisations will henceforth be issued by the DPN management or by the management of the plant concerned, after examination by an internal commission independent of the decision-making chain and comprising safety and quality experts. EDF will monitor the working of this system and report to the ASN.

The ASN intends to adapt its inspection procedures to these new arrangements, for example by carrying out inspections on the working of the "internal authorisation" processes. The ASN will also retain the right to issue requests prior to certain operations if it considers them to be necessary.

2 | 2

Continuous safety improvements

2 | 2 | 1

Anomaly correction

In recent years, a number of "conformity" anomalies have been detected in EDF nuclear power plants, to a large extent as a result of the systematic conformity checks required by the ASN, but also because of the interrogative attitude of the operator, which sought out these anomalies itself. The

ASN requires that those anomalies with potential safety consequences be corrected within a time commensurate with their significance.

The ASN considers that the checks conducted are the guarantee that a good safety level is maintained and that a facility on which nothing is done to find anomalies would only give the illusion of being safer than one on which the operator looks for, finds and corrects conformity discrepancies.

Systematic checks: conformity examinations

The ASN requires that conformity examinations be conducted as part of the periodic safety reviews. The conformity examination consists in comparing the state of the facility with the design safety requirements, taking account of changes made since construction, and listing any anomalies. These anomalies can be of various origins: design errors, construction defects, discrepancies introduced during maintenance, deterioration due to ageing and so on.

This examination includes a check on the conformity of the steps taken to protect against external hazards, including extreme weather conditions and earthquakes, and against internal hazards such as high-energy pipe breaks, as well as a check on the ability of the equipment to operate in the degraded ambient conditions likely to exist in the event of an accident (known as "qualification for accident conditions"). To this must be added a "programme of additional investigations", the aim of which is to check the parts of the facility which are not covered by maintenance schedules because access to them is too difficult.

The conformity examination on the 900 megawatt reactors ran from 1997 to 2001, while that for the 1300 megawatt reactors started in 1999 and ended in 2003.

"Real time" checks

In addition to the process of systematic anomaly searches, a questioning attitude on the part of the operator's staff is another means of detecting conformity discrepancies: routine field inspections or even a critical review of older design studies in the engineering centres can contribute to this. Several anomalies were discovered in this way and the ASN reckons EDF's attitude in this area to be positive.

Informing the ASN and the public

A specific procedure was set up to inform the ASN about the conformity anomalies discovered by EDF. When there is any doubt as to the conformity of an item, EDF notifies the ASN and undertakes a process of "characterisation" which aims to determine whether there is a real deviation from the design safety requirements and if so, to specify the equipment affected and assess the consequences of the anomaly for safety. The ASN is informed of the characterisation results and a significant safety event declaration is sent out to it as necessary.

The most significant conformity anomalies (INES scale level 1 and higher) are posted on the ASN's website.

This procedure guarantees transparency both to the ASN but also to the public.

The ASN's remediation requirements

The ASN examines the remedial measures proposed by EDF, in particular the lead-times, taking account of the safety consequences of the anomaly.

Any conformity deviation which significantly impairs safety must be corrected rapidly, even if the remedial measures entail a large volume of work. The facility may have to remain shut down until the repairs are made if the risk involved in operating it is considered to be unacceptable and if there

are no possible palliative measures. Conversely, repair of a less serious anomaly may be spread over a longer period of time if particular constraints so warrant.

For earthquake resistance anomalies, one factor in assessing the urgency of the repair is the seismic level for which the equipment in question is designed. In cases in which there is only a need to restore a safety margin for equipment items which can already withstand a large-scale earthquake, longer repair lead-times may be granted.

Examples of anomalies currently being handled

– Anomaly on certain electrical marshalling boxes in EDF NPPs.

Certain safety-related equipment located inside the reactor building must be able to function in an accident situation. It is subject to "qualification" requirements, the aim of which is to ensure that it can function in a harsh environment inside the reactor building (temperature, steam, irradiation, etc.). This equipment falls into category "K1" and must in particular continue to receive electrical power even if water or steam is present.

Investigations carried out following detection of an insulation fault on an electrical switchboard in Penly 2 showed that this fault stemmed from the "K1" qualified marshalling box onto which water had trickled. Examination of the box during the February 2004 refuelling outage showed that the connection cables were not watertight.

The watertightness faults were the result of indentations on the cable insulation and in certain case the bare copper wires were visible. These anomalies, which were likely to affect all the EDF PWRs, were the result of incorrect cable stripping procedures by the EDF subcontractors at initial installation or during subsequent facility modifications.

If water is splashed onto one of the affected boxes, or if there is steam in the reactor building, this could lead to isolation faults and in an accident situation prevent operation of the necessary equipment connected to the box. The fuel cooling function in particular could no longer be guaranteed in these situations. Not all the marshalling boxes are affected.

The anomaly has no impact on normal operation of the reactors, however, given its potential impact on the safety of the facilities, this event was classified level 2 on the INES scale in April 2004.

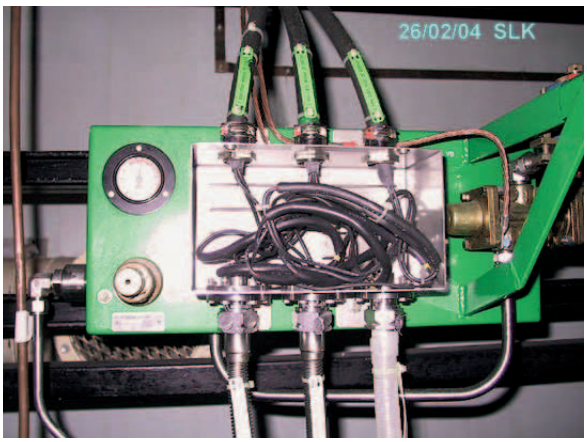
In July 2004, the ASN asked EDF to repair equipment deemed to have high priority no later than 1 July 2005, and the other equipment before 1 July 2006. During the site inspections carried out during the reactor outages, the ASN also checks that the repair work on this equipment is done properly.

– The recirculation sump filters clogging risk

In the event of a pipe break accident on the primary system inside the reactor building, the safety injection system (RIS) and containment spray system (EAS) are automatically triggered. These systems inject water which is first of all pumped from a tank. When this tank is empty, the water from the leak and that already sprayed is collected from the sumps at the bottom of the building housing the reactor and then reinjected by the RIS and EAS systems, via the recirculation system.

Given the flow of water in the reactor building, the debris generated by the pipe break (particles of lagging, concrete or paint) are likely to reach the sump filtration grilles. This results in a risk of sump clogging and of foreign bodies entering the systems, with possible malfunction of the recirculation function. This physical phenomenon was indeed taken into account in nuclear reactor design. However, experience feedback and studies conducted at an international level for the past ten years have raised questions as to the pertinence of the rules used for the design of the filtration systems.

According to initial results from the experimental research programme initiated by the IRSN on this subject, the ASN in October 2003 asked EDF for its opinion regarding the risk of failure of the recir-



K1 marshalling box in the Penly 2 reactor

culation function, for all French reactor models. In its reply dated 24 December 2003, EDF stated that in certain highly improbable accident situations (complete break of a primary system pipe), clogging of the sump filters could not be ruled out, but that it could be ruled out for less serious breaks. All French nuclear reactors are concerned to various extents, with the older ones apparently being the most prone to this phenomenon, as they offer a smaller filtration surface area. The ASN required EDF to examine and propose solutions to remedy the anomaly. Given its potential impact on the safety of the facilities, EDF declared a significant safety event on 31 December 2003, classified level 2 on the INES scale, and the ASN issued a press release in early January 2004.

In order to characterise the anomaly correctly and design a lasting solution, EDF drew up a "studies reference system" which in particular defines the scenarios employed in the analyses. There are many parameters that can influence the sump filters clogging phenomenon and the physical processes involved are complex and hard to model. The studies reference framework, forwarded to the ASN at the end of April 2004 constitutes therefore the basis for sizing the filtration systems and consequently for defining the modifications to be made to the equipment. At the request of the ASN, it was examined at the end of 2004 by the Advisory Committee for nuclear reactors. On the basis of the results of this consultation, the ASN will rule on the acceptability of the technical solutions adopted.

2 | 2 | 2

Safety reviews

In France, the ASN carries out a complete "check-up" on each NPP at intervals of about 10 years. The periodic safety review is an opportunity for in-depth inspection of the installations to check that they comply with all the safety standards. It is also an opportunity to compare the safety level of the installations with the more recent installations and to make the modifications considered to be necessary with a view to improving safety. In this respect, the safety reviews are one of the cornerstones of ASN policy, which is to ensure that not only does the operator maintain the level of safety of its installations, but also improves it.

The safety reviews therefore have two primary objectives:

• firstly, to compare the level of safety of the facilities with their initial "safety reference framework" in order to identify any deterioration over time, as well as the faults and weaknesses of the safety analysis. This is the conformity examination.

• secondly, to compare the safety of the facilities with the most recent safety standards, in order to improve the level of safety. This is the safety review. This review is able to identify modifications likely to bring about a significant improvement in the safety level and establish a new "safety reference

framework". Advantage is taken of the 10-yearly reactor outages (see § 1|2|3) for deployment of these safety improvements.

The review process comprises an orientation phase, setting the topics and scope of the conformity and review studies, a study phase, the aim of which is to determine the modifications to be made, and a modifications examination phase. After the study phase, the choice of topics for the reactor conformity examination is finalised. Each of the phases in principle comprises a proposal from the operator, consultation of the Advisory Committee for nuclear reactors and a position from the ASN. Before the first ten-yearly outage associated with the safety review, the examination must rule on the acceptability of the new safety reference framework and the continued operation of the reactors following their ten-yearly outage.

The twenty-year safety review for the 900 MWe reactors

The modifications arising from this safety review continued to be implemented during the course of 2004 on the occasion of the second ten-yearly outages at Blayais 3, Cruas 3, Dampierre 4 and Tricastin 4. Among the modifications made by EDF could be mentioned those aimed at improving the reliability of the backup turbine generator, the steam generators auxiliary feedwater system and the ventilation systems in premises housing safeguard equipment.

The thirty-year safety review for the 900 MWe reactors

After defining the guidelines for this safety review in 2003, the ASN in 2004 defined the procedures for consulting the Advisory committee for nuclear reactors concerning the various study topics, in particular serious accidents, containment of radioactive materials, fire, explosion risks and the use of probabilistic safety studies. Advisory Committee consultations began in December 2004 on the subject of serious accidents and should continue on the other topics during the first half of 2005. The choice of the modifications to be made will in particular be guided by the cost/safety benefit studies. The modifications resulting from this review are scheduled to be implemented during the third ten-yearly outages on the 900 MWe reactors, starting in 2008.

The twenty-year safety review for the 1300 MWe reactors

Examination of the modifications to be implemented during the second ten-yearly outages on these reactors as of mid-2005, continued in 2004 in accordance with the examination process drawn up by the ASN.

The conformity examination, which includes points such as protection against hazards originating in the reactors' industrial environment, protection against internal missiles and the operability of the equipment in incident or accident situations, was completed in 2004 for all the sites in the 1300 MWe plant series by presentation to the ASN of the conformity examinations for the Nogent-sur-Seine, Golfech and Penly plants.

At the request of the ASN, the conclusions of the safety review for the 1300 MWe reactors will be discussed by the Advisory Committee for nuclear reactors during the second half of 2005. The modifications decided on during this review will be incorporated during the second ten-yearly outages of the 1300 MWe reactors as of 2005.

2 | 2 | 3

Modifications made to the equipment and to the operating rules

As part of the process of continuous improvement of the safety of its reactors, but also to improve the industrial performance of its production tool, EDF periodically makes changes to equipment and operating rules. These changes can be the normal result of handling of conformity deviations, the safety reviews, or experience feedback. The ASN has set up a process to check and approve these modifications, compatible with the reactor safety issues.

For equipment changes, this process aims to adapt the level of examination to the relevance for safety, by classifying the changes in 3 groups according to safety criteria. Only group 1 and 2 modifications, which have a notable impact on safety, require prior authorisation by the ASN. The process also specifies the nature of the information the ASN expects from the operator by stipulating the content and frequency of transmission of certain information documents. In 2004, ASN approvals primarily concerned changes to the equipment of the 1300 MWe reactors to be implemented during the second ten-yearly outages scheduled from 2005 onwards. The modifications about upgrading of the software used in an accident situation was given particularly close attention.

Documentary changes are subject to prior approval by the ASN when they affect chapters III, VI, IX and X of the RGE (see § 1|2|2). For these changes, the ASN asked EDF to draw up preliminary notes on the safety issues of the main changes to the operating rules. This has in particular led in 2004 to an improvement in the time taken to examine the changes to the operating rules.

2 | 3

Nuclear power plant ageing

2 | 3 | 1

A relatively young fleet of nuclear power plants

The nuclear power plants currently in operation were built in a very short space of time: 45 reactors, representing 50,000 MWe, or three quarters of the fleet, were commissioned between 1979 and 1990, with an additional 10,000 MWe between 1990 and 2000.

The French nuclear fleet is also the youngest of all the fleets in the major nuclear countries, with the exception of China.

In December 2004:
- the average age of the thirty-four 900 MWe reactors was 23 years (between 17 and 28);
- the average age of the twenty 1300 MWe reactors was 17 years (between 12 and 20).

2 | 3 | 2

The main factors in ageing

To understand the ageing of a nuclear power plant, apart simply from the time that has elapsed since it was commissioned, a number of factors must be highlighted.

The lifetime of non-replaceable items

In the design, a certain number of reactor components were designed on the basis of a predetermined operating period. These items are therefore subject to close supervision to ensure that their condition and the trends involved are as expected. This is in particular the case with the reactor vessel, sized to withstand the effects of embrittlement due to neutron irradiation of the core zone steel for a period of 40 years (equivalent to continuous operation for 32 years). This is checked by monitoring "control samples" and appraising them at regular intervals.

Deterioration of replaceable items

These are phenomena such as wearing of mechanical parts, hardening and crazing of polymers, corrosion of metals, etc. The equipment requires particularly close attention during the design and manufacturing stages (particularly the choice of materials) along with a monitoring and preventive main-

tenance, repair or replacement programme as necessary. It must also be possible to demonstrate the feasibility of possible replacement.

Equipment or component obsolescence

The availability of spares which have been qualified for installation in the reactors is highly dependent on any changes occurring within the suppliers' industrial situation.

Should the manufacturer cease to make certain components, or simply go out of business, this could create spare procurement problems for certain systems.

New spares would then require safety justification before they could be installed in the reactors.

Given the length of this procedure, the operators must adopt a vigorous forward-looking policy in this area.

The ability of the facility to follow changes in safety requirements

Greater knowledge and technological improvements, as well as changes in the social acceptability of risk are also factors which can lead to the decision that an industrial facility requires extensive renovation work or - if this cannot be done at an acceptable cost - to closure at a time in the future to be defined.

2 | 3 | 3

Strategy to deal with equipment ageing

This "defence in depth" type strategy is based on three lines of defence.

Including ageing in the design

The design and manufacture of components, the choice of materials and the installation arrangements must be tailored to the intended operating conditions and take account of the known or presumed deterioration processes.

Monitoring and anticipating ageing phenomena

Deterioration phenomena other than those included in the design may be brought to light during the course of operation. Periodic monitoring and preventive maintenance programmes and conformity examinations (see § 2|2|1), or examination of experience feedback are ways of detecting these phenomena.

Repairing, modifying or replacing equipment likely to be affected

This type of action has to be planned in advance, given the procurement lead-times for new components, the time to prepare for maintenance, the risks of obsolescence of certain components and the risk of gradual loss of staff technical skills.

2 | 3 | 4

ASN policy

From a strictly regulatory standpoint, in France there is no limit on the time that a nuclear power plant is authorised to operate.

However, the ministers with responsibility for nuclear safety may at any time ask an operator to conduct a safety review of its facility. The practice in France is thus to conduct a safety review every

10 years. These reviews are a particularly good opportunity for an in-depth examination of the effects of ageing, but also of the need for and feasibility of modifications to be made if the facility is to keep pace with changes in the safety requirements (see § 2|2|2).

In preparation for the third ten-yearly outages of the 900 MWe reactors, the first of which will start in 2008, the ASN therefore in 2001 asked Electricité de France to present a precise description of ageing for each reactor concerned and demonstrate the possibility of continuing with operation beyond 30 years in satisfactory conditions of safety.

In reply to this request, Electricité de France drew up a programme of work which was examined by the Advisory Committee for nuclear reactors in December 2003. The organisation set up by EDF under the terms of this programme, and the methodology employed to take account of ageing were felt on this occasion to be satisfactory.

2 | 4

The EPR project

2 | 4 | 1

The Government's position on the project safety options

The ASN considers that the safety of the reactors in operation in France today is satisfactory. However, it considers that any new generation of nuclear power plant reactors must offer a higher level of safety.

It was by applying this fundamental principle that the safety objectives of the future pressurised water reactors were jointly defined by the French and German nuclear safety authorities, with the aim of taking advantage of the experience acquired on current reactor design and operation, opting for an "evolutionary" approach, although without ruling out the possibility of adopting innovative technical solutions.

The main safety options for the EPR project were first of all jointly examined by the French and German safety authorities until the end of 1998, and then by the French safety organisations with the participation of German experts since that date.

2004 was marked by the announcement of the French Government's position concerning the EPR project safety options. On behalf of the Ministers with responsibility for nuclear safety, the Director General for Nuclear Safety and Radiation Protection at the end of September sent a letter to the Chairman of EDF notifying him officially of the conclusions of this examination.

In this letter, posted on the ASN's website, the French Government stated that at this stage of the investigation the safety options presented conform to the goal of safety improvements in comparison with current reactors and asked EDF to comply with the two sets of technical rules appended to the letter. This assessment of the safety options will also have to be confirmed by examination of certain detailed design studies.

This type of position regarding the safety options of a reactor model, which is not a step specified in the regulations and which is comparable to the "certification" issued by certain foreign countries, has a twofold advantage:
• it sets the main characteristics of the project in terms of safety, so that the designer does not have to go back over technical points which have already been discussed;
• it officialises the reference framework of technical requirements applicable to the analysis of the detailed design studies and the preliminary safety report.

This can in no way be considered an authorisation to build.

2 | 4 | 2

Examination of the detailed design studies

In 2004, examination of the detailed design studies continued, particularly on the basis of the preliminary safety report submitted in early 2004 by EDF, with two meetings held by the Advisory Committee for nuclear reactors. Of the subjects covered, we could mention the design of the containment, of the corium recovery system, or the I&C hardware architecture.

The studies submitted by EDF on the subjects examined this year were on the whole deemed to be satisfactory. The ASN did however consider that the worker radiation protection objectives in the studies presented by EDF were not ambitious enough. The ASN asked accordingly that the EPR project design be optimised with respect to this point.

With regard to re-examination of the corium recovery system conducted at the end of 2004, the ASN considers that certain scenarios which are of importance in demonstrating the correct working of the system need to be further justified and validated, in particular by conducting additional experiments.

Finally, on 21 October 2004, EDF officially announced that it wanted to select the Flamanville site for installation of an EPR reactor. Further to this announcement, the ASN is preparing to examine the studies concerning specific aspects of the chosen site to be supplied by EDF (seismic activity, flooding risk, design of the pumping station, etc.).

2 | 4 | 3

Examination of the nuclear steam supply system construction options

Examination of the design and manufacturing choices for the major components of the primary system continued in 2004. In July 2003 the Standing nuclear section of the Central Committee For Pressure Vessels had examined the choices concerning the reactor vessel nozzle support ring. In December 2004 it examined the design and manufacturing choices for the pressuriser with respect to the layout, materials, sizing, accessibility for in-service inspection and radiation protection provisions. The choices proposed frequently turned out to be significant improvements over existing plant pressurisers, but alternative solutions, in particular for certain manufacturing processes, need to be examined and additional demonstrations are needed to justify the sizing and mechanical strength.

2 | 4 | 4

Cooperation with the Finnish nuclear safety authority

After signing a contract with Areva at the end of 2003 for the construction of an EPR reactor, TVO - a Finnish electricity production utility - submitted a construction permit application to the Finnish Nuclear Safety Authority (STUK) in early 2004, with the aim of starting work in early 2005. The Finnish and French nuclear safety authorities therefore made the perfectly natural decision to work together closely on this matter. The ASN in particular gave STUK access to all documents concerning the examination under way since 1993.

It should also be noted that the Finnish and French nuclear safety authorities held several meetings in 2004 for a six-monthly review of the progress made in the technical investigation of the projects and a Finnish expert was appointed as a member of the Advisory Committee for nuclear reactors.

2 | 5

Research into pressurised water reactor nuclear safety an radiation protection

Fundamental and applied research is one of the keys to progress in the field of nuclear safety and radiation protection, for several reasons:

• development and validation of innovative technical solutions allow the emergence of new products or operating processes and their use in place of techniques or processes offering a lesser degree of protection;

• certain research work aims to improve knowledge of the risks, which will help define the protective measures needed or even shed light on risks hitherto poorly evaluated: experiments on PWR sump clogging phenomena, studies into human reliability helping better quantify the role of human factors...

• finally, research is useful in developing high level skills in the field of nuclear safety and radiation protection, thus helping to ensure that there is a ready supply of specialists.

The fact of being familiar with latest research results and knowing which questions are still to be answered, means that the ASN knows how far, in technical terms, an operator can be pressed to implement safety or radiation protection improvements. Moreover, the ability of the ASN - or the experts on which it relies - to initiate research also sometimes enables them to identify safety questions that were wrongly considered to have been resolved. For example, interpretation of the experiments conducted by the IRSN brought the risk of nuclear reactor sump clogging back into the spotlight.

It is also important for the operators to make a significant contribution to the nuclear safety and radiation protection research effort, using the results to make their facilities even safer. The ASN thus asked EDF to send it an annual statement of the budget and workforce assigned to nuclear safety and radiation protection research, so that it could examine the corresponding trends. The ASN's findings show that EDF's budget in this field has remained at a high level. It also observes that research in this area is still driven by a number of factors:

• future reactor projects: the EPR project has led to R&D work into new technical solutions, the implementation of which on the existing reactors will be examined during the ten-yearly safety reviews;

• the desire of industry to improve the performance of its facilities: for example, EDF's would like to increase nuclear fuel performance in particular generated work on cladding materials and the design codes. This work is also a means of increasing the available knowledge and in some cases advancing the safety level, for example by highlighting weaknesses in the methods previously used;

• the reactor lifetime issue. EDF's wish to continue with operation of the existing plants initiated research into materials, particularly the performance of the concrete containments and the properties of steel under the effects of irradiation;

• taking account of experience feedback from incidents; for example the research into the risk of flooding or modelling of oil slick drift.

Finally, the ASN has drawn up an initial inventory of PWR nuclear safety and radiation protection research in France. This shows that the work is about two-thirds funded by industry (mainly EDF and AREVA), with the remaining third coming from the State, via the CEA or the IRSN. The sums involved are considerable. A significant part of this effort is devoted to serious accidents, in other words with core melt, and the means of minimising the consequences. Conversely, the topics related to human and organisational factors receive less funding. This could be improved given the fact that these latter issues are major contributory factors in incidents.

3 PLANT SAFETY

3|1 Construction supervision

The construction of pressurised equipment for PWRs containing radioactive fluids is regulated by the order of 26 February 1974 and basic safety rule II.3.8 (see chapter 4, § 1|1|4) for the main primary and secondary systems and by the decrees of 1926 and 1943 for the others. Responsibility for the construction, covering design, industrial manufacture and on-site installation lies with the manufacturer (Framatome ANP or EDF). It is up to the manufacturer to demonstrate the conformity of the equipment it designs. It chooses the manufacturing processes, the checks to be used and the acceptance criteria for the results of these checks. To do this it usually employs industrial codes, which are sometimes specific to the nuclear industry. It is also up to the manufacturer to supervise its suppliers and subcontractors.

The ASN supervises the whole process in order to ensure that the constructor complies with the regulations and assumes its responsibility properly.

This construction supervision takes place:

• during design, on the basis of the justification files provided by the contractor. These files describe the equipment and its components, the loads to which they are subjected in normal operation or would be subjected to in an accident situation, their mechanical behaviour in response to these loads, the characteristics of the materials used, the manufacturing processes and their supervision;

• during manufacture/installation: on the one hand prior to the beginning of these operations, based on documents describing the technical options adopted by the contractor and on the other hand via checks in the field and in the factory, during execution, to check compliance with the stipulations of the files concerning equipment dimensions, the materials used, the manufacturing processes employed and their qualification, the supervision carried out and its results.

It ends with hydrostatic testing. The ASN is responsible for overseeing the hydrostatic test, which is the final full-scale strength and tightness test, decides on its outcome and issues the test report, without which no pressurised equipment can be brought into service.

This process is specific to France, even if in other countries the differences are minimal. For pressurised equipment which is not designed to contain radioactive fluids, there is a European directive which harmonises construction and inspection practices. While maintaining manufacturer responsibility, it lays down essential safety requirements, compliance with which is checked by an independent organisation notified by one of the member states.

In order to improve safety by incorporating the technical advances of the directive, the ASN is currently working on a new draft regulation which for nuclear pressurised equipment would specify construction and inspection procedures similar to those of the European directive, with specific additions to take account of the nuclear aspect.

The ASN also checks fuel fabrication. In this field, its role is to check that EDF exercises appropriate supervision of its suppliers in accordance with the requirements of the order of 10 August 1984. Two inspections concerning the fabrication of Westinghouse fuel assemblies were therefore carried out during 2004. The ASN found no significant discrepancies during these inspections.

3 | 2

Operation and control

3 | 2 | 1

Normal operating conditions

Technical operating specifications (STEs)

The general operating rules (RGE) include the reactor technical operating specifications (chapter III of the RGE), the role of which is:
- to define the normal operating limits of the facility if it is to remain in conformity with the reactor design basis scenarios;
- depending on the state of the reactor in question, to activate the safety functions necessary to the control, protection and safeguard of barriers as well as implementation of incident and accident operating procedures;
- to specify the course of action to be followed if a normal operating limit is exceeded or if a required safety function is unavailable.

EDF may be required to modify the STEs for various reasons: to take account of experience feedback, to improve safety, to improve reactor economic performance, or to take account of the consequences of changes made to the equipment. These changes in the STEs require prior authorisation by the ASN on the basis of safety justifications provided by EDF.

In 2004, the ASN examined a number of "amendment documents" modifying the STEs proposed by EDF, which were approved or are the subject of additional justification requests. These include:
• an amendment document concerning all reactor models and designed to modify certain STE criteria to take account of the lessons learned from the summer 2003 heat wave;
• an amendment document concerning 1300 MWe and CPY type reactors, designed to comply with the ASN's requests concerning the safety of fuel storage in decay pits.

Analysis of these documents reveals that considerable efforts have been made by EDF to present high-quality documents with clear identification of the changes proposed and the safety justifications. The ASN will see to it that this effort continues in 2005.

Waivers with respect to STEs

When an operator feels that it is unable or does not wish, on safety grounds, to comply strictly with STEs during an operating phase or a maintenance operation, it must apply to the ASN for a waiver, on a case by case basis. The ASN examines the request and decides whether it can be accepted, imposing compensatory measures for non-compliance with STE requirements where appropriate.

The ASN will strive to ensure that the number of waivers is limited. EDF is therefore required:
• periodically to re-examine the reasons for the waiver requests in order to identify those which would justify adaptation of the STEs;
• to identify "generic" waivers, in particular those linked to implementation of national modifications and periodic tests.

The number of waivers examined in 2004 was 89. The two most frequent requests for waivers in 2004 were:
• unavailability of the RIS 11 PO test pump, as a result of curative maintenance work on the RIS/RCV link shut-off devices;
• unavailability of the auxiliary offsite power source, due notably to maintenance work on the 400 and 225 kV metal-clad substation housings.

The waiver files sent by the operators are not always of high enough quality (down-time omitted, insufficient compensatory measures), which means that the ASN has to ask for further information.

Operating thoroughness

During site inspections, the ASN checks:
• compliance with the STE and, as necessary, with the palliative measures associated with the waivers;
• the normal operating document quality such as operating instructions or certain alarm sheets;
• consistency between the normal operating documents and the STE;
• staff training in handling certain "sensitive" reactor transients, such as entering the RRA low operating range (PTB RRA).

These inspections conducted in 2004 show that in most of the NPPs there is a certain lack of thoroughness in applying the STEs and normal operating documents. The ASN therefore decided to reinforce its site inspections in 2005 on the subject of operating thoroughness.

3 | 2 | 2

Incident and accident operation

Incident and accident operation was originally founded on an event-based approach which used a single initial diagnosis to identify an "initiating event" and implement a predetermined operating strategy. This approach was unable to deal with a combination of equipment or human failures.

Incident and accident operation today uses the principle of the state-based approach (APE) which is a major advance in safety terms over the event-based approach. The APE consists in applying operating strategies which are drafted according to the identified physical state of the nuclear steam supply system, regardless of the events that led to this state. Should the state deteriorate, a permanent diagnosis enables the procedure or sequence in progress to be aborted and a more appropriate procedure or sequence to be applied.

The operating documents used in incident and accident situations are drafted on the basis of incident and accident operating rules which constitute chapter VI of the general operating rules. These rules are subject to approval by the ASN.

During 2004, the ASN continued to examine changes to the operating rules proposed by EDF and in particular approved:
• the creation of new reactor operating rules in the event of fire, called operator fire action sheets (FAIOp), for the 900 and 1300 MWe plant series. Drafting of the FAIOp operating rules is part of the fire action plan that EDF is committed to implementing on the 900 and 1300 MWe reactors before the end of 2006;
• changes to operating rules concerning management of the plant flooding risks (except for the Fessenheim and Bugey reactors, for which the examination is ongoing).

Generally, the documents submitted for ASN approval by EDF are of good quality, even if discussions are in progress with EDF so that the origin and end-purpose of the proposed changes are more clearly identified in the requests.

Inspections into incident and accident operation take place regularly in all plants. During these inspections, the management of incident and accident operation documents (reproduction, distribution, etc.), and the training of operating staff are in particular examined. The inspections performed in 2004 highlighted no major issues. Overall, the ASN considers that the sites have satisfactorily assimilated incident and accident operation rules (transcription into local documents, distribution and training of staff).

Reactor operation in severe accident situations

If the reactor cannot be brought to a stable condition after an incident or accident and the scenario resulting from a series of failures leads to core damage (core melt), the reactor is said to be entering a severe accident situation.

For this type of very hypothetical situation various steps are taken to enable the operators, supported by the emergency teams, to manage reactor operation and ensure containment of radioactive materials in order to minimise the consequences of the accident. The emergency teams can in particular rely on the serious accident response Guide (GIAG), a new version of which was presented by EDF in early 2004 for the CPY plant series. EDF also plans to draft a new version of this guide in the near future, specifically to take account of management of an accident occurring during a reactor outage.

In order to improve the definition of all the safety requirements to be met in serious accident situations and further to an ASN request, EDF proposed a draft "serious accidents" reference framework which will be reviewed by the Advisory Committee for nuclear reactors in 2005.

Moreover, as part of the 30-year safety review for the 900 MWe reactors, the ASN at the end of 2004 consulted the Advisory Committee for nuclear reactors about the modifications to be implemented on these reactors to improve the extent to which the risks associated with serious accidents are considered.

Finally, the installation of catalytic hydrogen recombiners, which enables the hydrogen levels in the containment to be reduced during a serious accident, thereby reducing the risk of hydrogen explosion, began in 2004. This installation of hydrogen recombiners followed a decision made by the ASN on 28 June 2001 which asked that recombiners be installed on all PWR reactors in operation by the end of 2007.

3 | 3

Maintenance and tests

3 | 3 | 1

Maintenance practices

Deregulation of the electricity market leads EDF to control its expenditure. Optimising maintenance costs is one way for EDF to improve its competitiveness. EDF has therefore developed a "maintenance reduction" project which aims to concentrate maintenance on equipment which would constitute a safety, radiation protection or operational risk in the event of failure, and is relying on maintenance methods which do not require equipment dismantling.

A first change occurred in the mid-90s with implementation of the "reliability centred maintenance" (RCM) method.

This is the result of a functional analysis which determines the type of maintenance to be carried out according to the consequences of equipment failure on the system concerned, rather than simply according to their causes, as in the previous approach. The ASN felt that this approach did not compromise safety. Following ASN requests and in order to take account of experience feedback from the plants, EDF adapted the RCM method.

Taking advantage of standardisation of the NPPs in France, EDF is developing the concept of "pilot equipment" based maintenance, creating technically homogeneous families of similar equipment operated in the same way. The selection and close monitoring of a limited number of these items - which then act as pilot items within these families - could, if no deterioration is detected, spare systematic monitoring of all the items.

The ASN is currently examining this new approach and the way it could be applied to the reactors.

More generally, the ASN is closely monitoring how EDF takes account of experience feedback about the behaviour of the equipment concerned by these maintenance methodology changes, in particular with regard to the content and frequency of the inspections.

3 | 3 | 2

Industrial code changes

The industrial codes used by the manufacturers and operators in the field of nuclear reactor safety are drafted by the French association for nuclear power plant NSSS equipment design, manufacture and in-service surveillance rules (AFCEN), of which both EDF and Framatome ANP are members.

Current codes for nuclear islands are the RCC-M 2000 edition for design and construction of mechanical equipment, the RCC-E 4th edition for design and construction of electrical equipment, as well as the in-service surveillance rules for mecanical equipment (RSE-M code). These codes were accepted by the ASN in 2001, 2003 and 2002 respectively, in certain cases with requests (see chapter 3 § 2|2|2).

In 2004, the ASN continued to examine changes to the RCC-M and RSE-M codes. For the RCC-M code, these changes led to most of the reserves issued at acceptance in 2001 to be lifted and took account of some of the new technical rules applicable to the construction of the nuclear steam supply system. For the RSE-M code, these changes correct the discrepancies with respect to the 10 November 1999 order identified at its acceptance in 2002. Pending a decision on the proposed changes, which should be made in 2005, the ASN considers that the accepted versions of these codes, plus the particular restrictions and provisions stipulated, are still in force.

3 | 3 | 3

Qualification of inspection methods

The “non-destructive testing” type inspection methods used for in-service surveillance of the equipment in the reactor main primary and secondary systems have to be qualified. Article 8 of the order of 10 November 1999 (see chapter 3, § 2|2|1) specifies that “prior to their being used, the non-destructive examination processes employed on the equipment in-service shall undergo qualification by an entity chosen by the operator”, the competence and independence of this entity having to be demonstrated. This obligation entered into force on 29 November 2004.

The qualification approach, which is the result of work done at an international level, aims to demonstrate that the examination method used is in fact capable of detecting the deterioration it is supposed to be looking for. The order of 10 November 1999 provides for creation of a qualification commission recognised as competent and independent both from the reactor operators and those directly involved in developing the processes. This commission, chosen by EDF, obtained its accreditation from the COFRAC (French accreditation committee) in 2002. It assesses the representativeness of the mock-ups used for the demonstrations and the defects introduced into them. On the basis of the qualification results, it confirms that the examination method does indeed achieve the intended performance levels. A description of the qualification process has also been codified in the in-service surveillance rules for mechanical equipment (RSE-M): as applicable, the aim is either to demonstrate that the inspection technique used is able to detect a degradation described in specifications, or to explain the performance of the method.

After a slow and belated introduction of the qualification process by EDF, it is now operational. However, the resources deployed by EDF have made it possible to make up only part of the delay and the ASN therefore closely examined the palliative measures proposed by the operator to support its request for extra time to complete certain files.

Following this examination and after receiving the opinion of the Central Committee for Pressure Vessels (see chapter 2, § 2|1|5 b), the ASN agreed to 31 December 2005 as the deadline for complete implementation. The processes which have not yet been qualified will be subject to a specific monitoring procedure in 2005.

Internationally, the operators have a transitional period of varying length for implementing the provisions of this type. Actually, requirements may differ considerably from one country to another and only apply to some of the techniques employed.

3 | 3 | 4

Periodic tests

In order to check the availability of safety-related equipment, in particular the safeguard systems to be used in the event of an accident, good operation tests are periodically carried out.

In 2004, the ASN continued to examine changes to the periodic test programmes. This chiefly involved:
• approval of the periodic test programmes for the CPY plant series with "PTD lot 93-2000" status;
• examination of the impact of the hardware modifications resulting from the periodic safety review associated with the second ten-yearly outages of the 1300 MWe reactors;
• examination of changes to the periodic test programmes for the 1450 MWe reactors resulting from incorporation of the "EFP" modifications batch.

Furthermore, during the last quarter of 2004, the ASN together with EDF began to look at how to change the periodic test programme approval procedures. The discussions will continue in 2005.

3 | 4

Fuel

3 | 4 | 1

In-pile fuel management trends

In order to enhance the availability and performance of reactors in operation, EDF, together with the nuclear fuel manufacturers, is looking for and developing improvements to fuels and their in-pile management with a view to maximising efficiency.

Since 1996, extending cycle lengths has been a major factor in optimising reactor fuel and operations. These cycle extensions are accompanied by an increase in fuel enrichment, but the quantity of energy released remains limited to an average of 52 GWd/t per fuel assembly. This value corresponds to the maximum authorised limit in terms of burnup for all the management systems in force on the various plant series.

The GEMMES and CYCLADES management systems employed respectively on the 1300 MWe plant series since 1996 and the CP0 series since 2002, led to the length of an operating cycle being increased to 18 months.

The ASN ensures that these changes are accompanied by a demonstration of reactor safety based on scenarios specific to each management system. When a management change leads EDF to revise an accident study method, prior examination of it is required and it cannot be implemented without the approval of the ASN.

In order to improve investigation of future reactor fuel management systems, the ASN since 2000 has been using a specific process for examining this type of dossier, involving a three-stage investigation:

- examination of fuel management feasibility;
- examination of the safety file;
- examination of the operating documentation.

MOX-parity

The MOX-parity management concerns the 20 reactors in the EDF fleet authorised to recycle plutonium and is characterised by an increase in the burnup fraction of the MOX fuel assemblies as a result of the higher number of in-pile irradiation cycles for these assemblies (4 cycles instead of 3) and a change in their initial plutonium content (average of 8.65% as opposed to 7.1%). The purpose of this latter change is to compensate for the isotopic degradation of the plutonium resulting from reprocessing of fuels for which the burnup fraction was raised and to ensure that MOX fuel offers equivalent energy to UO_2 fuel 3.7% enriched with uranium 235. The purpose of this management is also to help control the quantities of plutonium generated by the French nuclear power plant fleet.

During the month of September 2004, the ASN ruled on the first part of the MOX-parity management safety file and informed EDF that it had a number of reservations about the maximum probable end of life corrosion thickness on the fuel rod clad.

The ASN also considered that some of the experimental results obtained during the summer of 2004 on MOX rods irradiated for 4 and 5 cycles, required more detailed analysis.

EDF duly noted the above reservations and decided to review its file.

GALICE

EDF is envisageing eventually replacing the current GEMMES management system in use on the 20 reactors of the 1300 MWe plant series by GALICE management. Assembly enrichment would rise from 4% to 4.5% UO_2, with maximum fuel burnup then being 62 GWd/t and a hybrid refuelling policy: some assemblies would only go through 3 cycles, while others would undergo 4. The average cycle length would still be 18 months, but could eventually be modulated between 15 and 21 months, in order to offer a degree of flexibility when planning refuelling outages.

Analysis of the feasibility file was completed at the end of 2004. It showed that the justifications for a certain number of points concerning the nature of the rod clad material (M5 alloy, see § 3|4|2) are still insufficient and that the method used to study the primary loss of coolant accident requires further examination.

ALCADE

ALCADE management is envisaged as of 2007 for the 4 reactors of the N4 series. In order to lengthen the operating cycles of these reactors, which would go up from 11 to 18 months, fuel assembly enrichment would be increased to 4.2% and fuel burnup to 54 GWd/t. The feasibility file is being examined by the ASN.

3 | 4 | 2

Fuel assembly modifications

EDF is continuing several experimental programmes aimed at improving both fuel safety and performance levels. The improvement areas explored are numerous and concern both the composition of the metal parts of the assembly (clad, skeleton assembly, nozzles, etc.) and the fuel pellet matrix.

FUEL MANAGEMENT IN USE ON THE FLEET – THE SITUATION AS ON 31 DECEMBER 2004

Management	Characteristics	Campaign length	Reactors concerned
Standard 900 MWe (GARANCE)	1/4 core refuelling with UO_2 fuel	12 months	Gravelines 5 and 6 Blayais 3 and 4 Cruas 1 to 4
Hybrid MOX (GARANCE MOX)	1/4 core refuelling with UO_2 fuel initially enriched to 3.7% uranium 235 and 1/3 core refuelling with MOX fuel	12 months	Blayais 1 and 2 Chinon B1 to B4 Dampierre 1 to 4 Gravelines 1 to 4 St-Laurent B1 and B2 Tricastin 1 to 4
Extended campaigns 900 MWe (CYCLADES)	1/3 core refuelling with UO2 fuel initially enriched to 4.2% uranium 235	18 months	Fessenheim 1 and 2 Bugey 2 to 5
Extended campaigns 1300 MWe (GEMMES)	1/3 core refuelling with UO2 fuel initially enriched to 4% uranium 235	18 months	Belleville 1 and 2 Cattenom 1 to 4 Flamanville 1 and 2 Golfech 1 and 2 Nogent-sur-Seine 1 and 2 Paluel 1 to 4 Penly 1 and 2 St-Alban 1 and 2
Standard 1450 MWe	1/4 core refuelling with UO2 fuel initially enriched to 3.4% uranium 235	11 months	Chooz B1 and B2 Civaux 1 and 2

Addition of a bottom grid

Since 2001, certain 1300 MWe reactors have been affected by vibration of the fuel assembly rods in the grid cells. This vibration leads to friction, clad wear (fretting) and finally clad failure.

To remedy this problem, the fuel manufacturer FRAGEMA, EDF's main fuel supplier, proposed a modification to its latest generation of assemblies, designed to reinforce the most heavily stressed part. The new type of assembly, called AFA3GLr, is equipped with an additional reinforcement grid at the bottom of the assembly, designed to better secure the rod in its cell. After initial authorisation to load this type of fuel into the Cattenom 3 reactor at the end of 2002, followed by other authorisations in 2003 and 2004, the ASN in early 2005 authorised the loading of this fuel in the 20 reactors of the 1300 MWe plant series.

Fuel clad using M5 alloy

M5 alloy is a clad material which offers better corrosion resistance than the materials used hitherto and it is chosen with a view to the increase in future fuel management burnup fractions. Use of fuel assemblies with M5 alloy clad (PENTIX fuel) began in 1999 in Nogent 2.

In July 2003, EDF asked the ASN for authorisation to burn an AFA3GLr-AA fuel load in the Nogent 2 core. In comparison with Pentix fuel, AFA3GLr-AA is characterised by addition of a reinforcing grid at the base of the assembly, by use of an M5 structure, and by lowering of the fuel rods designed to compensate for the lesser elongation when irradiated. The ASN approved this file in March 2004 but felt that the performance of the M5 alloy assemblies needed to be better quantified prior to implementation of GALICE management scheduled for the 1300 MWe series and for which the reference fuel assembly is AFA3GLr-AA.

Furthermore, as clad failures had also been detected on the PENTIX assemblies, the ASN informed EDF that the causes of these clad failures had to be clearly identified before M5 clad material could be put into general use. A certain number of questions concerning LOCA, the pellet-clad interaction phenomenon and the impact of M5 on the fuel cycle also required a decision by the ASN prior to use of this type of assembly for the future fuel management systems.

In March 2004, the ASN also took part in a meeting with the British nuclear safety authority about the use of M5 alloy as a clad material. This led to information being shared about the behaviour of M5 alloy in the reactor and a review of current R&D on this subject.

RFA 900 and RFA 1300 fuel

In 2004 EDF continued the work already started with a view to diversifying its nuclear fuel supplies from the Westinghouse group. The RFA 900 and RFA 1300 assemblies use technologies to hold down the rods in the skeleton which are different from those used by Framatome, but they have comparable characteristics with regard to protection against loose parts and, for the assemblies intended for the 1300 MWe plant series, against vibration wear at the base of the assembly.

Feeling that operating conditions in reactors abroad were not sufficiently representative of those of the French reactors and that experience feedback concerning burnup of the RFA 1300 fuel authorised in 2002 and the RFA 900 fuel authorised in 2003 was still insufficient, the ASN in 2004 only authorised occasional introduction of this type of fuel into the 900 MWe reactors (Gravelines 1, 2, and 6, Cruas 1 and 2, Dampierre 1 and 3, Blayais 2, Tricastin 2 and 4) and the 1300 MWe reactors (Belleville 1 and Paluel 4).

Rod Cluster Control assembly drop time

Anomalies with insertion of the RCC assemblies into their damper, a system which slows the assemblies when they reach the bottom of the core, had been observed on the 900 MWe and 1300 MWe reactors as of 1996. These anomalies did not however compromise reactor safety. The investigations carried out by EDF concluded that braking at the end of RCC assembly travel was due to excessive deformation of the fuel assemblies under the irradiation effect.

From 1997, the ASN had asked for preventive and supervision measures concerning this phenomenon. These measures had limited the number of anomalies although without eliminating them.

Reactors are today only being operated with fuel assemblies in which the structure has been reinforced, making them less susceptible to deformation. As no RCC assembly insertion anomaly has been observed on these fuel assemblies the ASN scaled down in April 2004, the prevention and monitoring measures. On the basis of this satisfactory experience feedback, EDF asked the ASN for a complete lifting of these measures for current fuel management. EDF's request is being reviewed by the ASN.

3 | 4 | 3

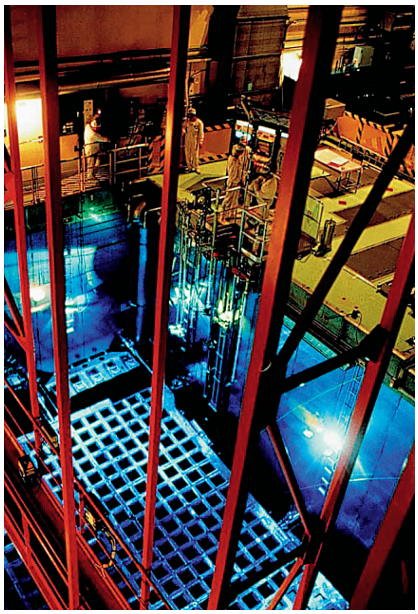
Fuel handling operations

Refuelling operations, during which end of life fuel assemblies are replaced by new assemblies, take place with the reactor shutdown and vessel open. Refuelling requires underwater handling of fuel

assemblies between the fuel building pit and that in the reactor building, so that they can be positioned in the reactor vessel in accordance with predetermined reloading sequences.

On 2 April 2001, an offset in the refuelling sequences in Dampierre 4 had led to incorrect positioning of a large number of assemblies in the reactor. These multiple errors led to a concentration of new assemblies in the reactor vessel, which nonetheless remained sub-critical. This incident was classified level 2 on the INES scale by the ASN. Since then, EDF has been gradually implementing measures designed to improve the organisation and supervision of handling operations and operator training in the risk of criticality.

In 2004, further errors in positioning of a few assemblies occurred at refuelling of the Gravelines 2, Golfech 2 and Paluel 3 reactors. The ASN reiterated its request that EDF reinforce its steps to prevent fuel assembly positioning errors in the reactor.



Spent fuel pool at the Saint-Laurent nuclear power plant

3 | 5

The primary and secondary systems

The main primary and secondary systems (CPP and CSP), presented in § 1|1|3, are fundamental components of a reactor. They operate at high temperature and high pressure and as they contribute to all safety functions - confinement, cooling, reactivity control - they are the subject of extensive supervision and maintenance by EDF and in-depth monitoring by the ASN. Surveillance of the operation of these circuits is regulated by the order of 10 November 1999, mentioned in chapter 3, § 2|2|1.

In 2004, the ASN's main concerns were how the operator dealt with stress corrosion damage and processing of steam shutoff valve faults. The ASN felt that the condition of the CPP and CSP in the French reactor fleet gave no cause for concern in the short term but that the known ageing and deterioration phenomena needed to be taken into account and it asked for appropriate measures in preparation for the third ten-yearly outages of the older reactors, the 900 MWe series.

3 | 5 | 1

The system reference files

In order to ensure that the operator of a nuclear power plant has assimilated the nuclear steam supply system manufacturer's recommendations and adapted its operating conditions accordingly, the regulations require the creation of "reference files" for the reactor main primary and secondary systems.

The order of 10 November 1999 thus required that the operator gather and update all system design, manufacturing and operating documents which contribute to justifying system integrity. For reactors already in operation at the time the order was published, a time was allocated for compilation of these files.

Owing to the homogeneity of the French nuclear reactor fleet, EDF chose to organise these reference files into "standardised series" files for all the reactors of each series (900 MWe, 1300 MWe and N4), breaking them down into "unit" files for each individual reactor, in particular comprising data about maintenance, faults and events that occurred on this reactor. For each plant, these data must appear in a documentary system allowing easy access to this information.

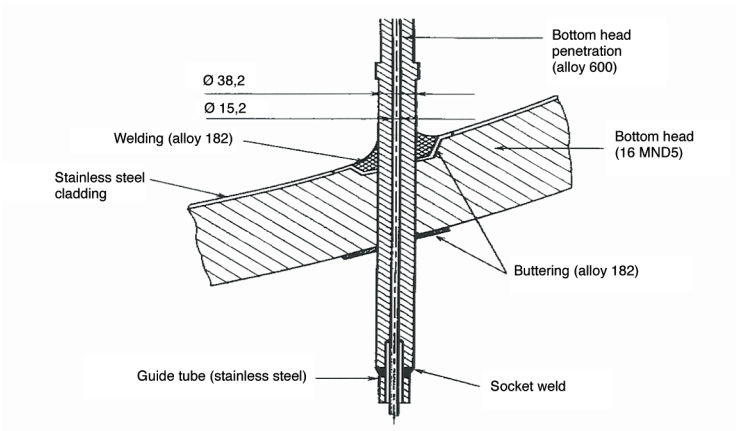
In 2004, the ASN focused on using inspections and technical investigations to assess the work done by EDF to compile and update the documentary systems. Although the action plans have been prepared for creating the documentary system, actual integration of the reference files into the documentary system is so far only partially complete.

The ASN feels that the files also need to be updated on a number of particular points, in particular the description of accident situations, and the inclusion of thermohydraulic phenomena in the operating procedures.

3 | 5 | 2

The use of nickel-based alloys

In a PWR, several parts have from the outset been made of nickel-based alloy: the steam generator tubes, the partition plate separating the hot box from the cold box in the steam generators, the steam generator tube sheet lining, the vessel closure head adapters, the vessel bottom head penetrations, the vessel internals lower support guide welds. The use of this type of alloy is justified by its resistance to generalised or pitting corrosion.



Example of nickel-based alloy zones on the main primary system: vessel bottom head penetrations

In reactor operating conditions, Inconel 600 nickel based alloy is sensitive to stress corrosion, a particular type of corrosion that occurs in the presence of high mechanical stresses. It can lead to cracking, which can be quick, for example on the 1300 MWe reactor pressuriser instrumentation nozzles in the late 1980s, or on the heat-treated steam generator tubes in the early 1990s.

An overall approach to treatment of the zones concerned has been adopted in France. Several zones of the main primary circuit made of 600 alloy are thus subject to particular monitoring, in accordance with ASN decision n° 010067 of 5 March 2001 (available on the website www.asn.gouv.fr). For each one, the in-service surveillance programme, defined and updated annually by the operator, has to meet requirements concerning the inspection objectives and frequencies. In addition, steam generators and vessel closure heads are covered by a major replacement programme (see § 3|5|3 et 3|5|4 below).

In 2004, during the steam generator partition plate inspections, cracks (which had already been detected on some of them in 2002) were attributed to stress corrosion. According to prior analyses by EDF, the steam generators on which they had occurred were not particularly susceptible to this type of damage. Following this discovery, additional examinations and safety analyses were therefore carried out and will be continued.

In the light of recent events, the ASN is stepping up its vigilance and asked EDF to adapt its maintenance strategy on the Inconel 600 or 182 zones to this unprecedented experience feedback. The extent to which it meets its commitments, particularly concerning development of automatic tools for easier inspection and repair of these zones, will be closely monitored. This type of process will have to be implemented for assessment as of 2005.

3 | 5 | 3

Reactor vessels

The vessel is one of the essential components of a PWR. This component is 14 m. high, 4 m. in diameter and 20 cm. thick. It houses the reactor core and its instrumentation and in normal operation is completely filled with water, bringing its weight to 300 t. It can withstand a pressure of 155 bars at a temperature of 300 °C.

Regular and precise monitoring of the reactor vessel is essential for the following two reasons:

• vessel replacement is not envisaged, for reasons of technical feasibility and economics;

• rupture of the vessel is an excluded accident, so its consequences are not included in the reactor safety evaluation. Validating this assumption however means that appropriate design, manufacturing and operating measures be taken.

In normal operation, the vessel gradually deteriorates as the neutron radiation from the reactor's fissile core slowly embrittles the vessel metal. This embrittlement makes the vessel particularly sensitive to pressurised thermal shocks or to sudden pressure surges when cold. The presence of a crack would then be potentially damageing.

To prevent against all risks of this type, the following measures were taken as of commissioning of the first EDF reactors:

• a program to monitor the effects of irradiation: capsules containing test specimens made of the same metal as the reactor vessel were placed inside the reactor, near the core. Some of these capsules are regularly extracted and subjected to mechanical testing. The results of these tests give a good picture of how the vessel metal is ageing, and in fact even give advance "early warning" as the capsules are situated close to the core and receive more neutrons than the actual vessel itself;

• periodic ultrasonic testing: this check is used to monitor any defects located under the vessel's inner stainless steel lining.

Furthermore, although such violent thermal shocks are not encountered in normal operating conditions, the safety approach is to envisage numerous accident scenarios and check the good equipment behaviour in these scenarios.

The ASN examined the vessel files transmitted by EDF and considers that they demonstrate a 30-year life for the 900 MWe reactor vessels.

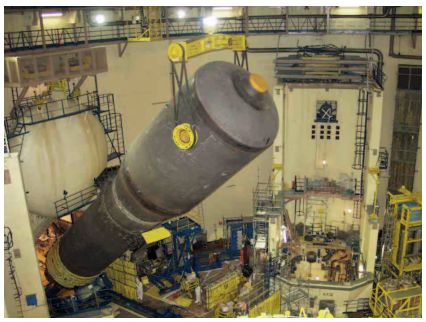
The ASN however thinks that EDF must still demonstrate the life of its vessels beyond 30 years. To do this, EDF provided answers to the questions asked following the session of the standing nuclear section (SPN) of the Central Committee for Pressure Vessels, held in 1999. These answers are contained in a summary file currently being examined and which will be assessed by the SPN's experts in June 2005.

Subsequent to this examination, the ASN will adopt a stance on the operating conditions for the reactors beyond 30 years. The ASN also considers that the generic file will have to be completed reactor by reactor with a "continued operability file". Each of these files will have to present the specific particularities of the vessel and the steps taken by EDF to guarantee its correct performance and will be examined by the ASN, which will then rule on the conditions on which operation of the vessel concerned may continue after the third ten-yearly outage.

3 | 5 | 4

Steam generators

The steam generators are exchangers of heat between the water of the primary system and that of the secondary system. The exchange surface consists of a tube bundle comprising between 3,000 and 6,000 tubes depending on the model, which confines the primary system water and exchanges heat without the primary and secondary fluids ever coming into contact.



Steam generator replacement at Tricastin 4

The integrity of the steam generator tube bundle is therefore a major safety issue, as any damage to the tube bundle can lead to a leak from the primary system to the secondary system. In addition, a break in it during an accident scenario would bypass the containment which constitutes the third confinement barrier.

13 of the first 900 MWe reactors are currently equipped with steam generators in which the tube bundles are made of non-heat treated Inconel 600 alloy. These tube bundles are today suffering from stress corrosion induced cracking (see § 3|5|2 above).

The steam generators are covered by a specific in-service surveillance programme drawn up by EDF and revised every 3 years. The current version of this programme was examined by the ASN in 2003 and accepted by DGSNR decision n° 030472 on 1 December 2003 (available on the website www.asn.gouv.fr). The tubes with major damage are plugged so that they can be removed from service.

Since the early 90s, EDF has also been conducting a programme to replace the steam generators with the most heavily damaged tube bundles. In 2004, the steam generators in Tricastin 4 were replaced, marking the half-way point for the steam generator replacement programme, as it was the thirteenth reactor in which the steam generator tube bundles made of non-heat treated Inconel 600 alloy were replaced. This programme will continue at the average rate of one reactor every year.

In addition to this in-service surveillance, the generators undergo a hydro-test every 10 years. During the reactor ten-yearly outage (see § 1|2|3), the primary system undergoes an overall pressure test which involves submitting the system to a higher pressure than its normal operating pressure. On the occasion of the second ten-yearly outages for the 900 MWe reactors, which began in 2002, major leaks were found on certain steam generators most heavily affected by stress corrosion. At the request of the ASN, EDF defined special monitoring and maintenance measures for these steam generators and proposed a programme of early replacement, leading to planning, at the latest during the third ten-yearly outage, of the replacement of the steam generators of the thirteen 900 MWe reactors still equipped with generators comprising tube bundles of Inconel 600 MA alloy. The 900 and 1300 MWe reactors equipped with steam generators with tube bundles made of Inconel 600 TT alloy will be the subject of a study and assessment programme in order to gain a clearer understanding of their behaviour during the hydrotest and determine how to eliminate the leaks observed during the tests.

The ASN submitted this programme as a whole to the Central Committee for Pressure Vessels (see chapter 2, § 2|1|5 b).

3 | 5 | 5

Steam isolation valves

The steam isolation valves (VIV) are one of the limits of the main secondary systems and are subject to pressurised equipment regulations.

During the checks conducted on the VIV in the 900 MWe reactors, EDF discovered manufacturing defects such as shrinkage cavities. After attempting to eliminate or repair these defects, EDF presented justifications to show that they did not compromise safety, in that they were as-manufactured and were not the result of an in-service degradation phenomenon, did not present the morphology of cracks and had not evolved during service.

These justifications were submitted to the experts in the standing nuclear section of the Central Committee for Pressure Vessels. Based on their recommendation, the ASN has accepted maintaining the valves as-is provided that EDF eliminates 2 defects in particular and conducts monitoring of pilot defects.

3 | 6

Containment

The containments undergo inspections and tests with the aim of checking that they indeed meet the safety requirements and in particular that their mechanical performance is satisfactory and guarantees correct tightness when the pressure in the reactor building is higher than atmospheric pressure, which can be the case in certain types of accidents. These tests, particularly at the end of construction and then during the ten-yearly outages, include a pressure rise-up to the inner containment design pressure.

The containments of the 900 MWe reactors consist of a single wall of pre-stressed concrete covered with a metal liner. Until now, the leak rates from these containments during the ten-yearly inspections were in conformity with the regulatory criteria. Their ageing will be examined in 2005 with a view to the 30-year safety review, the aim of which is to guarantee their tightness and mechanical strength for a further 10 years.

The containments of the 1300 MWe and 1450 MWe reactors comprise 2 concrete walls. A change in the leak rates from the inner wall of some of these containments, mainly under the combined effects of concrete creep and the loss of pre-stressing of certain cables, has been observed in recent years. Although account was taken of these phenomena at the design stage, they were sometimes underestimated. In an accident situation therefore, certain areas of the wall could find themselves under traction, a stress condition favourable to cracking and therefore leaks. To take account of this phenomenon, EDF has implemented a preventive repair programme aimed at restoring the tightness of the most heavily affected areas. On the basis of a recommendation of the Advisory Committee for nuclear reactors in early 2002, the ASN approved this strategy. This work is done at each ten-yearly outage. At the end of 2004, 17 out of 24 units had been dealt with. All the reactors concerned will have undergone the necessary maintenance work by 2011.

Finally, on 15 march 2004, during a meeting with the Spanish nuclear safety authority, the ASN presented French safety practices with respect to containment inspections and tests.

3 | 7

Protection against external hazards

3 | 7 | 1

Earthquakes

The buildings and equipment in NPPs which are important for safety are designed to withstand earthquakes of an intensity higher than all the earthquakes that have already occurred in the vicinity of the site, plus an additional safety margin. The rules for dealing with the seismic risk are regularly updated in order to take account of new data with retroactive application on a case by case basis during the periodic safety reviews. The conformity examinations are also an opportunity for detailed

checks. Although when compared with other countries France is not particularly seismic, considerable efforts are devoted to this subject by EDF and close attention is given by the ASN.

Updating of the design rules

After the 2001 update of the basic safety rule (RFS) concerning evaluation of the seismic levels to be taken into account on the plant sites (RFS 2001-01), the ASN in 2005 continued work into updating the RFS for the construction rules to be used to protect against the effects of an earthquake. The current rule dates from 1985 and the new data available in this area must be taken into account. This new "seismic design" RFS will detail the main steps in the design of the civil engineering structures with regard to earthquakes, from a statement of the basic principles underpinning this design, to determination of the spectra to be used for sizing of the equipment anchored to the civil engineering part. It will apply to all surface BNIs. The ASN's objective is that this rule be published by the end of 2005.

Seismic design reviews

Within the framework of the current safety reviews, the seismic design review in particular consists in updating the level of the earthquake to be taken into account, under application of RFS 2001-01.

For the 30 year safety review on the 900 MWe reactors, the ASN in particular asked EDF to examine the seismic design of the electrical buildings in some of the reactors of the CPY plant series (Gravelines, Saint-Laurent, Dampierre, Cruas, Tricastin) and of the turbine halls for the reactors of the CP0 series (Fessenheim, Bugey). These studies will during the course of 2005 conclude as to the possible need to modify the installations to increase the level of reactor safety.

With regard to the 20 year safety review for the reactors of the 1300 MWe series, EDF examined the seismic stability of the turbine halls in the P'4 type reactors (Cattenom, Nogent-sur-Seine, Belleville, Golfech, Penly) and the strength of the civil engineering structures in the electrical and the safeguard auxiliaries buildings in the P4 type reactor (Flamanville, Paluel, Saint-Alban). These studies revealed that the original design would guarantee that these reactors could withstand the safe shutdown earthquake reassessed in accordance with RFS 2001-01.

French seismic design review practice was presented to the Japan Nuclear Energy Safety Organisation (JNES) at a meeting in June 2004.

3 | 7 | 2 Climatic hazards

Flooding

Further to flooding of the Blayais site in December 1999, EDF undertook steps aimed at reassessment of the protection of the sites against external flooding hazards. This reassessment in particular comprises a revision of the maximum design flood level (CMS) and of the additional hazards which could lead to flooding of the sites, such as particularly heavy rain, water storage tank breaches, rising groundwater levels and reactor procedures in the event of rising water levels. A file was produced for each site and protection improvement works have been defined.

The work made necessary by the flooding risk review is in progress and EDF is committed to completing it by the end of 2007. In particular, the sluice gates protecting the pumping station at the Chooz nuclear power plant were installed, the building permit for a peripheral dyke to protect the Belleville nuclear power plant is currently being examined and the additional protection on the Bugey plant by building a peripheral wall is being examined by the ASN.

The ASN considers that the progress of studies and work is as expected. Nonetheless, for the particular case of the Tricastin NPP, the CMS review studies are not yet complete. Additional studies to check the strength of the infrastructures located on the Rhône river upstream of the plant are still required.

Finally, a working group was created to revise RFS I.2.e about handling of the flooding risk. The revised RFS will concern the choice of the hazards liable to lead to flooding of the site and how to characterise these hazards as a whole. It will apply to all basic nuclear installations.

Experience feedback from the summer 2003 heat wave

National and international experience feedback highlights climatic hazards, the scale, frequency of type of which leads to questions being asked with regard to the initial design of the facilities. Among the most recent events is the exceptional heat wave of summer 2003.

The lessons learned led EDF to implement a "climatic hazards" action plan concerning all of its activities (nuclear and conventional power generation, electricity distribution). This action plan was in particular applied to nuclear production and steps were taken in anticipation of summer 2004.

Generally speaking, the ASN considered that the arrangements implemented by EDF for summer 2004 were in line with the lessons learned from the 2003 heat wave and are designed to deal with another heat wave on a comparable scale.

With regard to the longer term, the resistance of nuclear power plants to climatic hazards is included in the programme for the forthcoming periodic safety reviews, the purpose of which will be to re-assess the levels of the hazards to be considered in the design of the facilities and, as applicable, to determine any equipment or operating changes to be examined.

Main points of the EDF action plan for nuclear power generation and the steps taken during the summer of 2004.

Modification of authorised limits for thermal releases into waterways concerned by the Bugey, Golfech and Tricastin plants.

The temperature limits on the cooling water releases in exceptional climatic situations as laid down in the inter-ministerial order of 11 June 2004 are 1 °C (Bugey) or 2 °C (Golfech and Tricastin) higher than the limits normally applicable. They take account of the temperatures observed during the summer of 2003, for which no effects on the environments concerned were identified.

For each of the three sites, operation in the new temperature range is dependent on the need for availability of the generating capacity of all or part of the site reactors to guarantee the safety of the electricity transport grid or maintain electricity supplies to the country. Before using this option, EDF must prove that it is necessary and inform the authorities accordingly. Increased measures to monitor the impact of discharges into the environment are also stipulated.

These exceptional measures were not used in 2004.

Adaptation of facility operating and maintenance methods to the high summer temperatures.

This measure led to preventive servicing, maintenance and inspection of the ventilation and cooling systems prior to the summer of 2004.

Installation of additional air-conditioning systems for the more vulnerable premises.

These arrangements were implemented during the summer of 2004, but were used less extensively than in 2003, given the more clement climatic conditions.

Installation by EDF of an alert system for the entire nuclear power plant fleet, based on observed temperature criteria.

This alert system comprises four levels: "Watch", "Vigilance", "Pre-alert" and "Alert". It may lead to deployment of the additional cooling resources previously mentioned, or even reactor shutdown in certain cases.

In 2004, EDF was not forced to shutdown any reactors because of meteorological conditions.

3 | 7 | 3

The fire and explosion risks

Fire risk

The fire risk in EDF's nuclear power plants is handled using the principle of defence in depth, based on:
• prevention, which primarily consists in limiting the quantity of combustible material present in the premises and in identifying and analysing the fire risks, in particular a fire permit having to be granted and protective measures taken, for all work likely to initiate a fire;
• the design of the installations, which should prevent a fire spreading and limit its consequences. This is in particular based on the division of the facility into sectors designed to contain a fire within a given perimeter, and on protection of the equipment providing redundant safety functions;
• firefighting, which should enable a fire to be tackled and extinguished within a time compatible with the duration of the fire and the fire-resistant capability of the fire sectors.

Prevention

With regard to prevention, EDF has implemented its new system of "fire permits" in the plants. The ASN noticed improvements in 2004 in the drafting of the fire permits and their actual use in the plants. It does however feel that the steps taken must be actively pursued, in particular with respect to risk analysis and identification and implementation of protective measures.

Furthermore, the studies concerning the identification of areas storing fire loads during reactor shut-down periods requested by the ASN in 2002 are currently being finalised by EDF and should be ready by the end of 2005. The ASN checked that the degree of progress of this subject in 2004 was satisfactory.

Design

With regard to design, EDF is continuing to deploy the fire action plan (PAI), to ensure the conformity of and improve fire protection for the 900 and 1300 MWe reactors. During the 2004 inspections and the six-monthly meetings with EDF, the ASN checked correct implementation of the PAI and compliance with the completion dates set for the end of 2005 in the decision of 12 September 2000.

For the 900 MWe plant series, for which the safety review corresponding to third ten-yearly outages is under way, the ASN asked EDF to examine any additions to the current design:
• through the use of the results of probabilistic fire safety studies, to supplement the deterministic studies,
• by assessing the existing design margins of the fire-resistant parts, with respect to the fire durations estimated in the premises.

In addition, the 31 December 1999 order sets environmental protection requirements (retention of fire fighting water, containment of toxic fumes, etc.)... Under application of this order, EDF submitted risk assessments and proposed improvements to the design of its installations. The ASN reviewed these answers in 2003 with the help of its technical support body and asked for additional studies by the end of 2004.

Firefighting

With respect to firefighting, the ASN asked EDF in May 2001 to conduct an overall review of its policy. In reply, EDF has developed a new doctrine which was implemented from July 2003. The ASN duly noted this modification and considers that it offers a better answer to its requirements in fire-fighting improvement areas. It reckons in particular that the part about increased skills is just as important as that concerning organisational improvements.

At the request of the ASN, EDF further reinforced its doctrine in 2004, in particular by aiming for faster activation of the response teams as of the fire alarm, rather than after the fire has been confirmed, which on certain sites requires drafting of a fire detection improvement plan. This plan is being gradually implemented as of 2004 and should be completed by the end of 2005.

In 2005, the ASN will check what EDF has done to deploy this new doctrine in the plants. It will also check that the other aspects of the action plan are actually implemented in the plants.

During the inspections conducted in 2004, the ASN concentrated in particular on the time taken for the EDF on-site response teams to reach the location of the fire outbreak, on personnel involvement in firefighting and on implementation of a response organisation conforming to this new doctrine. The ASN observed that the response time objectives are not always met during the exercises, that the personnel's attitude to a simulated fire drill is not always appropriate and that the response procedures for a real fire breakout or an exercise were not always followed. However, on those plants for which rapid deployment of the response teams is now effective, significant progress was observed.

During the inspections in 2004, the ASN also checked monitoring of the firefighting staff (EDF employees and outside fire brigade) to radiation exposure. The absence of passive or operational dosimetry during the firefighting work was observed several times. In reply, EDF has begun to examine the problem and its revised firefighting doctrine will contain means of ensuring that exposure of the participants is monitored. This subject will be examined by the ASN.

Experience feedback

Following the fire in Cattenom 2 in May 2004 (see box), the ASN asked EDF to examine the possibility to reinforce monitoring of the electrical power cables in the Cattenom plant, and on all the plants in the French fleet. The file is currently being studied by EDF.

Explosion risk

On the basis of the conclusions of the 2002 inspections on this subject, the incidents and the anomalies detected in the plants, the ASN asked EDF to improve the way in which the risks of explosion of internal origin are taken into account. It in particular asked EDF to look again at the existing systems for protection against the effects of an explosion of internal origin as part of the periodic safety review of the 900 MWe plant series on the occasion of the third ten-yearly outages and to initiate a similar approach for the other plant series.



Deteriorated cables following the fire at the Cattenom nuclear power plant

The 16 May 2004 fire in the Cattenom nuclear power plant

On Sunday 16 May 2004, at around midday, a fire broke out in the non-nuclear part of reactor n°2 in the Cattenom nuclear power plant, in an electrical power cables opening between the turbine hall and the electrical building.

The I4D incident response procedure was applied for the first time in an emergency situation and enabled the reactor to be safely shut down. This procedure requires isolation of the electrical channel concerned by the fire to avoid erroneous measurements being transmitted or incorrect orders being sent due to malfunction of the cables subjected to the heat of the fire. The reactor was then operated using equipment supplied by the other electrical channel which is specially protected for this purpose.

In terms of the response, the immediate dispatch of the power plant's firefighting teams after the electrical fault alarms appeared and the intervention of the fire brigade enabled the fire to be brought under control. The fire was declared by the fire brigade to be extinguished after 2 hours 30 minutes on the electrical building side and 6 hours on the turbine hall side, after a check to ensure that there were no residual fires.

The origin of the fire outbreak was overheating of an electrical power cable supplying the steam cooling system pumps as it left the turbine hall. The temperature rise, amplified by the confined space, initiated combustion of the cable, damageing the other electrical cables following the same path.

The assessment conducted by EDF subsequent to the event concluded that the cable that initiated combustion was under-sized with respect to the technical characteristics of the pumps, which are particular to the Cattenom nuclear power plant.

Since then, two cables have been installed to replace the damaged power cable and provisions made to monitor the temperature of these cables on all reactors in the Cattenom nuclear power plant. The sizing of the high-power electrical cables for the entire French nuclear power plant fleet is currently being studied by EDF at the request of the ASN.

This event had no consequences for the personnel or the environment and all safety functions were guaranteed.

This incident was classified level 1 on the 7-level international nuclear events scale (INES).

The methodology developed by EDF, and in particular application of this methodology to the risks of hydrogen-related internal explosion in the buildings of the nuclear island, will be reviewed in 2005 by the Advisory Committee for reactors.

3 | 7 | 4 Other hazards

Lightning

In accordance with the ASN decision of 15 October 2002, EDF submitted the "lightning" studies, which determined the work needed for conformity with the ministerial order of 31 December 1999 and carried out the conformity work in the plants concerned (Penly and Cruas) by 31 December 2004.

The ASN notified EDF of its additional requests, including a study of the impact of the lightning risk on the safety of the facilities. However, the ASN felt that the lightning risk studies produced were of good quality and were drafted in accordance with the applicable standards.

Heavy loads carried over the reactor vessel

During exceptional maintenance operations such as replacing the vessel head and more conventional maintenance operations such as "tightening-loosening" vessel studs, handling of associated ele-

ments may require them to be carried over the vessel with the core loaded. These operations may also take place with the containment's equipment hatch open. The general operating rules (RGE) prohibit fuel handling when the reactor building is not correctly isolated from the outside.

At the request of the ASN, EDF conducted a fleet-wide analysis of these cases of equipment being carried over the loaded core vessel, whether or not the vessel head is in place. The analysis looked at ways of limiting these movements and, for those which remain necessary, how to prevent a load dropping and if it did, minimising its consequences.

The conclusions of this analysis led EDF to modify its practices to limit these handling situations and to submit a proposal to the ASN for modification of the general operating rules, particularly in order to define containment configurations for which these load movements remain authorised. This file is currently being examined.

Finally, while this matter was being dealt with, the issue of the conformity to the current lifting equipment regulations was raised, in particular with respect to worker protection. This subject was covered by the Directorate for energy demand and energy markets (DIDEME) of the General Directorate for energy and raw materials (DGEMP), jointly with the DGSNR.

3 | 8

Other subjects

3 | 8 | 1

Pressurised equipment

Owing to the energy that they could release in the event of failure, regardless of the possible risk related to the fluid (liquid, vapour or gas) that would then be released, pressurised equipment entails risks that must be controlled.

This equipment (containers, exchangers, piping, etc.) is not solely limited to the nuclear industry and is present in numerous industries such as chemical industry, oil processing, papermaking, refrigeration industry. It is therefore subject to regulation set by the minister for industry, who imposes the requirements with a view to guaranteeing its safe manufacture and operation.

Application of the regulations concerning the operation of pressurised equipment in nuclear reactors is monitored by the ASN. In particular through actions on the site, this consists in checking that the operator, who has prime responsibility for the safety of its equipment, applies the requirements imposed upon it. It must in particular:
• collect and update the information needed for safe operation of its equipment;
• maintain, monitor and repair as required to ensure that the safety level of its equipment is as required, and conduct the periodic inspections at the specified intervals on the relevant equipment;
• remove from service equipment for which the safety level is impaired;
• install and maintain protective devices designed to ensure that the maximum temperature and pressure limits are not exceeded during operation;
• submit the relevant equipment to periodic re-qualification (inspection, testing and check on safety accessories) and to inspections following significant repairs. These operations must be carried out by duly qualified independent bodies.

The ASN also examines any request for waiver to the regulations and supervises the qualified bodies interventing in the NPPs. It is represented on the Central Committee for Pressure Vessels and in this respect takes part in drafting and in revising the regulations applicable to pressurised equipment.

On 9 August 2004, an accident on a steam line killed 5 people and injured 6 in the Mihama NPP in Japan.

The line, which was located in the reactor 3 turbine hall, was leaking steam while the workers were preparing for the maintenance outage scheduled for 5 days later. The reactor was shut down and no radioactivity was released.

The Mihama plant comprises 3 PWRs. Reactor n° 3, with a power output of 826 MWe, has been operated since 1976 by Kansai Electric Power Company (KEPCO).

The accident occurred on a reheater condensates drain line (see schematic diagram in § 1|1|1). This line carries steam at a temperature of 140 °C and a pressure of 9.3 bar, at a flow rate of 1700 t. per hour. It is made of carbon steel, has an outside diameter of 560 mm and an initial thickness of 10 mm, for a minimum calculated thickness of 4.7 mm.

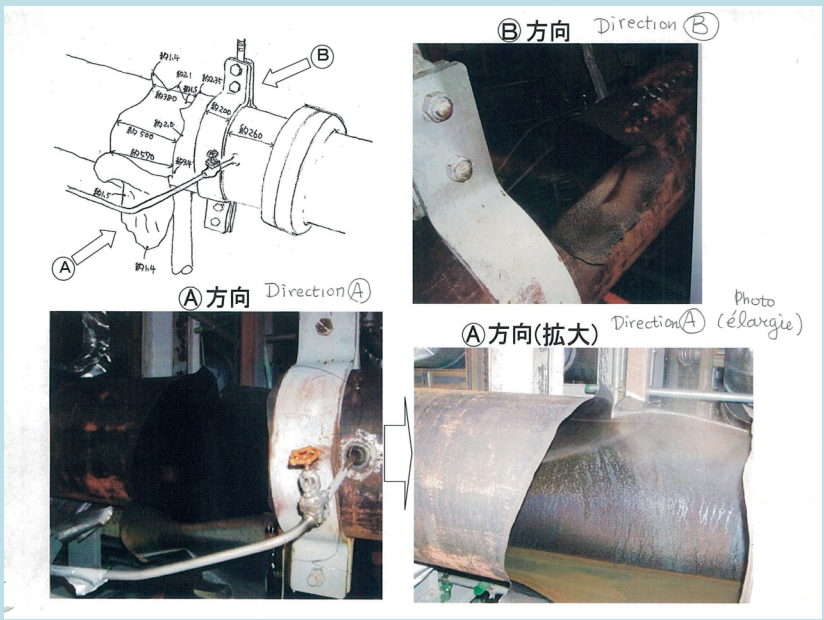
The break occurred downstream of a diaphragm in a zone where the steam flow is highly turbulent. The combination of erosion (mechanical wear due to the turbulence of the flow) and corrosion (caused by a chemical reaction between the steel and the steam) caused gradual thinning of the pipe in this zone. The loss of thickness directly generated a loss of pipe resistance to the pressure of the steam circulating through it, until the break occurred. These two phenomena taken together leave characteristic traces on the metal subjected to them, traces that were observed on the inner surface of the pipe. The thickness of the pipe at the location of the break was 1.4 mm.

According to the Japanese nuclear safety authority, the broken zone should have undergone thickness checks in application of the rules adopted by the operator in 1990 for pipes of this type. However, the thickness measurements were never taken on this zone because it had been omitted from the list of zones to be checked and neither the operator nor the contractors performing the inspections in the plant checked whether the list was complete. The Japanese nuclear safety authority concluded that there was a failure in quality assurance and maintenance management.

In France, the pipes of this type, which do no carry radioactive fluid, are subject to the regulations applicable to pressurised equipment. These regulations are the responsibility of the minister for industry and effective application in basic nuclear installations is verified by DRIRE staff.

This type of steam line is not specific to nuclear facilities. The ASN will pay attention to ensure that the measures taken by EDF to monitor these pipes in operation are sufficient and effective in preventing the risk of accident.

The carbon steel corrosion-erosion phenomenon, which seems to be the underlying cause of the Mihama accident, has been known about since the early 1970s. For its own plants, EDF developed a maintenance code, called BRT-CICERO, which anticipates the consequences of these phenomena in high-energy pipes, by modelling them and using a predictive estimation of the residual thicknesses of the pipes concerned. On the basis of these results, targeted ultrasonic thickness checks are carried out during reactor outages. Depending on the results of these checks, repairs are made, or the sections that so require are replaced.



Steam pipe at the Mihama nuclear power plant after the accident

3 | 8 | 2

Risks in the workplace

Nuclear power plants are the source of a number of risks to the workers, which are not always linked to the nuclear aspect of the activity. These "conventional" risks are for example linked to the electrical installations, the equipment containing pressurised gas or steam, to the hydrogen systems (explosion risk), to the nitrogen systems (anoxia), to work at height or to handling of heavy loads.

These risks must be dealt with in the first place by the operator, through application of the regulations in force in any industry, through analysis of the risk inherent in the equipment or the activities, and through implementation of appropriate technical, organisational and human measures.

It should be noted that the steps such as to guarantee personnel safety may in certain cases contribute to nuclear safety: this is for example the case with preventing the risk of explosion, of pressurised equipment bursts or falling loads.

Verification of application of these regulations is the job of "labour" inspectors who, in the case of nuclear power plants, operate within the DRIRE and for the most part are inspectors of basic nuclear installations. The inspections in this area are carried out in accordance with the directives of the Directorate for energy demand and energy markets of the General Directorate for energy and raw materials (DGEMP).

4 Radiation protection and environmental protection

4 | 1

Radiation protection of persons working in nuclear power plants

In a nuclear power plant, ionising radiation sources have various origins:
- the fuel,
- equipment activated by the neutron flux,
- the particles resulting from reactor primary system corrosion and conveyed by the primary fluid.

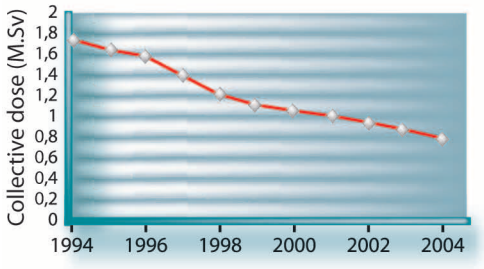
About 80% of worker dosimetry is thus received during maintenance carried out during outages.

EDF policy

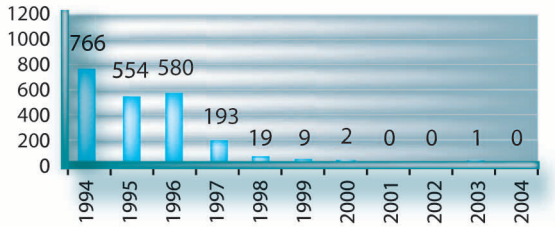
In 1999, EDF undertook to improve radiation protection and establish a level of requirements for it, comparable to that for safety, in particular by:
- defining a new radiation protection organisation,
- setting up forums for exchanges and decision-making,
- creating a radiation protection reference framework designed to improve control of regulatory aspects and set up a framework various subjects linked to radiation protection (radiological cleanness, optimisation, metrology, and so on).

This approach, which has been under development for 6 years and that the ASN considers adequate for remedying the problems encountered in the plants, led to a significant reduction in worker dosimetry, in particular collective dosimetry, for which the overall results are illustrated in the following graphs.

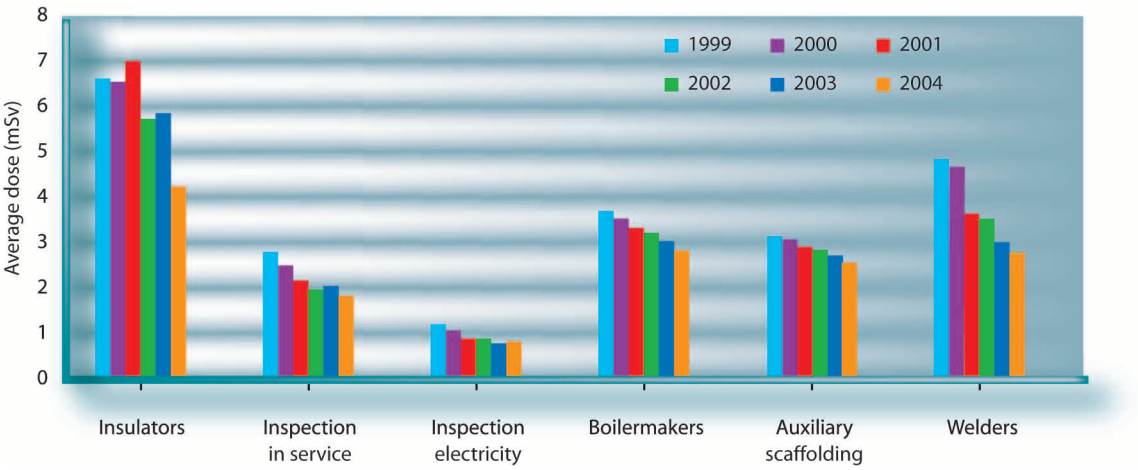
Mean collective dose per reactor (EDF data)



Number of persons (EDF + contractors) who received a dose higher than 20 mSv (EDF data)



Evolution of average individual dose according to categories of workers involved in reactor maintenance (EDF data)



ASN assessment and actions taken

In 2004, the ASN finalised the actions to assess radiation protection at EDF initiated in 2002, through:
• an examination by the Advisory Committee for nuclear reactors of the steps taken by EDF to improve radiation protection in the plants,
• a campaign of inspections in 2003 on the subject "Radiation protection management - Application of the ALARA approach", which the ASN reviewed in 2004,
• more generally, maintenance site inspections conducted during reactor outages.

The lessons learned from these assessment and inspection actions led to requests which were submitted to EDF. In general, the ASN considers the efforts made by EDF must be continued, even accelerated, for the most exposed categories of workers (insulators, welders, boilermakers and ancillary professions) as well as in fields such as plant support by head office departments, control of regulatory requirements by the plants, effective implementation in the field of appropriate radiation protection measures, with the corresponding checks, and harmonisation of practices between plants.

In order to meet these requests, EDF initiated updating of its radiation protection reference framework applicable to the 2005 outages campaign as well as of the cross-functional analyses, the outcomes of which are expected for the end of 2005.

At the same time, the ASN has initiated an internal approach which, at the end of 2004, enabled to develop new methods for inspecting PWR radiation protection.

Particular points

In 2004, the ASN authorised EDF to experiment with injecting zinc into two reactors. This is part of an overall process to reduce collective dosimetry based on changes to the chemistry of the primary fluid in order to reduce the quantity of radioactive particles in the reactor systems. This operation was identified by EDF, in particular through foreign operating practices, as a means of reducing primary system contamination due to radioactive cobalt deposited on the walls of the systems.

The Tricastin irradiation incident, which occurred on 11 March 1999, and that of Cruas, with less serious consequences, which occurred on 15 October 2001, as well as the generic request by the ASN, led to improvements to the prohibited area access process applied by EDF. However, the studies involved in setting up the physical modifications to secure access to the reactor pit in the event of high dose rates, as requested by the ASN, were not completed in 2004. EDF will have to commit itself to this point in 2005.

In 2004, the ASN took part in the 4th European seminar of the ISOE programme (Information System on Operational Exposure) created by the OECD in 1992. This seminar was an opportunity for the operators and nuclear safety authorities of the participating countries to discuss management of worker radiation protection in nuclear power plants.

Incidents

A specific analysis of declared significant radiation protection events is presented in the Incidents chapter which gives an analysis per origin and per topic.

4 | 2

Releases from nuclear power plants

4 | 2 | 1

Revision of the discharge licences

Under application of decree n° 95-540 of 4 May 1995 concerning discharges of liquid and gaseous effluents and intake of water by basic nuclear installations, the ASN in 2004 continued to examine applications for renewal of the water intake and non-radioactive liquid effluent discharge licences for nuclear power plants. These licences, issued at prefectural level under the previous regulations in this respect, comprise a stipulated validity limit. At the request of the DGSNR, the applications submitted by EDF concern water intake and all discharges, be they liquid or gaseous, radioactive or non-radioactive. These files are subject to a public enquiry.

The renewals currently being examined were presented by EDF as soon as the previous licences reached their expiration dates. The ASN's goal is for most of the existing licences to be reviewed in the next few years, in order to harmonise the specifications applicable to the various sites. In particular, for sites where the authorisation deadline was imminent, the ASN fixed deadlines for the submission of operator application dossiers by a decision of 4 July 2001. With regard to the other nuclear power plants, submission of the dossiers is staggered until 2007.

These renewals enable the ASN to group in a single document all the requirements previously specified by different ministerial or prefectural orders, according to the type of discharge concerned. These requirements in particular specify the quantities, concentrations and methods for monitoring the pollutants likely to be found in the discharges and in the environment, in accordance with the interministerial order of 29 November 1999. In this context, the ASN decided to modify the terms and conditions regulating discharge according to the following principles:

• with regard to radioactive discharges, the real discharges from NPPs are constantly falling and are well below current limit values, so the ASN is reducing these limit values. For each of the 900 and 1300 MWe plant series, it has set new limit values based on experience feedback about actual dis-



Rainwater sampling

charges, while taking account of contingencies related to usual reactor operations; the discharge limits were thus divided by a factor of from 1 to nearly 40, depending on the parameters, for current fuel management and were raised by a factor of 1.25 for liquid tritium discharges, based on the assumption of future management of fuel with a high burnup fraction;

• with regard to non-radioactive substances, the ASN decided to improve regulation of discharges in order to plug the gaps in the prior requirements.

4 | 2 | 2

Procedures carried out in 2004

In total, eleven discharge licensing orders were published in 2004 for the French nuclear power plants in operation.

Complete revision of the discharge and water intake orders

In 2004, examination of the renewal application dossiers from the Cattenom and Nogent-sur-Seine power plants continued and was completed.

Since 23 June 2004, the Cattenom nuclear power plant has been covered by a new order authorising it to continue to take in water and discharge effluent. It should be noted that the licence renewal application dossier submitted by EDF was extensively debated, in particular with a public enquiry between September and October 2003. Germany (in particular the Saar and Rhineland-Palatinate Lander) and Luxembourg were also consulted. The opinions expressed during these consultations were taken into account in the order and in particular limit values which were more restrictive than those requested by EDF were set (liquid tritium and chlorides for example).

The Nogent-sur-Seine nuclear power plant is covered by a new order dated 29 December 2004, authorising it to continue with water intake and discharges. The public enquiry into the application ran from 9 June to 9 July 2004 and led to few observations being made. To enable the operator to improve anti-scaling treatment of its cooling towers as quickly as possible by injecting sulphuric acid and polyacrylates, a specific order was signed on 15 October 2004 on the basis of a dossier submitted to the public enquiry. This text was abrogated after its requirements were incorporated into the order of 29 December 2004.

In May 2004 and December 2004 respectively, the Golfech and Dampierre power plants submitted an application for renewal. The application from the Golfech power plant is currently being examined and the public enquiry will be held in the first half of 2005. The acceptability of the application from the Dampierre power plant is currently being examined.

It should be noted that since investigation of the application from the Cattenom nuclear power plant, the EDF licensing applications involve an increase in liquid tritium discharges, that is linked to future fuel management. In this respect, and for the plants concerned, EDF is submitting dossiers for France's consultation of the European Commission under the terms of article 37 of the Euratom treaty. For the Cattenom and Nogent-sur-Seine NPPs, the recommendation of the European Commission was favourable, in particular given the very low radiological impact of the requested increase.

Partial revisions

Treatments related to the microbiological risk

The microbiological risk is dealt with in § 4|4|1.

Investigation of the dossiers covering effluent discharges resulting from biocide treatment to prevent the spread of amoeba in the Bugey, Chooz, Dampierre, Golfech and Nogent-sur-Seine NPPs ended with the signing of orders on 26 April 2004 for Bugey, Chooz and Nogent-sur-Seine and 27 April 2004 for Dampierre and Golfech.

Given the legionella concentrations measured in the cooling systems in the Chinon nuclear power plant, a dossier requesting licensing of effluent releases resulting from continuous monochloramine treatment was submitted by the operator, in order to replace the occasional treatment using chlorine. This application is currently being examined.

Thermal discharges

To take account of the lessons learned from the summer 2003 heat wave, Electricité de France sent the ministers responsible for industry and the environment applications for modification of the thermal release conditions applicable to the Bugey, Golfech and Tricastin power plants. These applications were examined during the first half of 2004. The orders of 11 June 2004 authorise the Bugey, Golfech and Tricastin plants to resort to thermal releases in the event of exceptional climatic situations (see § 3|7|2).

Particular problems

The water intake and effluent discharge licensing order for the Belleville NPP was renewed on 8 November 2000. Failure to comply with several requirements of this order was highlighted during the first year of application of this text. On receipt of formal notice from the ASN dated 21 December 2001, the operator in July 2002 submitted an application for modification of its licensing order. The application was submitted to the public enquiry in early 2004. However, examination of this application showed that no impact assessment concerning the NATURA 2000 sites had been carried out. Some of the sites had in fact been classified after the dossier had been declared acceptable by the ASN. The ASN nonetheless considered that the procedure could not be continued. At the same time, the operator had changed its operating methods and thus con-

siderably reduced its releases of copper and zinc, enabling it on the whole to meet the release limits since February 2003.

At the Saint-Laurent-des-Eaux nuclear power plant, during an unannounced inspection in 2003, the ASN inspectors noted that certain requirements of the 2 February 1999 water intake and discharge order were not met. The discrepancies lay in failure to abide by the liquid effluent sodium, sulphates, total phosphorus and chlorides concentration values prior to release. The ASN consequently formally notified the operator in November 2003 that it must adhere to the discharge limit values set for the parameters in question or, failing which, submit a duly argumented application for modification of the release licence in particular with regard to the environmental impact. The operator therefore submitted an initial dossier in January 2004, but considered to be incomplete. Therefore, a new dossier was submitted in October 2004. The acceptability of this dossier is currently being examined.

Examination of management of associated radioactive and non-radioactive effluent

In 2004, the ASN decided to consult the Advisory Committee for nuclear reactors concerning the management of radioactive effluent and of certain non-radioactive effluent discharged by the French nuclear power plants in operation and concerning the various ways of improving the situation. The Advisory Committee's recommendation is expected during the first half of 2006.

4 | 2 | 3

Radioactive discharge values

Discharge values in 2004

Every month the operator communicates its discharge results to the ASN. These data are regularly examined in the light of reactor operation during the period considered. Anomalies detected give rise to requests for complementary information from the operator.

The 2004 results concerning radioactive effluent discharges are presented in the following graphs. Per pair of units, the "liquid radioactive discharges" graph presents the 2004 discharges of liquid tritium and other than liquid tritium (carbon 14, iodine 131, nickel 63 and other beta and gamma emitting radionuclides). Per pairs of units, the "gaseous radioactive discharges" graph presents the discharges of gases (carbon 14, tritium and rare gases) and halogens and aerosols (iodines and other beta and gamma emitting radionuclides).

The gas discharge activity of the Nogent-sur-Seine nuclear power plant in 2004 is higher than the average with respect to two parameters:
- for the "halogens and aerosols" parameter, this is due to higher iodine discharges at the end of 2004. The origin of this high iodine activity is currently being investigated;
- for the "gas" parameter, this is due to higher discharges of rare gases, which are the consequence of a unit outage at the end of 2003 on the site.

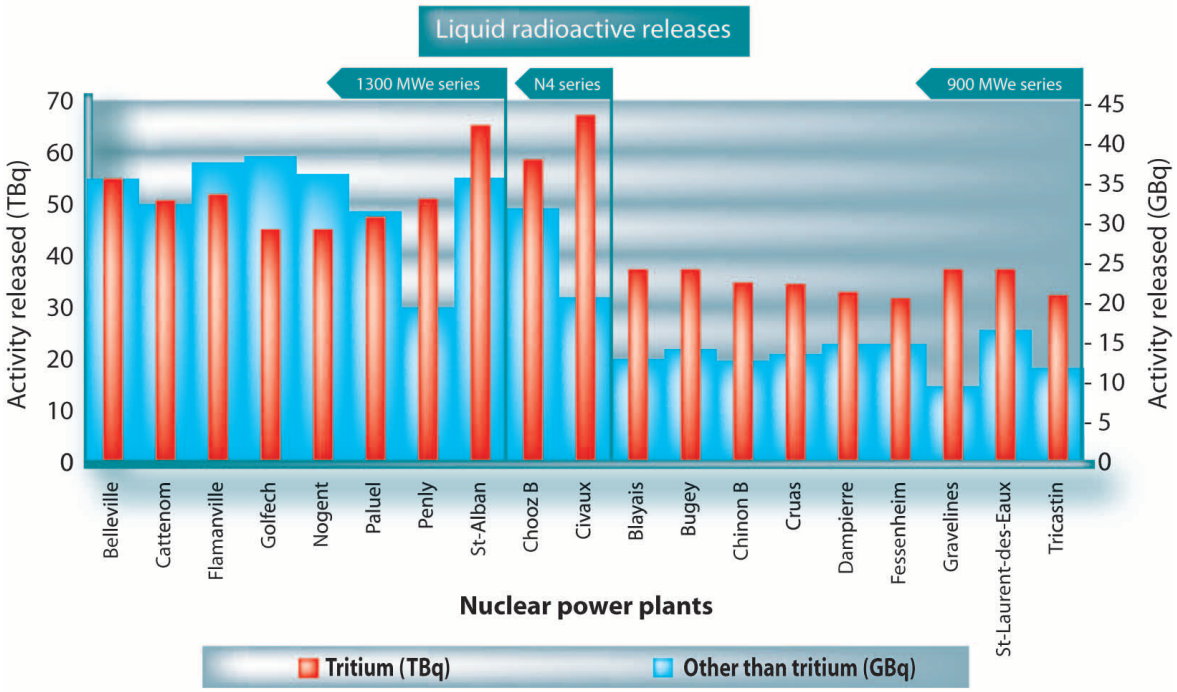
Radiological impact of discharges

The calculated radiological impact of the maximum discharges in the EDF application dossiers for the most exposed population reference group remains well below the acceptable limits.

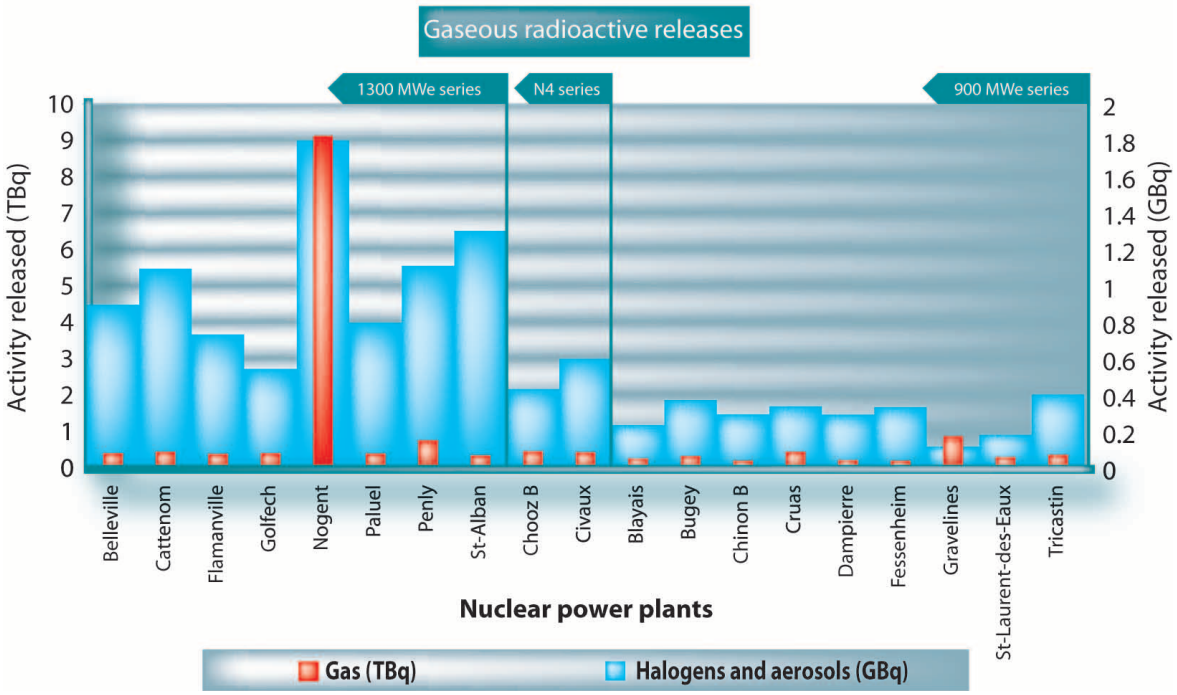
The annual effective dose received by the population reference group given in the EDF discharge and water intake licence applications is estimated at between a few microsieverts and a few tens of microsieverts per year.

For example, the annual effective dose corresponding to the values requested by EDF for renewal of the discharge and water intake licences for the Cattenom nuclear power plant was evaluated at

Source: regulatory registers



Source: regulatory registers



3.1 mSv/year. As the actual discharges in 2004 from the Cattenom power plant were lower than the stipulated discharge limits, the annual real effective dose for 2004 is lower than this value.

4 | 3

Technological waste management

Following the 10 November 2000 decision aiming at improving the storage conditions for nuclear power plant very low level waste (VLL), 14 of the 19 plants commissioned VLL waste storage facilities meeting the ASN's requirements. For 5 of them (Belleville, Cruas, Golfech, Gravelines and Tricastin), a modification of the BNI boundary was necessary in order to be able to include these facilities.

The time involved in the regulatory procedure, including a public enquiry, meant that the ASN had to postpone commissioning of these facilities. At the end of 2004, EDF was authorised by decree to modify the BNI boundary of 5 sites. The time needed to position the waste in these already constructed facilities was 3 months.

The ASN monitored the progress of the studies requested from EDF so that the design and operation of the nuclear power plant waste storage or processing buildings could eventually be improved. The safety analyses concerning these buildings were in particular submitted and are currently being examined by the ASN.

Finally, in 2004, the ASN conducted a series of inspections into waste management in the nuclear power plants. The lessons learned from these inspections will be examined by the ASN, in particular with regard to practices in this area, and will guide subsequent monitoring actions.

4 | 4

Protection against other risks and nuisances

4 | 4 | 1

The microbiological risk

Part of the energy produced by a NPP is evacuated into the watercourse or the sea via a cooling system, either directly or, for some of the plants located alongside a river, after cooling in the cooling towers. This latter device is a means of evacuating some of the heat into the atmosphere, thereby reducing the thermal dicharges into the river.

The issue of the development of micro-organisms in the systems of power plants with cooling towers has been studied by EDF for a number of years now. It is the subject of periodic exchanges on the basis of EDF studies particularly with the Directorate General for Health (DGS) and the ASN, and is periodically examined during the sessions of the French high public health council (CSHPF).

Amoebae

The heat exchanger, known as the condenser, which cools the secondary system via the river, is made of stainless steel or titanium for the more recent exchangers, or brass for the older versions. Stainless steel and titanium were in particular chosen when the brass models were replaced, because they entail lower levels of metal release through wear than brass, which generates releases of copper and zinc. The Bugey, Chooz, Dampierre (1 and 3), Golfech, Nogent and Civaux plants are fitted with stainless steel or titanium condensers, while Belleville, Cattenom, Chinon, Dampierre (2 and 4) and Saint-Laurent still use brass, and those at Cruas are "mixed", half brass, half titanium.

The amoebae do not develop in systems equipped with brass condensers, as this is a material that prevents them developing because of the copper toxicity for these micro-organisms.

Owing to the development of amoebae in their cooling systems, and in order to meet the limit value set by the health authorities of 100 Nf/l (amoebae of the *Naegleria Fowleri* type per litre) in the natural environment, the Bugey, Chooz, Dampierre (reactors 1 and 3), Golfech and Nogent plants use monochloramine treatment, while the Civaux plant for its part uses UV treatment of the released cooling water owing to the Vienne river's greater sensitivity to chemical treatment releases.

These measures enable the limit of 100 Nf/l to be met. For their part, the discharges are regulated by interministerial orders which limit the quantities of products released and require periodic forwarding of measurement results to the ASN and to the health authorities.

The ASN also asked EDF to look for alternatives to chemical treatment.

Legionella

Legionella can develop in all cooling systems of nuclear power plants equipped with cooling towers, but less so when chemical treatment of amoebae is used.

The legionella concentrations in the cooling system in question are therefore variable and depend on a variety of factors (time of the year, use of anti-amoeba treatment, etc.). They can be significant, up to several hundred thousand colony forming units per litre (CFU/l), or even more than a million for those plants with no anti-amoabe treatment: Belleville, Cattenom, Civaux, Chinon, Dampierre (reactors 2 and 4) and Saint-Laurent. They are less than a hundred thousand CFU/l on the other plants concerned: Bugey, Chooz, Dampierre (reactors 1 and 3), Golfech and Nogent.

The ASN and the DGS reckoned that it was necessary to adopt a position concerning the concentration limits to be followed in the cooling system of the secondary systems of power plants with cooling towers. The ASN therefore required EDF not to exceed certain legionella concentration levels in the secondary system cooling systems.

When setting these levels, account was taken of the results of EDF studies in which, for the same concentration in the systems, the large cooling towers (about 150 metres high) generate concentrations in the environment 50 times lower than the towers normally encountered in ICPEs (installations classified under environmental protection regulations). This value was reduced to 5 in the case of the Chinon nuclear power plant, where the cooling towers are of medium size (28 metres). The value to be met for the legionella concentration in the cooling systems of the secondary systems is therefore 5.10^6 CFU/l for those power plants with large cooling towers, and 5.10^5 CFU/l for Chinon. The measurement frequencies are tailored to the measured concentrations.

For systems other than the secondary system cooling system (air-conditioning for example), application of the legal current threshold for ICPEs is required.

The effect of this request was to implement chlorine treatment of the Chinon power plant stipulated by order of the prefect of the Indre-et-Loire. The value of 5.10^5 CFU/l could not be met solely using the preventive measures usually employed by EDF: elimination of the bacteria attachment zone, or biofilm, by mechanical cleaning. For the other plants, the value of 5.10^6 CFU/l is met through these measures alone.

The purpose of the limits mentioned above is to improve the current situation but they are nonetheless provisional. Beyond this position, an expert appraisal of the situation is necessary, in particular to allow an assessment of the various studies, especially the health studies, conducted by EDF. The DGS, DGSNR, and the Directorate for the Prevention of Pollution and Risks at the Ministry for Ecology

and Sustainable Development referred the matter to the French agency for environment health safety.

4 | 4 | 2

Prevention of water pollution

In order to comply with the requirements of the order of 31 December 1999 setting the general provisions to be met by BNIs with respect to protection of the environment, EDF developed specific studies into the prevention of accidental pollution of water by products hazardous to the environment, or by water used to extinguish a fire.

In particular, for large volume tanks storing radioactive effluent (average of 750 m^3 per tank) EDF in 2002 requested a waiver to article 14 of the order of 31 December 1999, for calculating the volume of holding back areas containing several tanks and designed to contain any leaks from these tanks. This waiver was not granted by the ASN, which asked EDF to look again at its studies. EDF thus proposed new solutions, in particular based on the creation of a retention area of a volume equal or close to the volume of the largest tank, plus a more distant retention area such as to ensure volume conformity with article 14 of the order. This remote volume consists either of a containment tank, or by pooling of the retention areas associated with groups of tanks that are geographically distant, or by the rainwater networks fitted with shutoff devices or associated with lifting pits. The arrangements proposed by the operator were considered to be adequate by the ASN which, in its decision n°0624/2004 of 17 August 2004, asked that conformity work be completed before 15 February 2006.

Finally, EDF submitted detailed dossiers for each site concerning installation of retention areas to recover fire extinguishing water: these dossiers are currently being examined by the ASN.

4 | 4 | 3

Noise

The impact of the facilities in terms of noise is regulated: the difference between the ambient noise level measured when the facility is operating and the residual noise level measured when it is shut down should not exceed 3 to 4 dB.

EDF carried out noise measurements on all the sites in order to comply with article 48-II-2 of the order of 31 December 1999. Measurements were taken at the end of 2004 by an independent firm of experts at the request of the ASN around the Bugey, Golfech, Chinon, Civaux, Dampierre and Saint-Laurent plants. The results of these measurements are consistent with those obtained by EDF on the Bugey, Golfech and Saint-Laurent plants, but require closer analysis for Chinon, Civaux and Dampierre.

EDF also transmitted the technical and economic soundproofing studies for the Bugey and Civaux plants. These initial studies lead EDF to conclude that it is technically inconceivable for these plants to be brought into conformity with the limits set by the order of 31 December 1999. EDF therefore looked for improvements aimed at eliminating the significant tones and reducing noise of an industrial nature. Further studies covering all non-conforming sites (Belleville, Bugey, Chinon, Civaux, Dampierre, Golfech, Nogent, Penly and Saint-Laurent) will be submitted in early 2005. EDF's proposals will be analysed by the ASN.

5 Summaries

5 | 1

Summary of incidents

5 | 1 | 1

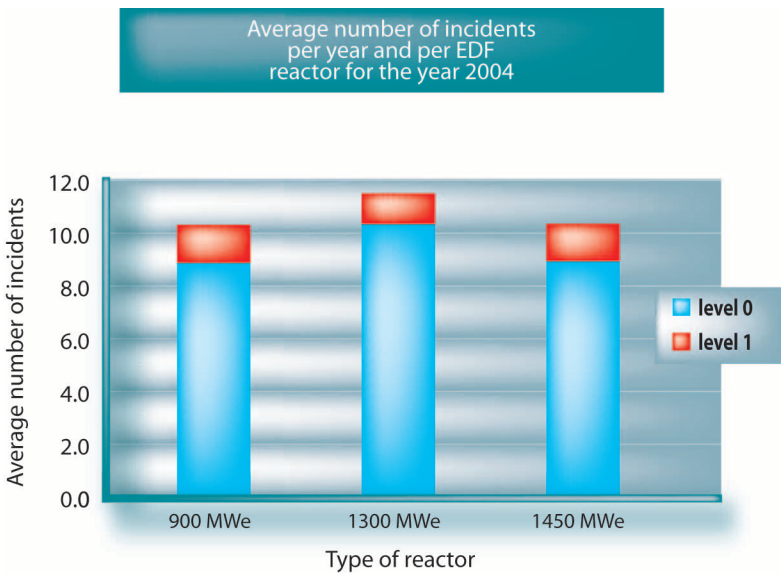
Summary of incidents in 2004

At the beginning of 2004, the arrangements to declare radiation protection or environmental incidents were clarified. Under application of these arrangements, EDF in 2004 declared 650 significant incidents classified on the INES scale, 461 of which concerned safety, 172 radiation protection and 10 uncontrolled releases of radioactive products into the environment.

The events declared with respect to environmental protection and which concern neither nuclear safety nor radiation protection, are not classified on the INES scale. 36 such events were declared in 2004.

The number of incidents declared in 2004 is stable with respect to 2003. The proportion of incidents classified 1 on the INES scale is about 10%, or 54 incidents concerning safety, one concerning radiation protection and one concerning the environment. This number is down by comparison with 2003, a drop that can primarily be explained by the absence of generic incidents classified level 1 on the INES scale. In 2003, five incidents affecting a group of reactors or all the reactors were declared by the EDF head office departments. Two of them required local analysis and consequently a fresh declaration by the sites concerned.

Furthermore, at the beginning of 2004, the ASN classified as level 2 an anomaly about certain electrical marshalling boxes in EDF nuclear power plants (see § 2|2|1).



5 | 1 | 2

Statistical analysis of the incidents in 2004

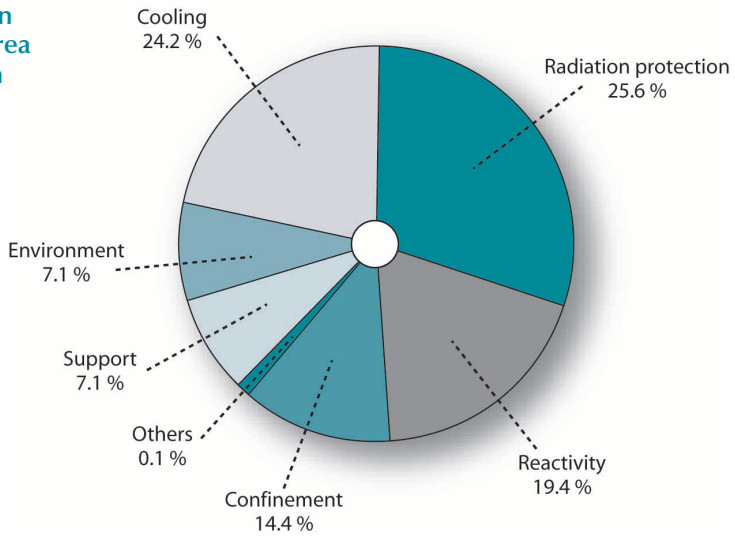
The analysis is about the incidents declared between 1 December 2003 and 30 November 2004.

Breakdown of incidents occurring on EDF reactors in 2004, per area of declaration and safety function affected.

The areas of declaration are safety, radiation protection and the environment. Safety itself involves three basic safety functions, control of reactivity, cooling of radioactive materials, and confinement of radioactive materials. Certain incidents do not directly affect one of the three safety functions, but do affect auxiliary systems such as electrical power supplies. These incidents are represented under the "support" heading.

The number of incidents per area of declaration is stable in comparison with 2003.

Breakdown of incidents in 2004 on EDF reactors per area and safety function affected



Breakdown of incidents on EDF reactors in 2004, according to the reactor state during the incident.

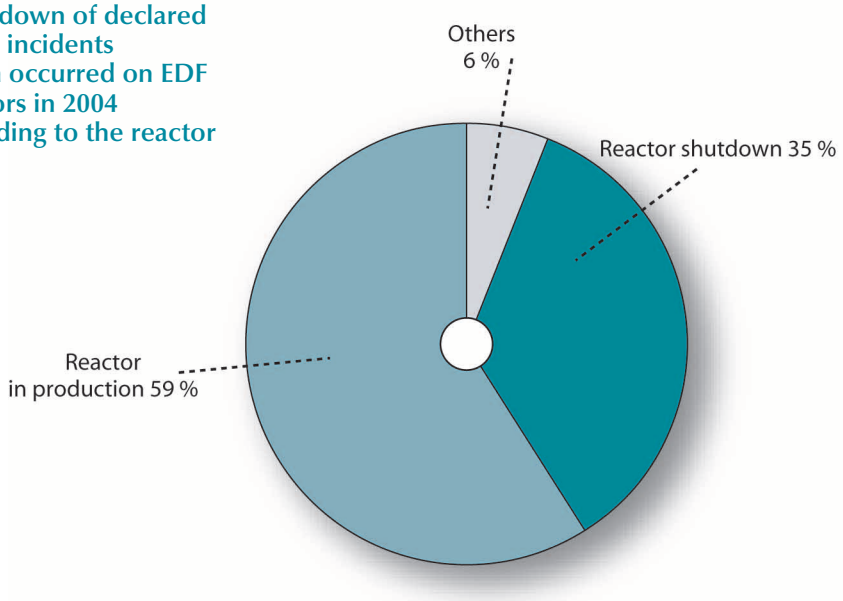
The occurrence of certain incidents is independent of the reactor state and they are placed under the "Others" heading. Incidents concerning the environment are practically all independent of the reactor state and were not included in this breakdown.

The graphs below illustrate the fact that the number of safety-related incidents that occurred when the reactor was operating is higher than those with the reactor shut down, while the opposite is true when looking at radiation protection.

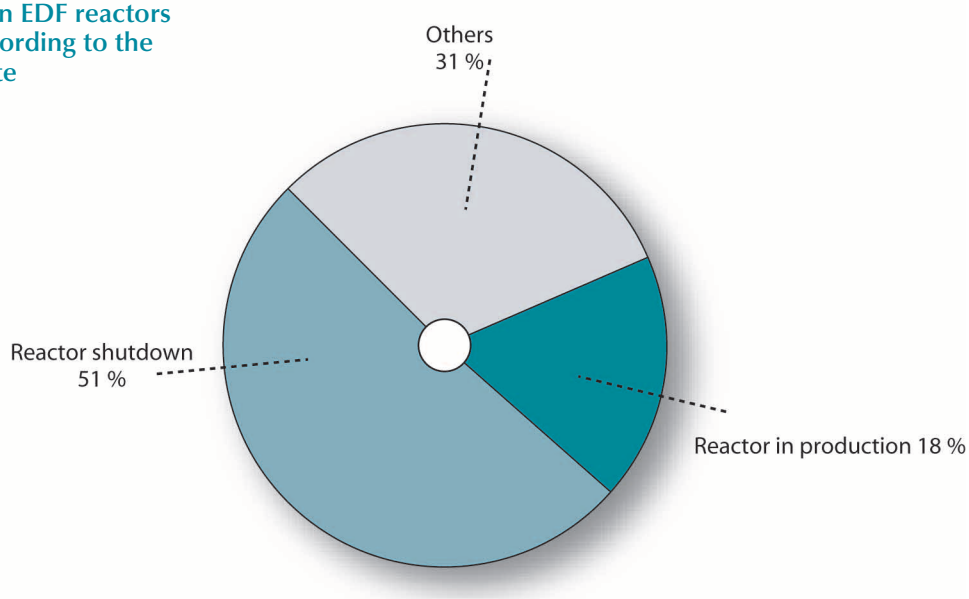
The high proportion of radiation protection-related incidents (51.1%) that occurred during reactor outages can be explained by the far higher number of maintenance operations carried out when the reactor is shut down.

It should be noted that the rate of safety incidents occurring during operation is slightly up on 2003, confirming the trend observed since 2001.

Breakdown of declared safety incidents which occurred on EDF reactors in 2004 according to the reactor state



Breakdown of declared radiation protection incidents on EDF reactors in 2004 according to the reactor state



Breakdown of incidents on EDF reactors in 2004, according to the main cause.

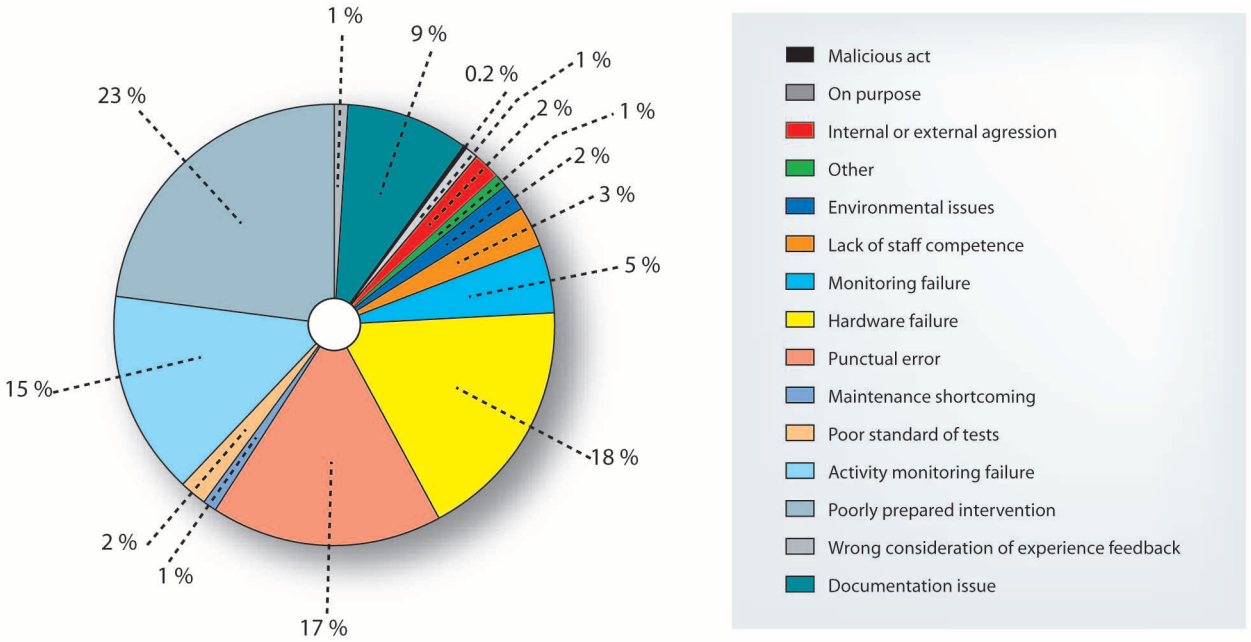
The graphs below show that the main causes of the incidents vary according to the area of declaration. The breakdown of declared safety-related incidents is appreciably the same as in the previous years: 18% of incidents are linked to equipment faults and nearly 70% to organisational and human causes.

Concerning radiation protection-related incidents, nearly 90% are linked to organisational and human causes. One should in particular note the following origins:

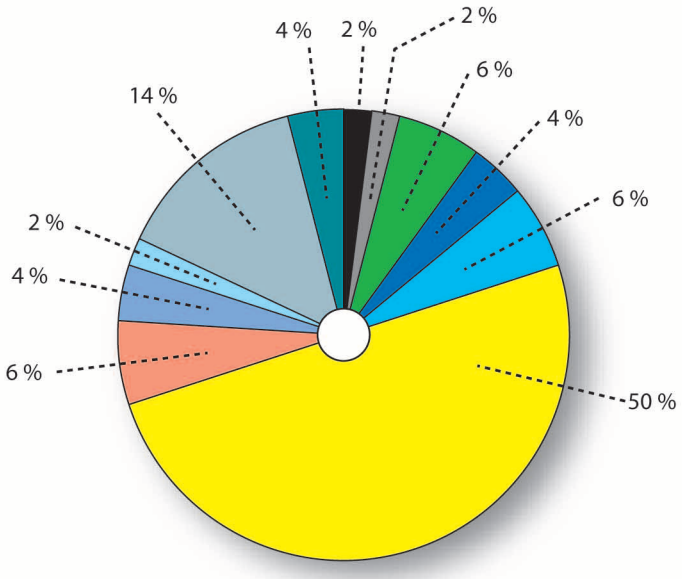
• about 21% originate from an isolated error,

• 20% originate from incorrect preparation of the maintenance work, reflecting incomplete knowledge of radiological conditions at the maintenance location, failure to analyse interference between work sites or shifts in the schedule, the consequences of which were poorly identified,

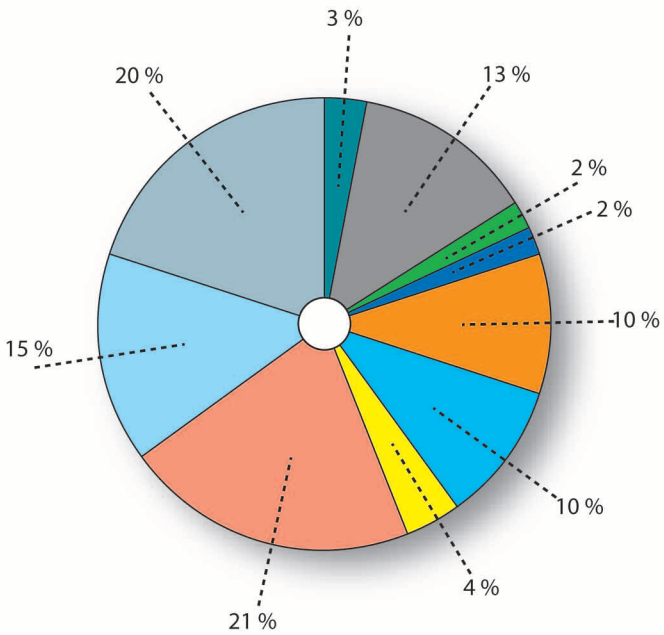
Breakdown of declared safety incidents in EDF reactors in 2004 according to main cause



Breakdown of declared environmental incidents in EDF reactors in 2004 according to main cause



Breakdown of declared radiation protection incidents in EDF reactors in 2004 according to main cause



• about 20% originate in a behavioural problems ("intentional act") or shortcomings in radiation protection ("lack of skills by one or more participants").

Environmental incidents are of three types, concerning:
• incidents linked to non-compliance with the requirements of the release orders (45%),
• release of ozone-depleting gases or greenhouse effect gases (31%),
• leaks or spillage of chemical or radioactive products (22%).

Incidents concerning non-compliance with the requirements of the release orders are nearly 75% due to organisational and human causes. With regard to the last 2 types of incidents, the origin is mainly due to equipment faults.

For the radiation protection and environmental fields, the process of declaration and analysis is extremely recent, which means that no trends have as yet been identified.

It is also worth mentioning the declaration of 2 incidents involving malicious acts during the labour disputes of June 2004. These involved intentional and temporary disconnection of the power supply to the radioactivity measuring instruments, which had no consequences on safety, radiation protection or the environment.

5 | 2

Significant events site by site

This table presents the most significant events during the course of 2003, for each nuclear power plant. All the generic incidents and anomalies can also be consulted on the ASN's website (www.asn.gouv.fr), under the heading "Actualité". Additional information is obtainable from the DRIREs concerned.

BELLEVILLE

Site:

Discharge order modification procedure following formal notice on 20 December 2001 (see § 4| 2| 2).

Public enquiry about dyke reinforcement work, in order to improve flood protection (beginning of works in 2005, scheduled to last 2 years).

Release of 105 m3 of contaminated effluent into the waste treatment building drain channels and sumps (break in a pipe on the waste treatment pumps).

Modification by decree of 29 October 2004 of the BNI perimeter.

BLAYAIS

Site:

Commissioning of new wastewater purification plant during the summer.

National emergency exercise on 9 December 2003, primarily concerning "nuclear safety".

Dredging of the Gironde estuary around the water intakes for the production units, from 30 January to 20 February 2004.

Reactor n°2:

Unscheduled shutdown on 24 September following a leak on the vessel vent flow indicator.

Reactor n°3:

Second ten-yearly outage, in particular comprising implementation of a large number of modifications resulting from the safety review, a containment tightness test and post-maintenance qualification with hydrotest on the main primary system.

BUGEY

Site:

The 4 reactors now use "CYCLADES" fuel management, running cycles of about 18 months.

Signing of the interministerial order of 26 April 2004 authorising the NPP to discharge effluent resulting from biocide treatment of the reactor 4 and 5 cooling towers.

Signing of the interministerial order of 11 June 2004 authorising the site to carry out thermal liquid discharges in exceptional climatic situations.

Increase in the storage capacity of the spent fuel pits by addition of extra racks.

Reactor n°5:
During a scheduled unit shutdown, leak from an RCC assembly which had a significant impact on the length of the reactor outage.

CATTENOM

Site:
Signing of the order of 24 June 2004 authorising water intake and effluent discharge.
Large-scale national emergency exercise on 29 January 2004.

Reactor n°2:
Fire on 16 May 2004, triggering the national emergency response procedure.
Unscheduled shutdown on 11 August 2004 and partial post-maintenance testing of the main secondary system under application of the ministerial order of 10 November 1999.

CHINON

Site:
Signing of a prefectoral public safety order requiring the NPP to carry out biocide treatment of the cooling tower to restrict the concentration of legionella.
Labour dispute, blocking access to the site.
Submission of an application for modification to the discharge and intake order to allow biocide and anti-scaling treatment of the cooling towers.

CHOOZ

Site:
Signing of the interministerial order of 26 April 2004 authorising the NPP to discharge effluent resulting from biocide treatment of the reactors 1 and 2 cooling towers.
Final commissioning of Chooz B on 30 January 2004.
Submission of an application to modify the authorisation for discharge into the Meuse of total nitrogen.
First removal of spent fuel in November 2004.

CIVAUX

Site:
Post-OSART inspection in December 2004.
ISO 14001 certification.

CRUAS

Site:
Implementation of the new order regulating water intake and discharge of liquid and gaseous effluent.
National emergency exercise focusing on civil security.
Modification of the BNI scope by decree of 29 November 2004.

Reactor n°1:
Unscheduled shutdown of unit 1 following rise in the leak rate between primary and secondary systems.

Reactor n°3:
Second ten-yearly outage.

DAMPIERRE

Site:
Acknowledgement of the pressure vessels inspection department.
Examination of the “dyke reinforcement” dossier: start of works scheduled for 2005.
Review inspection on the topic “radiation protection”.
Signing of the interministerial order of 27 April 2004 authorising the NPP to discharge the effluent resulting from biocide treatment of the reactors 1 and 3 cooling towers.

Reactor n°2:
Construction and authorisation to operate a retired steam generators storage building.

Reactor n°4:
Second ten-yearly outage.

FESSENHEIM

Site :

Major work under application of the order of 31 December 1999.

Reactor n°1:

5-month shutdown following a handling error resulting in an injection of resin into the primary circuit.
Shutdown for repairs following a leak on a steam isolation valve.

FLAMANVILLE

Site:

EDF announcement of its intention to install an EPR reactor on the site.
National emergency exercise on 14 December 2004.

GOLFECH

Site:

Signing of the interministerial order of 27 April 2004 authorising the NPP to discharge the effluent resulting from biocide treatment of the reactors 1 and 2 cooling towers.
Signing of the interministerial order of 11 June 2004 authorising the site to carry out thermal liquid discharges in exceptional climatic situations.
Dredging of the intake canal and the channel.

Reactor n°1:

Modification of BNI perimeter by decree of 29 November 2004.

Reactor n°2:

First ten-yearly outage.

GRAVELINES

Site:

Installation of a floating barrage during the summer of 2004 in front of the plant water inlet to supplement the existing arrangement comprising two skimmers to improve protection against oil pollution.
Publication in the official gazette of the plant discharge order.
National emergency exercise on 6 May 2004 with a test of the population telephone alert.
Modification of the BNI perimeter by decree of 29 November 2004.

Reactor n°6:

Level 1 radiation protection incident (65 people slightly contaminated).

NOGENT-SUR-SEINE

Site:

Signing of the interministerial order of 26 April 2004 authorising the NPP to discharge the effluent resulting from biocide treatment of the reactors 1 and 2 cooling towers.
Signing of the interministerial order of 15 October 2004 authorising the discharge of effluent resulting from anti-scale treatment of the reactors 1 and 2 cooling systems.
Signing of the interministerial order of 29 December 2004 authorising water intake and effluent discharge.

Reactor n°2:

Labour dispute lasting several weeks at the start of the reactor 2 outage and major problem with the reactor building polar crane.

PALUEL

Site:

Massive arrival of algae at the pumping station, leading to automatic reactor trips.

PENLY

Site:

OSART in December 2004.

Reactor n°2:

First ten-yearly outage.
Discovery of an anomaly on the electrical marshalling boxes leading to declaration of a generic incident classified level 2 on the INES scale.

SAINT-ALBAN

Site:

Dredging of the intake canal in the second half of the year.

National emergency exercise on 26 October 2004.

SAINT-LAURENT-DES-EAUX

Site:

Submission of an application dossier for modification of the discharge and intake order following formal notice from the Nuclear Safety Authority on 21 November 2003.

Pre-Osart conducted in February 2004.

Reactor n°1:

Vessel head replacement.

TRICASTIN

Site:

Modification of the BNI perimeter by decree of 29 November 2004.

Signing of the interministerial order of 11 June 2004 authorising the site to carry out thermal liquid discharges in exceptional climatic situations.

Reactor n°4:

Second ten-yearly outage, with replacement of the steam generators.

6 ASSESSMENT AND OUTLOOK

6|1

ASN assessment of the past year

Reactor operations

The ASN feels that documents such as reactor operating or maintenance rules, on which operation is based, are clear and of good quality. In particular, the documents drafted by the plants are in conformity with national directives. These documents do change regularly, to take account of safety improvements, but also because of EDF's aim to improve the economic performance of the reactors (shorter outages, less maintenance). The ASN observes that the plants have trouble in following the rate of change in these documents determined by the head office departments.

This set of documents is also not always properly applied in the field. During its inspections, the ASN found non-compliances with the compensatory measures associated with waivers to the general operating rules, the procedure to be followed in the event of equipment unavailability, or the action required by the alarm sheets. The supervision and monitoring requested in the operating procedures are not always carried out. An unquestioning attitude of the operating teams and inadequate second level monitoring are two of the reasons why operating errors do persist.

The ASN believes that the sites are reactive to operating events, correctly manage incidents when they occur and draw the necessary conclusions.

Finally, with regard to human resources, the ASN considers that the operating personnel levels are sufficient and that their training is appropriate. The gradual deployment of personnel training simulators on all the sites is considered to be a positive contribution in this direction.

Maintenance activities and subcontractors

In line with its policy of bringing down maintenance costs, EDF is implementing methods particularly aimed at concentrating maintenance operations on equipment for which a failure entails safety, radiation protection or operational issues. These methods are developed as part of the "reduced maintenance" project. The ASN notes that so far, these changes have had no impact on safety.

In the plants, the ASN observes certain deviations in the application of maintenance programmes, particularly in the field of civil engineering, and inadequacies in the preparation of maintenance work, with a need to perform more meticulous risk analyses. Head office supervision of this point should be strengthened. Lessons learned from the operations also need to be taken into account more exhaustively.

Most on-site maintenance activities are entrusted to subcontractors selected on the basis of an assessment and qualification system concerning which the ASN felt no particular comments to be necessary. However, the ASN does consider that EDF needs to make progress in supervising the activities of its subcontractors, notably as far as the quality of the subcontracted operations is concerned. In particular, the resources devoted to this supervision need to be reinforced, both in the plants and nationally.

The skills and resources allocated to maintenance are overall felt to be appropriate. The training and qualification of those involved is progressing, although their safety culture could sometimes be better.

Equipment condition

The ASN believes that the equipment maintenance and replacement programmes, the safety reviews approach and EDF's questioning attitude, whereby it checks the design and conformity of the facilities in order to correct any anomalies, help maintain the plant equipment in an adequate condition.

The ASN in particular notes that the equipment conformity deviations detected in the plants during the 2004 reactor outages were dealt with in a time compatible with their safety significance and in most cases led to a rapid return to conformity. For example, in the case of the generic anomaly classified level 2 on the INES scale about the isolation faults on the electrical cables in certain marshalling boxes, which were detected in 2004, the ASN noted the reactivity of EDF, which committed itself to a two-year repair programme.

However, the general condition of the premises with regard to aspects that do not concern safety but which could have repercussions on the behaviour of the maintenance staff, such as the cleanness of the premises or worksite organisation, is not yet up to international standards in all the plants.

· First barrier

The ASN feels that the issues linked to the integrity of the first containment barrier, that is the fuel clad, are on the whole well handled. The integrity of the first barrier is improving in all the plant series, through changes in fuel assembly design. EDF in particular showed itself to be reactive in the design of a solution to remedy the fretting problems on the 1300 MWe reactors.

Fuel and fuel operations represent a major financial issue for EDF, as shown by the numerous projects for new fuel management with higher performance. These changes lead EDF to submit dossiers which are sometimes inadequately justified, as was the case in 2004 with the "MOX parity" dossier.

The ASN also notes that the lessons learned from the April 2001 loading error in Dampierre 4 have not all been taken on board.

· Second barrier

For the ASN, the second barrier situation in the NPPs was stable in 2004.

The steam generators replacement schedule was revised (see § 3|5|4) and the vessel head replacement programme is gradually nearing completion. The ASN considers that a close watch must be maintained on the main primary system in the run-up to the third ten-yearly outages, which is a key opportunity for monitoring control of ageing phenomena.

· Third barrier

The major programme to reinforce the tightness of the 1300 and 1450 MWe reactor containments - scheduled to run until 2011 - restored a satisfactory level of tightness to the double-wall containments. EDF also reinforced its surveillance programme on the composite tightness linings, which is a positive point.

For the time being, the single-wall containments of the 900 MWe reactors pose no particular problems. Their situation will be reviewed in 2005 in the build-up to the 3rd ten-yearly outages.

Radiation protection

The national action plans defined and implemented by EDF to improve radiation protection are consistent with the diagnosis of the situation. The ASN in particular believes that reinforcing skills, working methods and supervision are appropriate actions.

The implementation of these action plans within the plants is methodical but the ASN has sometimes noted a lack of strict oversight of the steps taken and delays in transposing to the sites the requirements defined at the national level.

Pre-job dose assessments and risk analyses are not yet systematically carried out for all activities or types of activities. In addition, progress is still required in effective implementation in the field of the actions deduced from these preliminary analyses; the "radiation protection culture" of those involved must be reinforced further. Finally, progress in particular is still required in defining and carrying out field inspections during the operations, in particular to supervise the working conditions of the subcontractors. Generally, EDF's efforts are positive and radiation protection is increasingly taken into account, but progress is still to be made.

The environment

The environmental protection regulations applicable to basic nuclear installations in general and to nuclear power plants in particular, have been gradually reinforced. With regard to discharges, the ASN has initiated a process of systematic revision of the licences granted to each nuclear power plant. With regard to prevention of risks and nuisances, the ministerial order of 31 December 1999, which applies to all BNIs, introduces new requirements. The ASN notes with satisfaction that these regulatory changes have led to greater concern for environmental protection matters on the part of the nuclear power plants, be it in terms of facility design or operation.

With respect to facility design, EDF in 2004 continued a major effort to design and implement changes aimed at improving the prevention of risks and nuisances. This work is satisfactorily coordinated by EDF head office. It should continue in the coming years.

About discharge, the quality of the licensing application dossiers, even if a degree of improvement is visible, is once again this year insufficient, leading to numerous comments from the administrations before the dossiers can be declared acceptable. The ASN notes that in 2004, the requirements of the discharge licence orders were on the whole followed. It should be stressed that given the fact that the authorised discharge limits are set as close as possible to the actual discharges, in order to bring the operator to reduce its discharges to a level as low as reasonably achievable, any underestimation in the application dossier of the quantities discharged is likely to lead to non-compliance with the licence.

However, with regard to human factors, certain inappropriate actions persist - sometimes resulting in incidents - for example uncontrolled releases, even if personnel training and awareness programmes have been implemented. Finally, inadequacies have been observed in supervision of the quality of the operations entrusted to the subcontractors, especially those responsible for waste management.

Personnel and organisation

Efforts have been made by EDF head office to improve the extent to which human and organisational factors are incorporated into reactor design and operation: creation of a "human factors" engineering programme in the design of the EPR project, analysis of socio-organisational and human impacts in the existing reactors modification projects, summary of safety management actions and resources, analysis of incidents involving human factors. The ASN however notes that the human factors consultants in the plants are insufficiently involved in implementing these national programmes.

With regard to skills and qualification, the ASN notes no significant deviations.

Finally, the ASN feels that strictness and thoroughness in day to day operations need to be improved. The area most particularly concerned is that linked to reactor operations. There are also still deviations in the maintenance and radiation protection areas. The ASN considers that in these areas, internal supervisory measures by the operator need to be reinforced. The fact that in 2004 fuel handling incidents once again occurred, even though EDF had extensively reinforced its internal requirements to guarantee the correct performance of these operations, is in this respect significant. The ASN therefore plans in 2005 to conduct inspections into the strictness and thoroughness of operation and subcontracted work.

6 | 2
Outlook

In the power reactor area, the context of 2004 was one that saw significant developments that will contribute to orienting supervision in 2005.

First of all, the energy bill was examined by Parliament, then EDF announced its choice of Flamanville for the construction of an EPR reactor, and the Government defined its position concerning the safety options for this reactor project. In 2005, the continued examination of the EPR project detailed design studies, subsequent to adoption of the safety options, will represent a significant share of the ASN's work in the area of PWR reactors. Cooperation with the Finnish nuclear safety authority on this subject will also be continued.

There was also the commitment by the nuclear safety regulators of the leading European nuclear countries, who met under the auspices of the WENRA, to achieve safety harmonisation by the year 2010, in particular for power reactors. In 2005, the ASN will continue to contribute to the work of WENRA and will start implementation of this work in France through drafting of regulatory or assimilated texts. EDF will also be concerned by the current revision of the regulations concerning nuclear pressure vessels. These aspects are not unrelated to the following point: harmonisation of safety standards in Europe is in fact one way of continuing to advance safety in an environment marked by deregulation of the electricity markets and an increased focus on competitiveness.

Finally, there is the change in the status of EDF. Deregulation of the electricity markets is thus a key factor in the changing PWR nuclear safety supervision landscape. EDF has initiated numerous cost reduction and competitiveness improvement programmes, which are submitted to the ASN for approval whenever they affect safety issues. Even if the ASN reckons that it is perfectly normal for a company to be concerned by its competitiveness, it nonetheless keeps a very close watch on the

safety consequences of this search for improved competitiveness. So far, no negative effects have been identified.

The ASN in particular considers that the condition of the facilities is satisfactory and that EDF applies appropriate operating methods - maintenance programmes and operating rules - taking due account of the lessons to be learned from experience feedback. In the fields of radiation protection and protection of the environment, the ASN notes that EDF has adapted to a context of stricter regulations, by taking steps to achieve progress, and considers that in 2004 the results attained by EDF are encourageing. However, with respect to human factors, the ASN feels that day to day thoroughness needs to be improved in various areas, in particular reactor operation. Progress has nonetheless been achieved in personnel training. In organisational terms, the steps taken to ensure second-level supervision of activities must be improved. Thus in 2005, the ASN will be paying particularly close attention to the operational progress made by EDF and will continue its own assessment and supervision of human and organisational factors.

The particularity of France is that it operates a standardised fleet of NPPs which meets nearly 80% of the national electricity demand. Although this situation is one in which there is extremely efficient experience feedback between reactors, it also creates an obligation to anticipate any risk of generic faults. The conformity examinations, the permanent search for anomalies by the EDF engineering departments, the tests and inspections carried out during the ten-yearly outages are all opportunities for obtaining good knowledge of the current level of safety of the facilities. The ASN observes that this positive approach continued in 2004, and led to conformity being restored within times compatible with safety significance. In 2005, the ASN will ensure that work is started into preventing the risk of reactor building sump clogging.

It is also important for EDF to continue to take steps to improve safety still further. 2004 saw the implementation of nuclear power plant design changes, primarily during the second ten-yearly outages on the 900 MWe reactors. These changes are notably the result of the safety reviews or the application of new regulations, for example in the environmental field. They will continue in 2005, with the beginning of the second ten-yearly outages on the 1300 MWe reactors, and definition of the improvements to be made to the 900 MWe reactors on the occasion of their third ten-yearly outages, which is a particularly important opportunity with regard to ageing management. The ASN therefore intends to help direct the available resources towards those improvements which offer the greatest gains in terms of safety, through examination of the "cost/safety benefit" analyses presented by EDF.

Finally, with regard to power reactor supervision procedures, the ASN felt that the creation as of early 2005 of "internal authorisation" systems is a positive step as, for those operations which do not compromise the safety justification, this will enable EDF to go ahead with them without asking for authorisation from the ASN. This will oblige EDF to face up to its responsibilities even more and correct a natural tendency to rely on the ASN to check the quality of its dossiers. This will also enable the ASN to focus its supervisory action on subjects with more important safety implications.

NUCLEAR RESEARCH FACILITIES AND FACILITIES NOT DIRECTLY LINKED TO THE NUCLEAR POWER GENERATING INDUSTRY

CHAPTER 13

1 ATOMIC ENERGY COMMISSION INSTALLATIONS

1|1 Generic subjects
1|1|1 Increased CEA responsibility as a nuclear operator
1|1|2 Management of nuclear materials and monitoring of sub-criticality at the CEA
1|1|3 Management of sealed radioactive sources at the CEA
1|1|4 The effluent release and water intake licence applications
1|1|5 Safety reviews of old installations
1|1|6 Assessment of seismic hazards
1|1|7 Experimental reactor cores and devices
1|1|8 Research reactor maintenance outages

1|2 Topical events in CEA research facilities
1|2|1 Cadarache Centre
1|2|2 Fontenay-aux-Roses Centre
1|2|3 Grenoble Centre
1|2|4 Saclay Centre
1|2|5 Rhône Valley Centre
1|2|6 Phénix reactor
1|2|7 Effluent and waste treatment installations

2 OTHER BASIC NUCLEAR INSTALLATIONS

2|1 Chinon irradiated material shop (AMI)
2|2 Electromagnetic radiation laboratory (LURE)
2|3 European Organization for Nuclear Research (CERN) installations
2|4 Large National Heavy Ion Accelerator (GANIL)
2|5 Industrial ionisation installations
2|6 Laue-Langevin Institute high flux reactor
2|7 Maintenance shops
2|8 Inter-regional fuel warehouses (MIR)
2|9 CENTRACO waste incineration and melting facility
2|10 The ITER (International Thermonuclear Experimental Reactor) project

3 OUTLOOK

"Nuclear research facilities and facilities not directly linked to the nuclear power generating industry" cover all basic nuclear installations in the civil part of the French Atomic Energy Commission, the basic nuclear installations of other research organisations and a few other basic nuclear installations which are not power reactors and which are not involved in the nuclear fuel cycle.

1 ATOMIC ENERGY COMMISSIONS INSTALLATIONS

The facilities of the Atomic Energy Commission (CEA) Centres include various basic nuclear installations (experimental reactors, laboratories). Research is focused notably on the lifetime of operating plants, future reactors, fuel performance and nuclear waste.
The constant changes made to these installations, due to their research functions, require particularly attentive supervision and frequent updating of the relevant safety files. The action of the Nuclear Safety Authority (ASN) may be considered at two levels:
– at national level, it implements an overall approach to "generic" subjects concerning several installations. The person contacted in this context is generally the Director of Nuclear Protection and Safety, assisting the General Administrator of the CEA;
– as required, it examines the specific safety files of each CEA basic nuclear installation. In this case, it will mainly contact the manager of the Centre and the head of the installation concerned. Paragraph 1.1 below lists the generic subjects dealt with in 2004. Section 2 describes topical events in the various CEA installations currently operating. The installations undergoing clean-up or dismantling are discussed in chapter 15.

1 | 1

Generic subjects

By means of series of inspections and analysis of lessons learned from daily routine in the installations, the ASN identified topics on which it questioned the CEA: release of effluent discharges, assessment of seismic and fire hazards, criticality risk, environmental protection, management of nuclear materials or radioactive waste (see Chapter 16), dismantling of facilities (see Chapter 15), radiological cleanness, definition of accident management reflex stages, electricity supplies, external hazards, etc.

In view of the numerous subjects identified, the CEA contacted the ASN in 2000 with a view to planning the requisite actions. These planning arrangements have since given rise to annual exchanges.

1 | 1 | 1

Increased CEA responsibility as a nuclear operator

In 2003, the ASN informed the CEA that its new organisation was improving the clarity of the responsibilities and duties of the units, in particular with respect to continuity of action, independence of the supervision function and identification of installations assistance function. Furthermore, reorganisation of the head office departments brought safety and radiation protection closer together.

However, the ASN informed the CEA that it was waiting for self-assessment of the effectiveness of the organisational measures taken, in particular through indicators monitoring safety and the correct working of the organisation.

In this context, the ASN felt in 2002 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 do not compromise the installation safety demonstrations, without requiring formal authorisation from the ASN.

About fifteen installations were concerned by the end of 2004, and it is planned to extend the system to the remaining installations.

Eventually, this approach demands that the CEA keep the safety reference systems of its installations up to date.

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 overall increase in the hazards involved.

The ASN continued to keep a close watch on implementation of the internal authorisations system in 2004. A further series of inspections was carried out on all CEA sites and although these inspections showed up improvements in assimilation of the process by the CEA, the operator still needs to make further progress, particularly in the quality of the arguments used to back-up the appraisal of the safety files and in second level monitoring of the recommendations made by the internal safety committees.

1 | 1 | 2

Management of nuclear materials and monitoring of sub-criticality at the CEA

In the past, a number of incidents had revealed shortcomings in the CEA's nuclear materials management system. At the request of the defence high official with responsibility for Industry and the ASN, the CEA had initiated a broad-ranging action plan designed to inventory all objects in its possession containing nuclear materials and to improve the system for the management of these objects.

This action plan had in particular led to:
- redefinition of the respective responsibilities of those concerned;
- definition and application of a physical inventory methodology;
- the setting up of a housekeeping policy to relieve congestion in the installations and facilitate CEA nuclear material management.

However, experience feedback shows that the CEA needs to remain vigilant on this point. In 2003, it declared the discovery of unexpected objects on two occasions (unlisted experimental cans and a piece of fuel). Furthermore, a certain lack of thoroughness in the management of nuclear materials can lead to irregularities in criticality monitoring. On 16 December 2003, investigations as part of the periodic safety review on the MASURCA reactor in Cadarache, revealed that a box containing packaged nuclear material had not undergone a formal criticality-safety study.

In 2004, an incident likely to create a criticality problem was also declared by the CEA (BNI 72). This incident demonstrates the need to remain vigilant concerning these nuclear material accounting problems and the supervision of sub-criticality. This applies to both the operator and the Nuclear Safety Authority.

1 | 1 | 3

Management of sealed radioactive sources at the CEA

Since 2002, the CEA no longer enjoys its historical special status with regard to source possession licences. In 2002, many discussions were held to determine the conditions for transition to the common system, in particular with respect to the radioactive sources which today should be considered as waste (see chapters 10 and 16). During the course of 2003, the CEA submitted proposals to the ASN concerning its source management organisation in the various establishments, as well as the future of expired and/or disused sources, and the ASN accepted their general principles. During the course of 2004, the CEA gradually implemented its organisational arrangement in its various centres. The guidelines proposed by the CEA were accepted by the ASN and the source possession and utilisation authorisation applications are currently being finalised.

1 | 1 | 4

The effluent release and water intake licence applications

The CEA's effluent release and water intake licence revision process is continuing, under application of decree 95-540 of 4 May 1995 concerning gaseous and liquid effluent release and water intake by basic nuclear installations. One of the goals in this revision is to reduce the release limits to levels consistent with the actual releases from the installations.

The effluent releases and water intake at CEA Grenoble are now regulated by the order of 25 May 2004, published in the *Official Gazette* on 11 July 2004.

CEA Cadarache submitted an overall dossier for the site, for drafting of the orders regulating the BNIs under the control of the ASN, the BNIs under the control of the Delegate for Nuclear Safety and Radiation Protection for defence related activities and installations, and the ICPEs under the control of the prefect.

The effluent release and water intake licensing order for the CEA Saclay site should be revised soon.

1 | 1 | 5

Safety reviews of old installations

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 overall review from the safety standpoint. At the present time, compensatory provisions are necessary to ensure medium or even long term satisfactory safety conditions at these installations. In certain cases, replacement by new installations even proves necessary; the MAGENTA and CEDRA interim storage projects and the STELLA and AGATE effluent treatment station projects are the result of discussions along these lines (see chapter 16).

The ASN informed the operators that it feels a safety review of old installations to be necessary about every ten years. The safety reviews for the LEFCA (advanced fuel design and fabrication laboratory) and the experimental CABRI reactor on the Cadarache site were presented to the Advisory Committee for laboratories and plants and were monitored in 2004. The safety reviews for the solid waste management zone, the effluent and waste treatment plant and the CIS-BIO international facility on the Saclay site are also in progress, as is that for the PEGASE interim storage facility and the MASURCA reactor on the Cadarache site.

The CEA plans to conduct safety reviews on its other installations within the next six years, following a schedule approved by the ASN in 2002. ASN plans to precise its requirements regarding safety periodic review on the matters of responsibility, safety issues and plannings.

1 | 1 | 6

Assessment of seismic hazards

One objective when designing an installation is to maintain containment of nuclear materials in the event of an earthquake.

The safety review of the LEFCA installation, located in the Vallée des piles of the CEA's Cadarache site highlighted the existence of a "particular" site effect which could significantly increase the amplitude of an earthquake on a sedimentary basin. Given the current level of scientific knowledge, the Nuclear Safety Authority informed the operator, CEA, that it felt the SMHV-SMS (maximum historically probable earthquake-safe shutdown earthquake) approach used was sufficiently conservative in terms of the loading to be applied to the installation, provided that there was no risk of resonance between the building and the underlying sedimentary soil. The ASN asked the CEA to undertake studies to sort out the problem of the particular site effects for the Vallée des piles on the CEA's Cadarache site.

In 2003, a number of assessments were conducted into the question of the seismic risk in Cadarache. These assessments are currently being examined and the ASN has already asked the CEA to continue with its investigations to improve characterisation of the paleoseismic indicators identified around the Cadarache site.

The ASN informed the operator CEA that given the current state of knowledge, it considered that reinforcing a building by laying strips of carbon fibre fabric bonded to the elements to be strengthened was too innovative a process for structures subjected to seismic loadings. The ASN therefore asked that for the required reinforcements, the CEA restrict itself to proven and validated processes.

1 | 1 | 7

Experimental reactor cores and devices

One particularity of the many experimental reactors is the frequent modification of the reactor core configuration and the sometimes only very temporary introduction of experimental irradiation devices into the reactor core.

The ASN focuses particular attention on these operations, owing to the related risks, in particular concerning reactivity control (chain reaction) and the hazard constituted by the fuel elements.

Significant work was done in 2003 on experimental devices. A note stipulating the conditions for the design, production and licensing of these devices was issued by the ASN at the beginning of 2004. This note, which entered into force in July 2004, specifies that safety reviews are required on all experimental devices every 10 years.

With regard to management of the reactor core configuration, the ASN conducted a series of inspections in 2001 and work to improve supervision of the configuration modification operations was carried out by the ASN in 2004.

1 | 1 | 8

Research reactor maintenance outages

In 2004, the ASN undertook a programme to improve supervision of facilities shut down for prolonged maintenance or renovation work.

1 | 2

Topical events in CEA research facilities

This section deals only with research facilities currently operating. The installations in the clean-up and dismantling stages are dealt with in chapter 15.

1 | 2 | 1

Cadarache Centre

The Cadarache Centre is located at Saint-Paul-lès-Durance, in the Bouches-du-Rhône department. It covers an area of 1,600 hectares. The main purpose of the units installed there is the industrial application of research and development in the fields of power reactors and uranium or plutonium based fuel. It is for this reason that this Centre comprises about twenty BNIs operated by the CEA; some of which (Cabri and Phébus reactors) are used by the IRSN for its research work on safety. The site also comprises a classified basic nuclear installation.

· Jules Horowitz reactor

The construction of a new reactor is deemed necessary by the CEA in view of the aging of the currently operating European irradiation reactors, which will be shut down in the medium- or short-term. This new reactor could satisfy CEA research and development needs up to about 2050. The reactor is currently scheduled for start-up in about 2015.

If the prime objective of the reactor is the irradiation of materials and fuel, in support of the French nuclear energy programme, a certain number of additional functions, such as the production of neutron beams, are being investigated; provisions are being designed-in, to allow industrial neutron radiography or to enable a new medical technique developed for treatment of cancers, to be installed on the site.

The safety options file for the future reactor was transmitted to the ASN in January 2002. This file was examined by the Advisory Committee for reactors in the first half of 2003. The ASN informed the CEA in August 2003 that it had no objection to continuation of the RJH project, based on the safety options presented and provided that additional requests were taken into account.

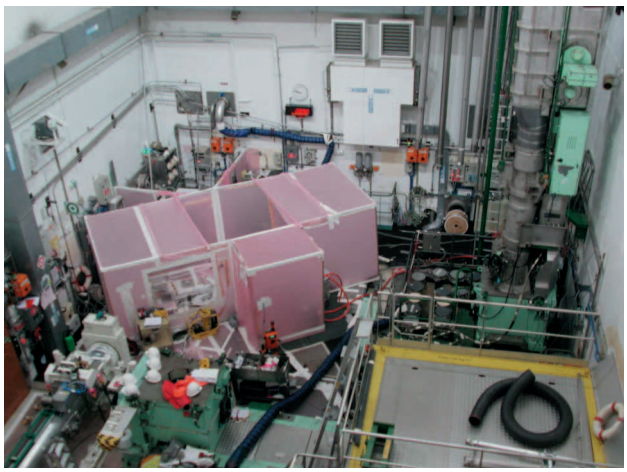
· CABRI reactor

The Cabri pool-type reactor is mainly used for experimental programmes aimed at better understanding nuclear fuel behaviour in the event of reactivity accidents.

A new research programme has been defined by the IRSN: the Cabri water loop project. These new tests will provide insight into high burnup fuel behaviour under accident conditions representative of the conditions encountered in a pressurised water reactor.

If the CABRI reactor is to be used for the new programme, then the installation will have to be modified, with the sodium loop being replaced by a pressurised water loop. The CEA therefore submitted a modification authorisation application to the Nuclear Safety Authority at the end of 2002. In parallel with this application, the CEA conducted a safety review of its entire installation in order to define the work needed to bring it into conformity with current requirements, with a view to continuing reactor operations for about a further twenty years. The preliminary safety analysis report for the modified installation was forwarded to the ASN in February 2002. It was examined by the Advisory Committee for reactors in the spring of 2004. During the inspections conducted for the installation safety review, the CEA in January 2004 brought to light local deterioration of a fuel rod,

but which was still leaktight. This event was subject to extensive investigation in order to determine the causes of this damage.



Modification works on CABRI reactor

The ASN informed the CEA in July 2004 that it had no objections to continuation of the CABRI water loop programme, based on the preliminary safety analysis report and provided that additional requests were taken into account.

The public inquiry prior to granting an installation modification decree, was held in the second half of 2003. On 27 January 2004, the public enquiry commission issued a favourable opinion, conditional on the installation modification application being approved. The draft decree authorising modification of the installation was presented at the end of 2004 to the standing section of the Interministerial Committee for Basic Nuclear Installations. Initial dismantling work on the old sodium loop began in mid-2003 and continued in 2004.

· PHÉBUS reactor

The Phébus reactor, put into service in 1978, is one of the CEA tools for the study of possible PWR accidents.



Control room during FPT3 test

The "fission product" (FP) experimental programme was set up to study, in a core meltdown situation, fission product behaviour and transport from the PWR fuel to the environment via the reactor primary system and the containment building. Lessons learned from these experiments will enable a better understanding of the consequences of a severe accident for the population and the environment. The experiments consist in degrading test fuel placed in a leaktight cell in the centre of the Phébus reactor core. The programme comprises six experiments, the first four of which were carried out in 1993 (FPT0), in 1996 (FPT1), in 1999 (FPT4) and in 2000 (FPT2). The FPT3 test was carried out in conditions similar to the FPT2 test, taking account of experience feedback from it. The authorisation application file for performance of FPT3 was sent to the Nuclear Safety Authority in June 2002. It was examined by the Advisory Committee for reactors on 18 September 2003. The ASN authorised performance of the test on 6 November 2003. The test took place on 18 November 2004.

· MASURCA reactor

The Masurca reactor was built for FBR core neutronic studies. It now takes part in minor actinide transmutation research, having been coupled with a particle accelerator, GÉNÉPI. Accelerator coupling and start-up took place at the end of 2001 for performance of the MUSE experimental programme.

As early as February 2000, the ASN informed the CEA that it was necessary to conduct a safety review of the reactor, the previous such examination dating back to 1988 and several reactor items

now being obsolescent. Files were forwarded by the CEA in 2004. However, the CEA is well behind schedule in this installation safety review and the ASN therefore informed the CEA that it was no longer in favour of authorising a further experimental programme after MUSE. The ASN feels that priority should be given to continuing with the safety review of the installation and to carrying out the corresponding renovation work.

· ÉOLE et MINERVE reactors

The Eole reactor is a host structure for LWR experimental cores. It consists of a reactor block with biological shielding compatible with high neutron flux operation, in which is installed a cylindrical vessel designed to contain different types of core and associated structures.

In 2002, the CEA made technical improvements to Eole's SIREX neutron control cabinets by replacing the conditioning frames to improve their resistance to electromagnetic interference. The CEA plans to initiate the safety review of this facility by the end of 2005.



MINERVE reactor control room

The Minerve reactor, located in the same bay, is used for cross-section measurement by oscillation of samples.

The reactor was completely unloaded and its pool drained in 2001 in order to renovate the reactor control and instrumentation system. This work ended in late 2002. The reactor was restarted in March 2003.

· CHICADE

CHICADE (chemistry, waste characterization) is a facility for research and development on medium- and low-level waste. CHICADE also carried out destructive and non-destructive characterisation work, in particular super-controls for ANDRA. The CEA decided to concentrate waste research work on the Marcoule site, so CHICADE will consequently be refocusing its activities on the characterisation of solid waste packages.

· Enriched uranium warehouse (MCMF)

Also known as the central fissile material warehouse, the MCMF is an interim storage facility for non-irradiated fissile materials momentarily unused or in the process of being regrouped.

In 2003, the operator began removal of the plutonium-containing material from the MCMF, as required by the ASN. Following examination of the safety options file for the MAGENTA facility, which is to replace the MCMF by about 2009, the ASN submitted a number of comments that the CEA will have to consider in the preliminary safety analysis report for the facility. The report is expected to be ready for the second half of 2005.

· Active fuel examination laboratory (LECA)

LECA is a laboratory for the destructive and non-destructive examination of fuel from FBR, GCR and PWR reactors (notably MOX fuel) and from Cadarache experimental facilities. This installation was commissioned in 1964. Renovation work, defined during the periodic safety review, started in

October 2000 will continue until 2005. In June 2004, the ASN authorised the sixth and final phase of LECA renovation, concerning the seismic reinforcement work on the civil engineering structures.

· Treatment, cleanup and reconditioning station (STAR)

STAR is a stabilization and reconditioning station for GCR spent fuel prior to reprocessing and a laboratory for destructive and non-destructive testing of PWR type fuels. In February 2004, the ASN authorised extension of the facility's operating range to take in reception, processing and reconditioning of various types of fuels which had undergone destructive and/or non-destructive testing as part of the research programmes of the CEA and other organisations. The STAR main building is designed to withstand a safe shutdown earthquake (SMS). It should ultimately take over the testing activities currently performed at the LECA.

· Laboratory for the experimental design and fabrication of advanced nuclear fuel (LEFCA)

The LEFCA is a laboratory designed for performing basic engineering studies on plutonium, uranium, actinides and their compounds in all forms (alloys, ceramics or composites) with a view to application to nuclear reactors, the performance of ex-pile studies necessary for the interpretation and understanding of fuel behaviour in the reactor and at the various stages in the cycle, and the manufacture of irradiation test capsules or experimental assemblies.

In February 2004, the ASN authorised continued operation of the facility for the next 10 years, provided that the operator takes account of a number of requests resulting from the facility safety review conducted between 1997 and 2003. The operator forwarded revised general operating rules and a proposed modification of the technical requirements. These documents, which will significantly alter the LEFCA's safety reference system, are currently being examined.

1 | 2 | 2

Fontenay-aux-Roses Centre

This centre is currently undergoing dismantling and clean-up (see chapter 15).

1 | 2 | 3

Grenoble Centre

The CEA has decided to stop all research activities in the BNIs on this site. This site is dealt with in chapter 15.

1 | 2 | 4

Saclay Centre

The Saclay Centre is located about 20 km from Paris in the Essonne department. It occupies an area of 200 hectares, including the Orme des Merisiers annex.

The Centre's activities range from fundamental research to applied research in a wide variety of fields and disciplines, such as physics, metallurgy, electronics, biology, climatology, simulation, chemistry and ecology.

The purpose of nuclear applied research is to optimise the operation and safety of the French nuclear power plants and to develop future reactors.

This research work is supplemented by research into radioactive waste management.

The Centre also houses a unit of the INSTN (national teaching institute for nuclear science and techniques) and two industrial companies: Technicatome, which designs nuclear reactors for ship propulsion, and Cis Bio International, which develops and markets diagnostic and radiotherapy products.

· CIS bio International facility

CIS Bio International is a key player on the French market for radiopharmaceutical products used for both diagnosis and therapy. As of 1996, the CEA gradually pulled out of running the installation and sold it to a pharmaceutical group, Schering S.A. Since December 2001, Schering S.A. has owned 100 % of the capital of CIS Bio International; the CEA however remains the official nuclear operator of the facility. The age of the installation, built in the 1950s, under-investment in recent decades, tense labour relations owing to the change in status of CIS Bio International, legal and financial disputes between Schering S.A. and the CEA and the priority given to just in time manufacturing of radiopharmaceutical products over the safety and radiation protection of the facility led to repeated incidents in 2003, 4 of which were classified level 1 on the INES scale and some of which, such as breakage of a flask of iodine 131 solution on 31 July 2003, resulting in releases of radionuclides into the environment or workers contamination.

After an instruction from the Nuclear Safety Authority, the chairman of the board of Schering S.A. agreed in early 2004 to implement a plan of action to remedy the situation. The ASN increased its field inspections in 2004 and met the board of Schering S.A. on a number of occasions in order to measure the effects and the results of the steps taken by the operator with respect to safety and radiation protection.

In October 2004, the ASN and the French Health Products Safety Agency (AFSSAPS) decided, in the light of the conclusions produced by the close monitoring introduced in 2004, to maintain a particularly close watch on the reinforcement of the safety and radiation protection culture, on compliance with good drugs manufacturing practices and pharmaceutical legislation. The operating safety of the installation will be regularly checked in 2005.

The ASN feels that rapid completion of the administrative procedure transferring responsibility as nuclear operator from the CEA to CIS Bio International is essential.

· Spent fuel test laboratory (LECI)

The spent fuel test laboratory is an installation designed to analyse the various components of fuels used in nuclear reactors (components of the radioactive material, components of the fuel assembly cladding, etc.), in order to determine their behaviour when irradiated. The Advisory Committee for laboratories and plants met on 28 April 2004 to examine the safety of LECI extension, based on the safety files forwarded by the CEA. Examination of these files revealed shortcomings in control of the civil engineering design of the installation, although it does however comply with the requirements of its authorisation decree. Given the small quantity of dispersible radioactive materials that is to be present in the installation, the ASN authorised commissioning of the extension provided that a certain number of requests were taken into account. In addition, it will only be possible to notify the new technical requirements for the installation after examination of a set of files concerning the safety of the LECI main building.

· Osiris and Isis reactors

The 70 MWth pool-type reactor Osiris is mainly used for technological irradiation tests on structural materials and fuels for various types of power reactor (notably PWRs), for the production of radioelements and doped silicon and for the irradiation of specimens for activation analysis. Since the end of 1996, the reactor core has consisted entirely of a new U3Si2Al type fuel.

The Isis reactor is a mock-up of the Osiris core. Its power is limited to 700 kWh and it is designed for neutronic measurements and dose metering. Modification of the reactor I&C system began in 2004 so that it could also be used for training purposes as of autumn 2005.

In 2004, the CEA continued with OSIRIS reactor renovation work.

In 2004, the ASN assessed the progress of the steps the CEA was asked to take following the 1999 safety review. The ASN also asked the CEA about the future of the installation, because despite the scale of the renovation work undertaken in recent years and without calling into question the quality of operation, the ASN nonetheless feels that given the age of the design, operation of the installation cannot be considered beyond the end of the decade.

· ORPHÉE reactor

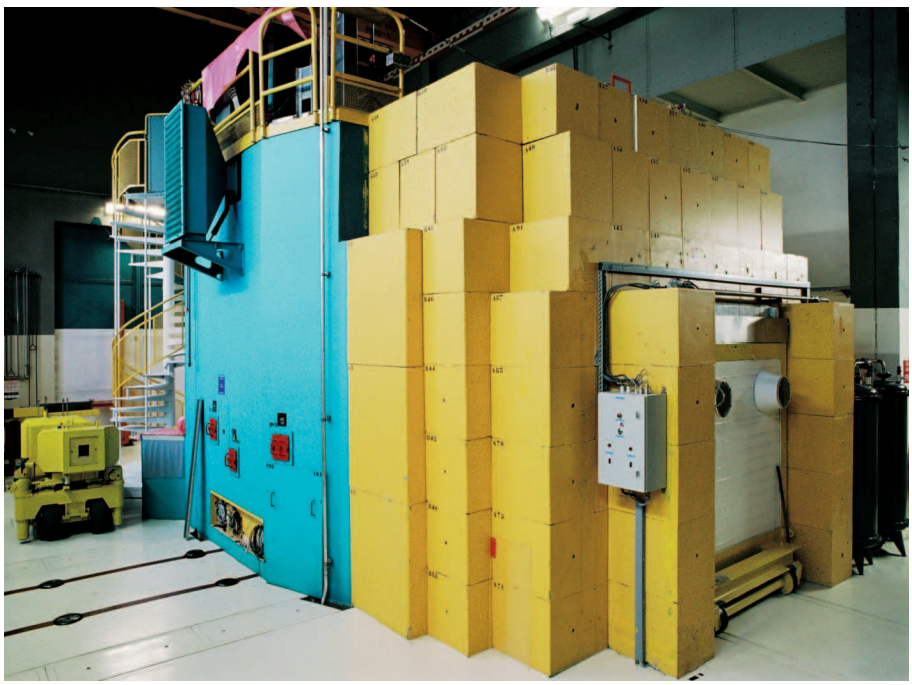
The 14 MWth Orphée reactor is a pool-type research reactor, equipped with nine horizontal fuel channels, tangential to the core, enabling the use of 20 neutron beams. These beams are used by the Léon Brillouin Laboratory (CEA and CNRS) to perform experiments in widely different fields, such as physics, biology or physico-chemistry.

This reactor is jointly funded by the CEA and the CNRS. Owing to new CNRS budget restrictions in 2003, the facility submitted files to the ASN describing restricted operations up until the end of 2005.

The authorisations allowing this new operating mode were issued at the end of 2003. The CEA is to decide on whether to continue operations of this reactor beyond 2005.

· ULYSSE reactor

The Ulysse reactor, with its maximum authorized power rating of 100 kWth, is mainly used for teaching purposes and practical applications. The CEA has decided on final shutdown of this reactor during the course of 2006. Training activities will be transferred to the Isis reactor.



ULYSSE – reactor bloc

1 | 2 | 5

Rhone Valley Centre

The Rhone Valley Centre administratively groups the sites of Marcoule (Gard) and Pierrelatte (Drôme). Non-classified installations represent only a fraction of the installations on these sites.

· ATALANTE

The Atalante installation (Alpha shop and laboratory for analysis of transuranians and reprocessing studies) will eventually group together CEA research and development resources concerning high level radioactive waste and reprocessing. These activities were distributed over three sites: Fontenay-aux-Roses, Grenoble and the Rhone Valley.

Examination of all the files dealing with analysis of the seismic risks forwarded by the CEA for the installation concluded in 2004 that the civil engineering structures of all the buildings were stable for a safe shutdown earthquake on the Marcoule site, provided that the reinforcement work proposed by the operator was carried out. The ASN informed the operator that it considered this reinforcement work to be an essential precondition for commissioning of the installation scheduled for mid-2007. The operator proposed a work performance schedule compatible with this deadline.

In 2004, the operator also began the examination of installation conformity with a view to its commissioning.

1 | 2 | 6

PHÉNIX reactor

The Phénix reactor, built and operated by the CEA jointly with EDF, is a fast neutron demonstration reactor. It is located near the Marcoule Centre in the Gard department). Its construction began in 1968 and first criticality occurred on August 31, 1973. Its rated power is 563 MWth.

The characteristics and performances of this installation are such that it is considered by the CEA to be an indispensable tool for the satisfactory completion of research programmes on plutonium combustion (CAPRA programme) and actinide incineration (SPIN programme). These research programmes come under article L.542 of the Environment Code concerning radioactive waste research.

After extensive reactor renovation work, and following examination by the Advisory Committee for nuclear reactors of the last files detailing repair of the reactor steam generators at the end of 2002, the ASN informed the CEA that it considered that satisfactory answers had been given to the issues linked to the periodic safety review of the installation and prior to reactor power build-up.

The ASN thus informed the CEA in January 2003 that it had no objection to resumption of reactor operations, at the partial power rating of 350 MWth, for the six irradiation cycles still to be performed until 2008.

The first cycle was authorised in June 2003, which enabled the CEA to resume power operations of the Phénix reactor in July 2003. A number of problems in the non-nuclear part of the installation, due to the prolonged reactor outage, delayed power build-up.

Finally, discovery of a leak on the steam generator N° 1 reheater led the CEA to shut down the reactor in September 2003. Reactor restart was subject to authorisation by the ASN.

This was granted in November 2003, following analysis of the CEA's assessments aimed at identifying the origins of the leak. Additional data still need to be sent to the ASN. The CEA will in particular be

required to explain the relevance of and the conditions for continued operation of the reactor should a similar leak happen again.

In September 2004, during checks required by the pressure vessel regulations, the operator brought to light malfunctions affecting 2 of the 12 modules of the economiser-evaporator stage of steam generator n° 3. In the light of the safety analyses presented and the reinforced inspection programme proposed by the operator, the ASN felt that the modules concerned could be kept in service until the next maintenance outage scheduled for April-May 2005. Barring further developments, the ASN did however ask that as a precaution, these items be replaced at that time.

1 | 2 | 7

Effluent and waste treatment installations

The CEA's effluent and waste treatment installations are spread over the Fontenay-aux-Roses, Grenoble, Cadarache and Saclay sites. They are generally equipped with characterisation facilities to enable checks on the declarations made by the waste producers and verification of the conformity of the waste packaged with respect to the specifications for acceptance prior to routing to the appropriate channel (storage facility, processing facility such as CENTRACO, repository). The processing and packaging installations primarily handle the liquid and solid waste generated by the CEA centre on which they are located. They occasionally process waste from outside nuclear sites (CEA or others) depending on their specific nature.

The installations devoted specifically to interim storage of waste and spent fuels are dealt with in chapter 16 (§ 7).

· CEA Fontenay-aux-Roses site

The radioactive effluent and solid waste treatment station (STED-Fontenay-aux-Roses) works specifically on the clean-up and dismantling of the CEA's Fontenay-aux-Roses site. BNI 34 now only deals with sorting, packaging and decontamination along with interim storage of solid waste and removal of radioactive liquid effluent from the site. It will be operated in its current configuration until the end of site clean-up, scheduled for 2010 (see chapter 15).

· Grenoble site

Since 31 December 2003, the effluent and waste treatment station (STED-Grenoble) has been storing solid waste and aqueous effluents produced by the denuclearisation of the site (see chapter 15).

· Cadarache site

The function of the effluent and solid waste treatment station (STED-Cadarache) is, following compacting where applicable, to package radioactive waste and decontaminate radioactive aqueous effluent. Beta-gamma emitter effluents are treated by evaporation. The concentrates are encapsulated in a cement matrix prior to storage at the Aube waste repository. Alpha emitter effluents are treated by a precipitation-filtration method; the resulting sludge is encapsulated in a cement matrix and sent to the Cadarache interim storage facility, pending final disposal.

During the course of 2004, no rapid corrosion problems were observed on the drums of radioactive organic liquids stored in the ZELORA interim storage facility. The material chosen by the CEA for packaging liquids identified as being particularly corrosive would seem to be appropriate.

The ASN does however want the CEA to give priority to the treatment of radioactive organic liquids.

Following the 1998 safety review of STED-Cadarache, operation was authorised to continue for a limited period, initially compatible with the time needed to create replacement facilities and subject to compensatory measures being implemented. The CEA committed itself to gradually ceasing certain activities on the STED-Cadarache site.

The slow progress in the installation creation projects has led the CEA to look at interim solutions for the management of its solid and liquid waste.

The waste treatment station (STD) ceased operation of the low-level waste dismantling cell and the 250-ton compacting press. The CEA hopes to continue with the supervision, storage and characterisation of the solid waste suitable for compacting and incineration until start-up of the LA ROTONDE replacement ICPE, scheduled for mid-2007.

The 500-ton press for compacting low-radiation level B waste will be kept in service.

With regard to the effluent treatment station (STE), the replacement installation will be AGATE, with start-up scheduled for 2010. In order to minimise road transport of liquid radioactive waste for treatment in another nuclear centre, the ASN envisages authorising extending STE operations, for strictly limited quantities.

· Saclay site

The solid waste management zone handles treatment and interim storage of solid radioactive residues produced in the Centre by the reactors, laboratories and workshops.

The solid waste management zone also recovers waste from small producers (scintillation liquid sources, ion exchanger resins) and provides interim storage for radioactive sources. Waste is now sorted at source. The lead decontamination oven was shut down in 2004. During this same year, the ASN authorised start-up of the RCB 120 cell for compacting and packaging Saclay Centre waste.

In 2004, the CEA made progress with disposal of the bulk store of irradiated fuel elements. These elements are sent to CEA Cadarache, for reconditioning in STAR and interim storage in CASCAD. Finally, the CEA is continuing with its safety review of the solid waste management zone and is in the process of defining the functions it wishes to maintain.

The radioactive liquid effluent management zone (STE-Saclay) processes low-level aqueous effluent and stores aqueous and organic effluent. The radioactive aqueous effluents are evaporated pending start-up of the STELLA facility scheduled for 2007. STELLA will package the concentrates in a cement matrix. In 2004, the ASN authorised start-up of the tanks in the RÉSERVOIR facility for interim storage of aqueous effluent only. RÉSERVOIR should offer the CEA sufficient radioactive effluent interim storage capacity pending the scheduled commissioning date for STELLA.

Decree 2004-25, published in the *Official Gazette* of 8 January 2004, authorised the CEA to modify the STE-Saclay by adding the STELLA extension to it.

The CEA is currently drafting provisional safety documents for STELLA and at the same time conducted the periodic safety review on STE-Saclay. The members of the Advisory Committee will jointly examine safety at STE-Saclay and the provisional safety reference system for STELLA.

The CEA is making progress in its projects for the recovery and treatment of old effluent stored at STE-Saclay. In 2004, the CEA managed to solubilise the medium-level aqueous effluents which were stored in bulk in tank MA 502. These solubilised effluents will be transferred to RÉSERVOIR for subsequent cement encapsulation in STELLA.

2 Other basic nuclear installations

2 | 1

Chinon irradiated material shop (AMI)

This installation, located on the Chinon nuclear site (Indre-et-Loire department), is operated by EDF. It is mainly used for examination and appraisal of PWR fuel elements and activated or contaminated materials.

During the course of 2004, EDF specified the options of the installation's safety reference system with regard to its operation following renovation. EDF in particular made a commitment to significantly reducing the inventory of radioactive materials present in the installation, to cease all reactor fuel element appraisal work and to confine the remaining inventory in a new building meeting current safety standards. In the last quarter of 2004, EDF forwarded the safety options file for the installation's target state as it would be following the renovation work at the end of 2006.

In September 2004, the ASN also authorised commissioning of a device called "waste sorting and packaging assembly" enabling EDF to continue with clean-up of pits containing old waste.

2 | 2

Electromagnetic radiation laboratory (LURE)

The electromagnetic radiation laboratory (LURE), located in Orsay (Essonne), is an installation providing synchrotron radiation (powerful X rays) for widely varying areas of research, with a maximum energy of 0.8 GeV for the super-ACO ring and 1.85 GeV for the DCI ring. Both rings are powered by the 50 MeV LINAC injector.

In June 2002, the operator announced its intention to cease operation of the facility at the end of 2003, apart from the autonomous use of the CLIO laser. The decommissioning phase began in early 2004. It should be noted that the facility's first ring (ACO ring), built in the 1960s, is now included on the "supplementary" list of industrial historical monuments.

2 | 3

European Organization for Nuclear Research (CERN) installations

The European Organization for Nuclear Research (CERN) is an intergovernmental organization established on the basis of a treaty between States for the purpose of carrying out purely scientific and fundamental research concerning high energy particles.

The CERN site is located near Geneva, on the Franco-Swiss border.

The safety of these installations is regulated by a convention binding the French Government and the CERN. The convention currently in force, which dates from July 2000, states that French legislation applicable to BNIs applies to the LHC and to the SPS, two rings which make up part of the CERN's installations. It also designates the DSIN (now the DGSNR) as the French Government representative to deal with technical matters concerning the convention. The ASN also has a seat on the CERN's radiation protection committee, in charge of all radiation protection problems on the site.

The CERN is currently working on setting up a hadron collider (Large Hadron Collider, LHC) which should enable progress to be made in particle physics research, notably by implementing proton-proton collisions at a beam energy of 7 TeV. The LHC will be installed in the Large Electron-Positon (LEP) tunnel. Work on the LHC site, which began in 1998, continued with dismantling of the LEP installations. These dismantling operations require effective radiation protection of the workers involved as well as provisional interim storage of activated materials, pending long-term disposal of very low level materials. Active commissioning of the LHC is scheduled for 2005.

2 | 4

Large National Heavy Ion Accelerator (GANIL)

The GANIL, located in Caen (Calvados department) is designed to accelerate all heavy ions (from carbon to uranium) with a maximum energy of 100 MeV per nucleon.

The CIRIL6 radiobiology laboratory was started up in autumn 2003. In May 2004, GANIL forwarded a safety options file for the SPIRAL 2 project (creation of new experiment rooms with a more powerful beam). This is currently being investigated by the ASN and its technical support organisation.

2 | 5

Industrial ionisation installations

Industrial ionisation installations provide gamma-ray (mainly cobalt 60 sources) treatment for medical equipment (sterilization) or foodstuffs. An ioniser consists of a concrete bunker inside which the ionisation processes take place. The sources are placed in a pool inside the bunker. They are remotely and automatically extracted from the pool during an ionisation operation. They are then lowered into the pool whenever an operator has to intervene. There is thus no risk of irradiation inside the bunker.

Such facilities have been installed at Pouzauges, Marseille, Sablé-sur-Sarthe and Dagneux.

On 20 November 2003, the ASN authorised resumption of industrial operations at the Pouzauges ionisation installation.

2 | 6

Laue-Langevin Institute high flux reactor

The high flux reactor (RHF) at the Laue-Langevin Institute in Grenoble constitutes a neutron source mainly used for experiments in the field of solid-state physics and nuclear physics. Maximum authorized power for this reactor is 58.3 MWth. The reactor core, cooled and moderated by heavy water, is placed at the centre of a reflector tank, immersed in a light water pool.



RHF – view of the installation

Following the May 2002 meeting of the Advisory Committee for reactors, the ASN asked for seis-

mic reinforcement work to be carried out on the installation. This work is still in progress and should continue until 2006.

The installation's liquid and gaseous effluent release licences are still being revised.

2 | 7

Maintenance shops

Three basic nuclear installations specifically handle nuclear maintenance activities in France. They are:
- the SOMANU (nuclear maintenance company) shop in Maubeuge (Nord department), specializing in the repair, servicing and appraisal of equipment, mainly from PWR primary coolant systems and auxiliaries, but excluding fuel elements;
- the cleanup and uranium recovery installation of the Tricastin service company (SOCATRI) in Bollène (Vaucluse department) which handles maintenance, interim storage and cleanup of equipment from the nuclear industry and storage of waste on behalf of ANDRA;
- the Tricastin operational hot unit (BCOT), also in Bollène, which carries out maintenance and interim storage of contaminated PWR equipment, except for fuel elements.

In 2004, the SOMANU was authorised to extend the active parts interim storage building in its Maubeuge shop.

Modification of the release licence, dealing with how supervision is carried out, is in progress.

The surface treatment shop, located in the non-nuclear part of the SOCATRI installation at Bollène, gave rise to groundwater pollution by hexavalent chromium in 1998. The cleanup operations, required by order of the Prefect on 26 November 1998 and consisting in pumping the groundwater for depollution by ion exchange resin treatment, are still proceeding, until the thresholds set by the above-mentioned order are reached.

With regard to effluent releases, the SOCATRI should be submitting a further release licence application as a result of the higher release levels of certain elements determined by a reassessment.

2 | 8

Inter-regional fuel warehouses (MIR)

EDF has two inter-regional fuel warehouses, on the Bugey site in the Ain department and at Chinon in Indre-et-Loire. EDF uses them to store nuclear fuel assemblies (only those made of uranium oxide) pending loading into the reactor. Accessibility considerations and a just-in-time fuel management policy have led EDF to indicate that it intends to close down the Chinon warehouse in the near future.

2 | 9

CENTRACO waste incineration and melting facility

The CENTRACO low-level waste processing and packaging centre, located in Codolet near the Marcoule site (Gard), is operated by SOCODEI. The role of CENTRACO is to process low or very low level waste by incineration or melting.

The CENTRACO incineration unit is designed to process all low-level, short-lived combustible solid and liquid waste produced by nuclear installations, research laboratories and hospitals. The ash and



Storage of melt process ingots and process waste

clinker resulting from incineration, and the dust and dressing products resulting from melting are blocked in a hydraulic binder in the cold inerting facility. After packaging in 400 litres shielded metal drums, they are shipped as ultimate waste to the ANDRA's Aube repository.

The CENTRACO incineration unit is designed to process low-level, short-lived waste resulting from routine operation of nuclear installations, maintenance and process changes, nuclear site dismantling and so on. The waste resulting from melting is recycled when it meets certain metallurgical criteria, either to produce radiological protection (PRI) used in packaging other medium-level waste, or in the manufacture of metal drums for packaging waste from the incineration unit intended for final disposal. The melting waste not recycled is then cast into ingots which are shipped as ultimate waste to the ANDRA's surface repository.

In 2004, the operator began to look at changes to the installation's operating range, in the light of experience feedback and changes to the VLL waste management technologies with opening of the VLL waste repository (see chapter 16). This could lead CENTRACO to apply for a modification to its authorisation decree and its liquid and gaseous effluent release and water intake licence.

In 2004, the ASN changed the status of the authorisation to use the automatic preparation chain for solid waste intended for incineration from provisional to permanent. SOCODEI acquired a more powerful X-ray device so that it could detect any prohibited products in the drums.

CENTRACO is also moving towards direct incineration of the waste drums, entailing a switch from packaging in steel drums at the producer to packaging in polythene drums.

2|10

The ITER (International Thermonuclear Experimental Reactor) project

The ITER project aim is scientific and technical demonstration of control of thermonuclear fusion during long-term experiments with significant power levels (500 MW for 400 s). This project is an international one and is currently receiving financial support from China, South Korea, Japan, Russia, the European Union and the United States. Cadarache is the site proposed by the European Union for construction of the controlled fusion machine with magnetic confinement of the deuterium-tritium plasma. This site is competing with the Rokkasho-Mura one in Japan. The various project partners have not yet succeeded in choosing the site for the future facility. Pending creation of the international ILE (ITER Legal Entity) which should be the operator, the CEA has started technical discussions with the ASN, and in February 2002 presented a safety options file. The ASN felt that the safety options for the installation were acceptable.

However additional requests were made, primarily concerning management of the beryllium risk (chemical toxicity), the radioactive waste and the tritium inventory.

Technical discussions continued in 2004 and the CEA's goal is to draft the preliminary safety analysis report for an installation of this type.

An international decision concerning the final location of ITER is expected by early 2005.

3 Outlook

The operators of basic nuclear installations devoted to research find themselves in a complex situation: on the one hand, they must comply with stringent constraints to satisfy safety requirements and, on the other hand, they must satisfy researchers seeking increasingly flexible working conditions. In this context, the operators often apply for limited authorizations to carry out experiments and installation modifications not provided for in the initial safety reference system of their facility. As regards the CEA, a formal framework was set up which, for specified installations, enables it internally to authorise certain operations or modifications which do not compromise the safety demonstration. This system will be gradually extended and should soon concern most of the CEA's installations. This approach is however accompanied by two stringent demands placed on the CEA. The first concerns complete updating of the safety reference systems as they evolve. The second concerns the CEA's undertaking to conduct regular safety reviews of its installations.

In 2004 therefore, the ASN sent the CEA requirements concerning the expected quality of the safety reviews to be conducted on its installations. The CEA will in particular be required, prior to the safety review, to submit two documents concerning on the one hand the future of the installation and its major changes in the coming decade, and on the other, the methodology used and the associated organisation and schedule. The ASN will maintain a particularly close watch on compliance with the ten-yearly deadlines for the safety reviews. Finally, it expects the operator to state its position regarding the acceptability of the deviations observed and to submit a document presenting the improvements it proposes.

The ASN is also asking the CEA to develop cross-functional monitoring and experience feedback analysis approaches.

Finally, research installations are often operated by large public research organisations and 2003 showed the extent to which their resources are dependent on the State's budget. A number of installations therefore experienced significant and unexpected cuts in their investment funding and even their operating resources, which obliged the ASN to respond quickly by examining applications for changes to the operating conditions. 2004 saw an improvement in this direction. The ASN will ensure that in the coming years, budgetary constraints have no impact on the safety and radiation protection of research installations operation.

THE NUCLEAR FUEL CYCLE INSTALLATIONS

CHAPTER 14

1 MAIN TOPICS COMMON TO ALL INSTALLATIONS

1 | 1 Fuel cycle consistency

1 | 2 Retrieval of waste due to past practices

1 | 3 Discharge licence revision

1 | 4 Incident management and operating feedback

1 | 5 Operator responsibility

2 MAIN INSTALLATIONS

2 | 1 Uranium conversion and processing plants

2 | 1 | 1 Comurhex uranium hexafluoride preparation plant

2 | 1 | 2 COGEMA TU5 shop and W plant

2 | 2 Uranium enrichment plants

2 | 2 | 1 The uranium isotopes gaseous diffusion separation plant (Eurodif)

2 | 2 | 2 The ultracentrifugation enrichment plant project

2 | 3 Nuclear fuel fabrication plants

2 | 3 | 1 Nuclear site at Romans-sur-Isère

2 | 3 | 2 Plutonium technology shop (ATPu) and chemical purification laboratory (LPC) at Cadarache

2 | 3 | 3 MELOX plant at Marcoule

2 | 4 COGEMA La Hague complex

2 | 4 | 1 Presentation

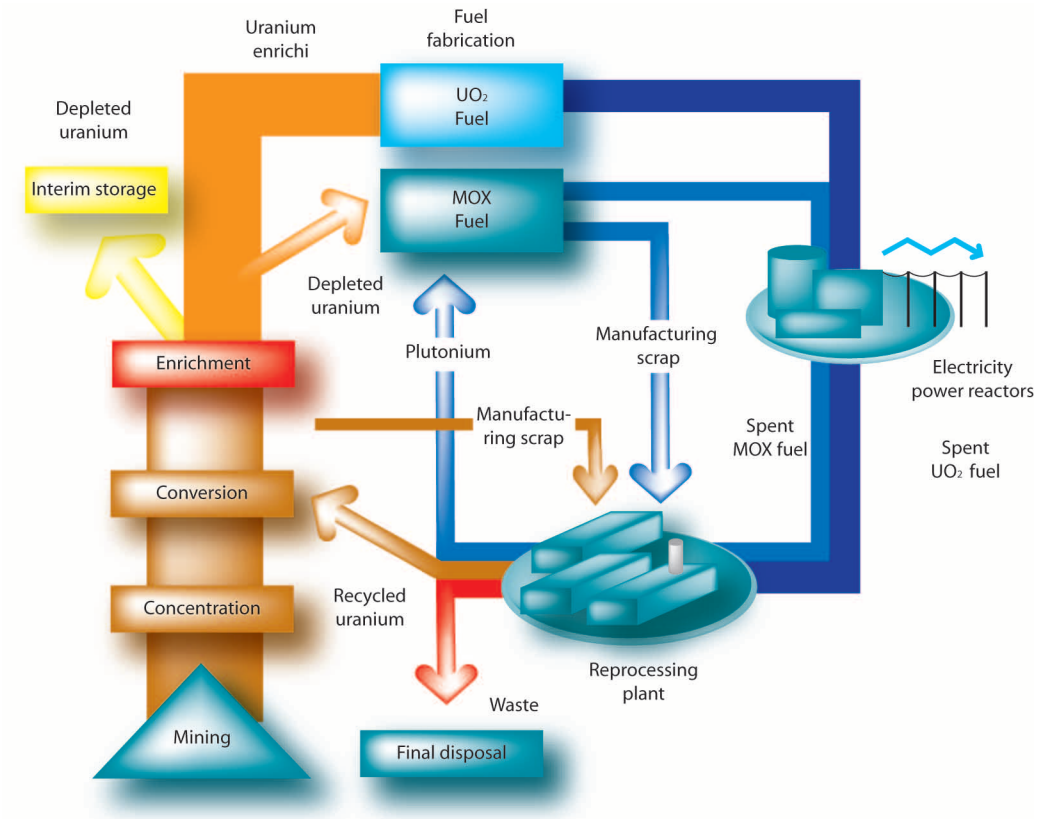
2 | 4 | 2 Operations carried out in the plant

2 | 4 | 3 Regulatory framework for the facilities

2 | 4 | 4 Site discharges and environment monitoring

3 OUTLOOK

Fuel cycle



Manufacture of the fuel and its subsequent reprocessing after it has passed through the nuclear reactors constitute the fuel cycle. The cycle begins with the extraction of uranium ore and ends with storage of a variety of radioactive waste originating from the irradiated fuel or from the industrial operations involved and utilising radioactive materials.

The uranium ore is mined, purified and concentrated into yellow-cake on the mining site. The installations involved use natural uranium, where the uranium 235 content is about 0.7%. They are not covered by basic nuclear installation regulations.

Most of the world's reactors use uranium which is slightly enriched with uranium 235. For example, the pressurised water reactor (PWR) series requires uranium enriched to between 3 and 5% with isotope 235. Prior to enrichment, the solid yellow-cake is converted into uranium hexafluoride gas during the conversion operation. This is done in the Comurhex facilities in Malvési (Aude department) and Pierrelatte (Drôme department).

In the Eurodif plant at Tricastin, the uranium hexafluoride is separated into two streams using a gaseous diffusion process, one relatively rich in uranium 235 and the other depleted.

The enriched uranium hexafluoride is then converted into uranium oxide to allow manufacture of fuel assemblies in the FBFC plants at Romans-sur-Isère. The assemblies are then placed in the reactor core where they discharge power by fission of the uranium 235 nuclei.

After about three years, the spent fuel is removed from the reactor and cooled in a pit, first of all on the plant site and then in the COGEMA reprocessing plant at La Hague.

In this plant, the uranium and plutonium from the spent fuels are separated from the fission products and the other actinides. The uranium and plutonium are packaged for interim storage before subsequent reuse. The radioactive waste is placed in a surface repository if low-level, or in interim storage pending an appropriate disposal solution.

The plutonium produced by reprocessing can be used to make fuel for fast neutron reactors (as was the case in the ATPu at Cadarache), or MOX fuel (uranium and plutonium mixed oxide), used in French 900 MWe PWRs, in the Marcoule MELOX plant.

The vast majority of the plants in the cycle belong to the AREVA group, which primarily consists of the COGEMA and Framatome-ANP groups. The uranium-based fuel manufacturing plants are operated by FBFC, a wholly-owned subsidiary of Framatome-ANP. The organisation of the COGEMA group comprises an executive committee, 4 divisions (Mines-chemistry, Enrichment, Processing-recycling-engineering, Services) containing 11 business units, corporate functions and an operational committee. Fuel cycle BNIs depend on the business units covering Chemistry (Comurhex, TU5, W, COGEMA Miramas), Enrichment (Eurodif), Processing (COGEMA La Hague) and Recycling (ATPu, MELOX).

Fuel cycle industry throughput (1)

Installation	Product processed	Tonnage	Product processedé	Tonnage
Comurhex Pierrelatte	Uranyl nitrate (based on reprocessed uranium)		UF_4 UF_6 U_3O_8	129 0 170
COGEMA Pierrelatte TU5 shop	Uranyl nitrate (based on reprocessed uranium)	1445	U_3O_8	1445
COGEMA Pierrelatte W plant	UF_6 (based on depleted uranium)	13 558	U_3O_8 produced U_3O_8 stored U_3O_8 stored in Bessines	13 532 1636 11 007
Eurodif Pierrelatte	UF_6	23 862	UF_6 (depleted uranium) UF_6 (enriched uranium)	21 608 3247
FBFC Romans	UF_6 (based on enriched natural uranium) UF_6 (based on enriched reprocessed uranium)	967 10	UO_2 (powder) UO_2 (fuel elements) UO_2 (URE-fuel elements)	349 618 0
MELOX Marcoule	UO_2 (based on depleted uranium) PuO_2	136 10	MOX (fuel rods)	104
COGEMA La Hague	Reprocessed spent fuel elements UP3 UP2 800 UP2 400 Spent fuel elements unloaded into pit	 641 460 0 1279	Vitrified waste packages produced UP3 (number of containers) UP2 800 (number of containers) NU produced PuO_2 produed	 370 298 1149 12.3

(1) The table deals with throughput in fuel cycle BNIs, except for the COGEMA W plant.

1 MAIN TOPICS COMMON TO ALL INSTALLATIONS

1 | 1

Fuel cycle consistency

With a view to upgrading the performance of reactors in service, EDF is implementing new fuel management systems, requiring prior Nuclear Safety Authority (ASN) authorisation.

As overall acting principal, EDF must be fully aware of fuel cycle technical and administrative constraints in order to deal effectively with the related forward planning: processing of materials involved, fuel fabrication, reactor fuelling, material transportation, spent fuel removal, delivery and interim storage, possible reprocessing, effluent discharge, waste management, etc.

The ASN supervises the consistency of these new fuel management systems with the texts applicable to fuel cycle installations and the transportation of radioactive and fissile materials: the authorisation decrees for these facilities, the liquid and gaseous effluent discharge and water intake licences, the technical specifications and the radioactive material transportation regulations.

EDF has to undertake a forward-looking study in cooperation with the fuel cycle companies, presenting elements concerning compatibility between current changes in fuel characteristics and fuel cycle installation developments.

On this subject and at the request of the ASN, EDF presented a safety dossier on the impact on fuel cycle installations of the innovations currently envisaged, considering:
- the quantities of radioactive materials due to previous fuel management systems currently in interim storage;
- current fuel management systems which could entail revision of the fuel cycle installation safety reference system or modification of the installations concerned;
- fuel assemblies where the rod structural or cladding materials differ from those taken into account in the fuel cycle installation safety studies;
- scenarios concerning new fuel management systems and new products, the implementation of which is planned within the next ten years;
- scenarios concerning the management of unloaded spent fuel;
- the impact of these new management systems and scenarios between 2000 and 2010, on the one hand, and beyond 2010, on the other, with regard to by-products and waste resulting from fuel fabrication and reprocessing (interim storage or potential disposal, together with reprocessing possibilities and associated channels).

The dossier submitted by EDF was examined during three meetings held between November 2001 and February 2002, by the Advisory Committees for laboratories and plants and for waste and by several members of the Advisory Committee for reactors.

For the ASN, the purpose of this 10-year forward-looking assessment process was to make sure that the options presented by the operators contained no redhibitory defect. With this in mind, the ASN wished to identify points requiring further justification or application for licences from the operators, as and when necessary.

The dossier presented by EDF provides significant clarification of how the fuel cycle operates and the safety issues, in particular adding the technical and regulatory limits that changes to fuel management policies could bring about, subject to adequate justification. The examination showed that the new fuel management arrangements presented by EDF seemed to contain no redhibitory defects.

In order to maintain an overview of the fuel cycle, the ASN feels that this dossier will have to be periodically updated. In particular, for any new fuel management system, the ASN asked EDF to pre-

sent a feasibility study of this new management system, accompanied by a revision of the "nuclear fuel cycle" dossier, specifying and justifying any differences.

This process is currently under way for the future MOX-parity and GALICE fuel management systems (see § 2|3|3).

In order to control throughput and stocks of materials, fuels and waste, with reference to the data presented in the "nuclear fuel cycle" dossier, EDF implemented a project known as "nuclear fuel cycle watch and anticipation". EDF presents an annual review of observed changes in the working of the fuel cycle.

1 | 2

Retrieval of waste due to past practices

La Hague



COGEMA La Hague – general view

Unlike the new UP2 800 and UP3 plants, most of the waste produced during operation of the first plant, UP2 400, was placed in interim storage without packaging for disposal. At the request of the ASN, a dossier presenting the programme for retrieval of old waste without packaging, still in interim storage facilities on the site, was transmitted by COGEMA.

Further to examination of this dossier by the Advisory Committees for laboratories and plants and for waste at the end of 1998, the ASN asked COGEMA, in a letter of 27 January 1999, to undertake, as soon as possible, the retrieval of the sludge in the STE2 silos, the waste in the HAO silo, and the waste in the 130 building silo.

The ASN notably asked COGEMA to present as soon as possible firm commitments regarding the startup date for these operations, to submit estimated schedules for the operations with the associated R&D actions and to present an annual report indicating progress made on the work in question.

Certain recent facilities are already operating and could deal with some UP2 400 waste. This is the case, for example, with the resin cementing shop (ACR) and the STE3 organic effluent mineralisation shop (MDSB).

STE2 sludge

Dealing with STE2 sludge is the subject of research and development work, in particular with a view to determining retrieval and transfer methods. The retrieval and packaging system proposed by COGEMA consists in bituminisation using a process developed in the STE3 shop. Considering available know-how on the medium and long-term behaviour of bituminised waste and the difficulties of implementing bituminisation processes, the ASN was of the opinion that COGEMA should study other packaging processes at the same time. A description of the DRY-PAC and cementing processes, together with the conditions under which these processes could be applied to STE2 sludge treatment, were presented by COGEMA. As the cementing tests did not give satisfactory results, three solutions could still be envisaged: use of new "safe" silos, sludge compaction producing packages compatible with interim storage requirements, or sludge bituminisation.

COGEMA was authorised to carry out sampling in one of the silos with a view to validating the transfer arrangements and to conduct bituminisation tests on about twenty drums in the STE3 shop in order to validate the adequacy of this process. Retrieval, transfer and bituminisation tests took place in 2002. The result of the analysis conducted in 2003 by the ASN and its technical support organisation showed that major developments were still needed before industrial retrieval of the sludge can take place.

In 2004, the operator submitted a dossier aiming to demonstrate the treatment process suitability in order to begin recovery and packaging operations from 2005 and it committed to produce 3000 drums in the first 3 years of operation, while continuing to look into alternative solutions. This dossier is being reviewed by the ASN and its technical support organisation.

HAO Silo

The HAO silo contains various hull and end-piece waste, fines, resins and technological waste produced by operation of the HAO shop since 1976. COGEMA is considering dealing with the hulls and end-pieces in this silo by compaction in the ACC shop. The first step should be the characterisation of these hulls and end-pieces prior to retrieval, sorting and transfer of the waste to packaging units. Sampling began in May 2002 and continued in 2003. Sample analysis is in progress in a laboratory at the Marcoule facility, and the corresponding report should be available during the first quarter of 2005. COGEMA is continuing to examine recovery and sorting of all this waste with a view to packaging it.

Silo 130

COGEMA is currently developing a mechanical waste retrieval system in this silo and is improving its knowledge of this waste.

This project is linked to the creation of a dedicated disposal facility and definition of an associated waste package. These recovery operations will not therefore be able to take place before 2010 and will involve a number of phases, with packaging of waste containing graphite and then the other waste. The retrieval systems will be likely to change during the course of the various phases, depending on the materials encountered and the retrieval conditions.

Former solutions for fission products stored in the SPF2 unit of the UP2 400 plant

To prepare for recovery and packaging of the fission products resulting from GCR reactor fuel reprocessing, and in particular containing molybdenum, COGEMA sent the ASN the specifications for the CSD-U standard waste package. This dossier is currently being analysed.

Other wastes

In September 2002, COGEMA sent the ASN a safety case about the characterisation and stowage of the waste drums present in the ATTILA pit. In August 2003, COGEMA was authorised to carry out these operations which should be completed in 2005.

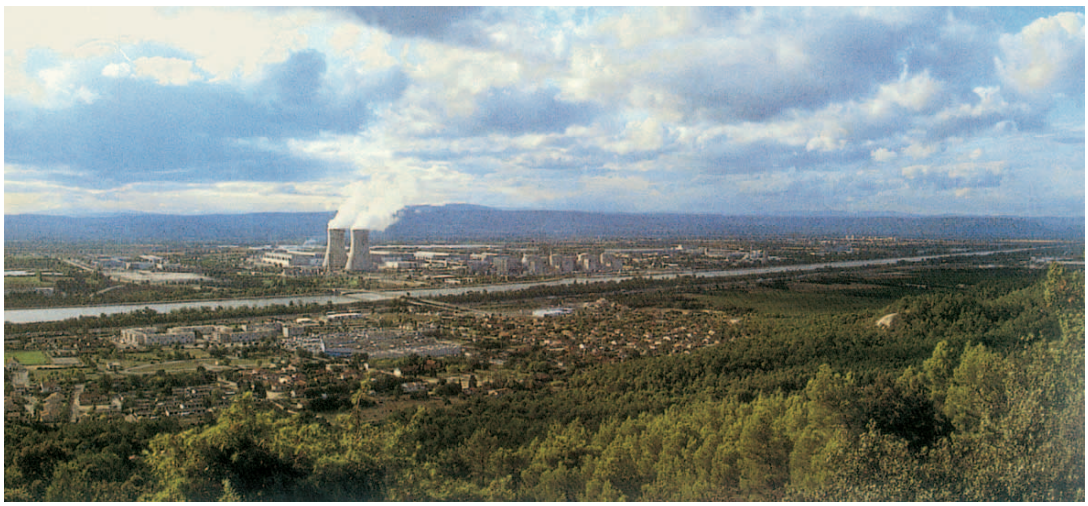
The ATPu

Since industrial production at the facility ceased in July 2003, the operator has been making the changes necessary for implementing packaging of the scrap from its previous manufacturing operations, prior to its shipment to the COGEMA La Hague site. These operations should last until the end of 2006. Nonetheless, this process will be interrupted for about three to four months, to allow fabrication of the EUROFAB rods (see § 2|3|2).

1 | 3
Discharge licence revision

The ASN initiated the revision of certain discharge licences, with a view to correcting three types of unsatisfactory situation:
- the older facilities for which regularisation has not been completely investigated by the Administration and for which effluents are monitored on a contractual basis;
- installations where effluents are discharged via purification plants belonging to other nuclear operators. Such installations do not have their own specific discharge licences;
- installations where the discharge licences are to a varying extent disproportionate with respect to technical possibilities and actual discharge rates involved or are incompatible with foreseeable plant modifications.

The new orders regulating effluent from the Comurhex, Eurodif and Socatri installations, should be ready for publication in early 2005. They are the end-product of a process started in 1999. The dossiers presented by the operators were the public inquiry subject, which began on 15 February and



Tricastin site – general view

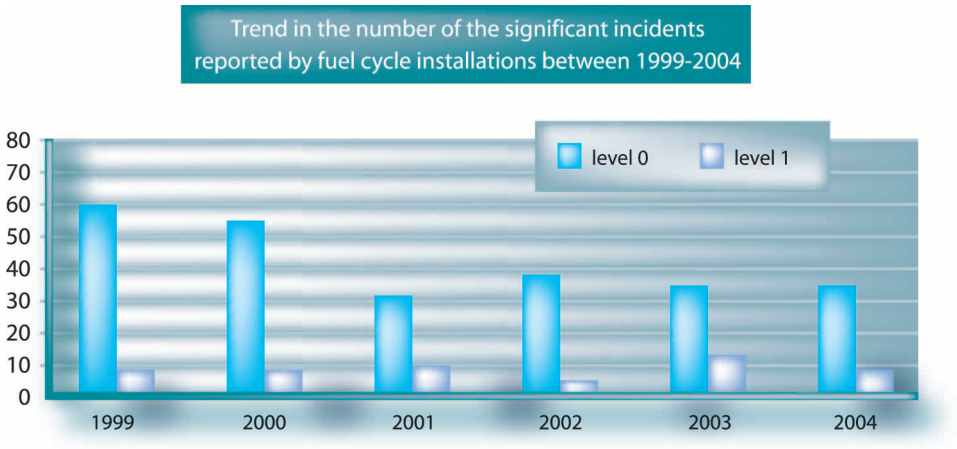
ended on 23 March 2001. The procedure and in particular the public inquiry showed no reason to oppose the various applications.

At the beginning of 2003, the operators of the COGEMA Pierrelatte and Comurhex facilities realised that handling of certain products could lead to release of tritium, or even carbon 14, which was not provided for in the above-mentioned applications. These operators submitted a new discharge licence application, which will be the subject of a public inquiry as soon as the above-mentioned orders have been published.

1 | 4

Incident management and operating feedback

The detection and processing of anomalies and incidents that have occurred in operation of the installations play a fundamental safety role. The lessons learned from correcting these unusual occurrences lead to new requirements applicable to safety-related items and to new operating rules. Operators must therefore set up reliable systems for the detection, correction and integration all safety-related events.



The following graph presents the trend in the number of significant incidents reported by fuel cycle installations.

ASN monitoring of these incidents and how they are managed by the operators in particular enables it to identify:
- incidents recurring on the same installation;
- incidents requiring operating feedback to other installations to confirm or invalidate their generic nature, in other words affecting or likely to affect several installations belonging to one or more operators.

No incident justifying such treatment occurred in 2004.

1 | 5

Operator responsibility

The nuclear installation safety is primarily based on the supervision carried out by the operator itself. In this respect, for each installation, the ASN checks that the organisation and resources deployed by the operator enable it to assume this responsibility.

The restructuring of the AREVA group led to increased vigilance in this area, in particular with respect to the small installations. It is important that the fact of centralising resources, particularly financial resources, enables each nuclear operator to can continue to assume its responsibility as operator. Thus, if a facility operator was not longer able to fully assume its safety responsibility, the ASN could ask AREVA to become itself the operator of this installation by means of an operator change procedure.

In addition, to increase the operators' sense of responsibility and to rationalise its supervisory actions, the ASN requested COGEMA to propose an internal authorisation system allowing changes of the installation or of the safety reference framework without compromising the overall safety demonstration. Only operations which do not fall outside the scope of the authorisation decree or the technical specifications of the installation could be dealt with this process. Significant modifications will still be submitted to the ASN for approval. This new system could be implemented for a trial period in 2005, concerning the COGEMA units at La Hague which are currently being decommissioned.

2 Main installations

2 | 1

Uranium conversion and processing plants

To allow production of fuel usable in the French reactors, the uranium ore first has to be converted into UF_6 and then enriched.

2 | 1 | 1

Comurhex uranium hexafluoride preparation plant

The ICPE (installation classified according to the environmental protection regulation rather than the nuclear installation regulation) part of the Comurhex plant in Pierrelatte is designed to manufacture uranium hexafluoride.



Comurhex – general view

This manufacturing uses natural uranium in the ICPE part of the installation and reprocessed uranium in the BNI part. This latter mainly consists of two shops:
- the 2000 facility, which converts uranyl nitrate from the reprocessing plants into UF_4 or into U_3O_8;
- the 2450 facility, which converts the UF_4 (whose uranium 235 content is between 1 and 2.5%) from the 2000 facility into UF_6. This UF_6 will be used to enrich the reprocessed uranium for recycling in the reactor. The operator made the decision to close down this installation.

The 2450 facility shutdown leads to 235U levels strictly lower than 1% for all activities in the COMURHEX BNI, which could enable the operator to benefit from downgrading to an ICPE rather than a basic nuclear installation.

Seismic risk

In July 2001, the ASN had asked Comurhex to assess the earthquake resistance of its basic nuclear installation. The studies which were in particular carried out to check the reprocessed uranyl nitrate tank strength, are still underway because the operator is currently considering the future orientations of this installation.

Waste removal from area 61

This area contains waste, some of which does not yet have any disposal channel. However, the rubble produced by COMURHEX can now be taken away to the Morvilliers VLL waste repository which opened in 2003.

2 | 1 | 2

COGEMA TU5 shop and W plant

COGEMA operates on the Pierrelatte site BNI 155, which comprises:
- the W plant (ICPE within the BNI perimeter) which converts depleted uranium hexafluoride (UF_6) into uranium oxide U_3O_8, a solid compound offering safer interim storage conditions;
- the TU_5 shop for conversion of uranyl nitrate ($UO_2(NO_3)_2$), produced by reprocessing spent fuel, into uranium tetrafluoride (UF_4) or into uranium oxide (U_3O_8). However, the current technical configuration of the installation is not compatible with the production of UF_4.

The installation can handle up to 2000 metric tons of uranium per year. It was commissioned on September 2004.



TU5 – general view

The uranium from reprocessing is partly placed in interim storage on the COGEMA Pierrelatte site and partly sent abroad for enrichment.

Planned modifications

The P0 interim storage project is being studied by COGEMA and could give rise to a licence application in the near future. The P0 would be intended for the interim storage of civil materials currently stored in classified BNI facilities also operated by COGEMA on the site, together with the uranium produced by reprocessing in the TU_5 shop.

2 | 2

Uranium enrichment plants

2 | 2 | 1

The uranium isotopes gaseous diffusion separation plant (Eurodif)

The isotope separation process used in the plant is based on gaseous diffusion. The plant comprises 1400 cascaded enrichment modules, split into 70 sets of 20 modules grouped in leak-tight rooms.

The gaseous enrichment principle consists in repeatedly diffusing UF_6 gases through porous walls called "barriers". These barriers offer preferential passage to the uranium isotope 235 contained in the gas. At each passage through a barrier, the proportion of this fissile isotope in the UF_6 increases accordingly.

Each enrichment module has a compressor for raising the UF6 gas to the required pressure, an exchanger removing the heat produced by compression and the actual diffuser containing the barriers.

The U235 enriched diffused gas flow is routed to the next higher module. The depleted, non-diffused flow is routed to the lower module. These modules or stages, grouped in four gaseous diffusion plants, constitute the enrichment cascade.

The UF6 is introduced in the middle of the cascade, with the enriched product drawn off at one end and the depleted residue at the other.



Eurodif – general view

Safety review of the plant after twenty years of operation

Following the safety review conducted in 2000, the operator in 2002 forwarded the dossiers concerning the seismic resistance of the plants. Additional investigations were necessary to determine the seismic behaviour of the U annex building, where the enrichment cascade feed and draw-off operations are carried out, taking account of the seismic movement determined according to the new RFS 2001-01. The investigations show that the earthquake resistance of the U annex building needs to be improved The operator proposed measures designed on the one hand to reinforce the civil engineering structures and on the other to limit the quantities of radioactive materials present in these buildings. The feasibility of this latter point was the subject of a safety case, transmitted by the operator in 2004.

2 | 2 | 2

The ultracentrifugation enrichment plant project

The ultracentrifugation process should eventually replace gaseous diffusion. COGEMA has transmitted the safety options dossier for the future ultracentrifugation enrichment units. This dossier was reviewed by the ASN and its technical support organisation. The operator also submitted the preliminary safety report for the installation which is scheduled gradually to replace the Eurodif plant from 2007. Commissioning of the three planned production units is scheduled for between 2007 and 2016.

This new plant was the subject of a public debate which ended on 20 October 2004. In this respect, no opposition to this project was revealed. This installation will be covered by a public inquiry during 2005 as part of the authorisation application process. Examination of this project led the ASN to visit nuclear installations in Europe which use the same technology and to initiate exchanges with foreign counterparts about the corresponding safety considerations.

2 | 3

Nuclear fuel fabrication plants

After the uranium enrichment process, the nuclear fuel is made in different installations, depending on its final destination. The UF_6 is converted into uranium oxide powder so that after processing it can be made up into fuel rods, themselves subsequently assembled to form fuel assemblies.

Depending on whether the fuel is intended for PWRs, fast reactors or experimental reactors, and depending on the fissile material it contains, it is manufactured in one of the following establishments: FBFC at Romans-sur-Isère or MELOX at Marcoule, this latter plant being designed to produce fuel containing plutonium.

2 | 3 | 1

Nuclear site at Romans-sur-Isère

The two basic nuclear installations, BNI 63 and BNI 98, installed on this site, on which they share a certain number of common resources, belong respectively to the CERCA and FBFC companies, which form part of the Framatome-ANP group fuel division. Under the terms of decree 63-1228 of 11 December, as amended, the FBFC company is the sole nuclear operator on the site.

BNI 63 comprises a series of shops for the manufacture of highly enriched uranium fuel for experimental reactors. BNI 98 production, consisting of uranium oxide powder or fuel assemblies, is intended solely for PWR reactors.



FBFC – pellet incorporation into fuel rod

Fuel element fabrication plant (BNI 98)

In 2002 and 2003, the ASN conducted a safety review on BNI 98. The ASN wanted on this occasion to take advantage of the experience of its Belgian, English, German, Spanish and Swedish counterparts which monitor the safety of similar plants in their own countries. After a seminar held on 27 January 2004, with all its counterparts who participated in this operation, the ASN presented the experience feedback from this international consultation at the IAEA's general conference in October 2004.

In 2002, the operator submitted an application to increase production capacity, requiring a modification of the prior authorisations granted by decree in 1978.

At the same time and in order to meet the objectives of the safety review carried out in 2003, the operator proposed renewing and modernising its industrial tool.

The two dossiers are being examined jointly by the ASN in order to ensure - given that the modernisation process is gradual - that the resources available on the site are at any time compatible with the production goal.

Within the framework of the procedure initiated, local investigations concluded with the Drôme Prefect issuing a favourable opinion. In 2005, the ASN will be receiving the Advisory Committee's opinion about the preliminary safety report dealing with increased capacity, the new radiation protection objectives and modernisation of the production tool.

CERCA company plant (BNI 63)

2004 saw a rise in fuel production for TRIGA type research reactors. The startup of this activity necessitated minor changes to the workshops. The programme to manufacture uranium and molybdenum alloy compacts was abandoned after the poor behaviour of these elements under irradiation was noted.

The CERCA company plant, one of the oldest French nuclear sites, created before the publication of the 1963 decree on nuclear installations. This installation was simply declared for regularisation after publication of this decree.

The ASN considers operation of this plant to be covered by a decree, like the FBFC company's fuel fabrication plant. The procedure could be started when the application is submitted for modification of the installations and could be based on the safety review for this plant currently in progress.

2 | 3 | 2

Plutonium technology shop (ATPu) and chemical purification laboratory (LPC) at Cadarache

Owing to the fact that it was impossible to demonstrate the earthquake resistance of these shops as applicable to Cadarache, and their non-compliance with today's anti-seismic design rules, COGEMA performed the last industrial activities in the ATPu in mid-July 2003. The effectiveness of this shutdown was confirmed by the ASN's inspectors during the course of an unannounced inspection on 1 August 2003.

This shutdown involves the ATPu and the LPC, which make up the Cadarache fabrication complex (CFCa) operated by COGEMA, in a common final shutdown and dismantling process to be covered by a decree. Thus, for each of the two installations, the operator will be required to draw up the dossier stipulated in article 6 ter of decree 63-1128 of 11 December 1963 as amended, as well as the impact study required by the decree of 12 July 1977.

The installation will package the scrap from its previous fabrication activities (see § 1|2) as well as that of other discarded materials containing plutonium, present in the other installations on the Cadarache site, provided that this scrap conforms to the installation's safety reference framework. Nonetheless, it will be necessary to adapt this latter, in particular to take account of the gradual decay of plutonium to americium, which characterises the older nuclear materials containing plutonium.

The application submitted on November 2003 for production in the ATPu, under the terms of the EUROFAB project, of the rods intended for fabrication of four test assemblies based on American military plutonium was examined and authorised in July 2004. The purpose of this project is to demonstrate the feasibility of eliminating surplus American military plutonium stocks in the form of MOX fuel. The relatively small operation, which has a limited safety impact, does not call into question the cessation of industrial production in the ATPu.

Radiation protection

The operations to package old materials containing plutonium, owing to the rise in their americium level, mean that the operator is required to reinforce its radiation protection measures.

Two incidents occurred in 2004 and led to the operator being issued with a reminder to comply with general radiation protection rules (compliance with procedures on exiting controlled areas, adequate zone markings).

2 | 3 | 3

MELOX plant at Marcoule

With the cessation of industrial production in the Cadarache shop (ATPu), MELOX is now the only French nuclear installation producing MOX fuel, consisting of a mixture of uranium and plutonium oxides.

After releasing a decree authorising the plant annual production capacity to be raised from 101 tons of heavy metal (or 115 tons of oxide) to 145 tons of heavy metal, to absorb the ATPu's order book, the operator in August 2004 presented a further application to increase the production capacity to 195 tons.

Using the rods manufactured in the Cadarache shop, the MELOX plant will also be fabricating the four assemblies for the EUROFAB project. The plutonium isotopes used in this context do not comply with the requirements of the plant's authorisation decree, so this campaign was authorised by decree published in the *Official Gazette* of 5 October 2004.

Investigation of this authorisation did not require a public inquiry, as there was no modification to the installation's risks and discharges.

The dossier submitted by the operator can be consulted in the premises of the General Directorate for Nuclear Safety and Radiation Protection, in those of the Gard Prefect's office and in those of the Languedoc-Roussillon DRIRE.

Radiation protection

Since 2000, the external collective and individual doses received by the workers have been rising. This is due both to the change in the actual radiological content of the materials used (plutonium resulting from reprocessing of higher burnup fraction fuels) and the rise in the plutonium oxide content of the MOX fuel.

In the context of the above-mentioned capacity increase, the ASN is particularly attentive to ensuring that the operator continues with and reinforces actions to optimise radiation protection to keep the rise in doses received under control.

In 2004, several radiation protection incidents occurred.

These incidents underlined the importance of checking equipment before, during and after an intervention, along with radiation protection signs and markings and the location of contamination measurement appliances.



MELOX – pellet production: the press

2 | 4

COGEMA La Hague complex

2 | 4 | 1

Presentation

The La Hague plant, designed for reprocessing of fuel irradiated in the power reactors (GCR then PWR) is operated by COGEMA, which replaced the CEA as nuclear operator under the terms of a decree of 9 August 1978. The plant is located on the north-western tip of the Cotentin peninsular, 6 km from cape La Hague and 20 km west of the town of Cherbourg. It covers a surface area of 220 ha, on a plateau culminating at 180 m above sea level. It comprises an additional 80 hectares in Moulinets valley, down to the seashore. The COGEMA site adjoins the ANDRA site (Manche repository) to the east. The BNIs were installed on land made up of sedimentary rock (sandstone and shale) situated on a deep base of granite.

In 1959, the CEA decided to build the UP2 400 reprocessing plant, designed to reprocess GCR type spent fuels. It came on-stream in January 1967 like the STE2 factility, the role of which was to purify liquid effluent before discharge into the sea. In 1974, the CEA was authorised to modify the UP2 400 plant to allow reprocessing of PWR spent fuel. Finally, COGEMA was authorised in 1981 to build the UP2 800 plant (primarily for reprocessing of French fuel), the UP3 plant (for reprocessing of foreign fuel) and a new liquid effluent treatment plant, STE3.

The various shops in the UP3, UP2 800 and STE3 were commissioned from 1986 (reception and interim storage of spent fuel) to 1994 (vitrification shop), with most of the process shops becoming active in 1989/1990.

Following a public inquiry from 2 February to 17 May 2000, COGEMA was authorised by three decrees of 10 January 2003, to modify the operating conditions of the UP2 800, UP3 and STE3 installations. The main modification concerns the individual capacity of each of the two plants, raised to 1000 t per year of initial metal (U or Pu), with the total capacity of the two plants being limited to 1700 t.

A fourth decree of 10 January 2003 also modified the boundary of the site BNIs.

The COGEMA La Hague site thus houses the following installations:
- BNI 33 covering plant UP2 400, the first reprocessing unit, and AT1, a prototype installation currently being dismantled;
- BNI 38 covering effluent treatment station no. 2 (STE 2);
- BNI 47 covering the Élan II B shop, a CEA research facility currently being dismantled;
- BNI 80 covering the HAO shop, the first PWR fuel reprocessing unit;
- BNI 116 comprising plant UP3, the East production unit;
- BNI 117 comprising plant UP2 800, the West production unit;
- BNI 118 comprising effluent treatment station no. 3 (STE3).

The production shops in the UP2 400 plant have all been shut down.



COGEMA La Hague – general view

Projet SITOP

The plant has now reached maturity. Contracts participating in the financing of the various facilities were completed in 2001. They will be replaced by contracts taking into account final shutdown and dismantling. A new organisation has gradually been set up, from the end of 2001, to ensure the competitiveness of the site. This new organisation is the subject of the SITOP project (for "site optimisation").

The ASN requested that this project be assessed by an outside body, in particular concerning human factors. This assessment confirmed the strong and weak points identified by the ASN during the sixty or so inspections performed each year.

2 | 4 | 2

Operations carried out in the plant

The main processing chain of these facilities comprises reception and interim storage installations for spent fuel, plus facilities for shearing and dissolving it, chemical separation of fission products, final purification of the uranium and plutonium and waste treatment.

First operations at the plant consist in delivery of transport packages and interim storage of spent fuel. Upon arrival at the reprocessing plant, the packages are unloaded, either underwater, in a pit, or dry, in a leak-tight shielded cell. The fuels are then placed in pits, where they will remain for at least three years.

After shearing of the rods, the spent fuel is separated from its metal cladding by dissolving in nitric acid. The pieces of cladding, which are insoluble in nitric acid, are removed from the dissolver, rinsed in acid and then water and transferred to a packaging unit. The solutions taken from the dissolver are then clarified by centrifugation.

The separation phase consists of initial separation of the fission products and the transuranic elements from the uranium and plutonium contained in the solutions, and then of the uranium from the plutonium.



Wet unloading at La Hague site

After purification, the uranium, in the form of uranyl nitrate, is concentrated and stored. This uranyl nitrate is intended for conversion into a solid compound (U308) in the Pierrelatte TU5 installation.

After purification and concentration, the plutonium is precipitated by oxalic acid, dried, calcinated into plutonium oxide, packaged in sealed boxes and placed in interim storage. The plutonium can be used in the fabrication of MOX fuel. The plutonium from foreign fuel is returned to the operators in the country of origin.

The production operations, from shearing up to the finished products, utilise chemical processes and generate gaseous and liquid effluents. These operations also generate what is called "structural" waste.

The gaseous effluent is given off mainly during cladding shearing and during the boiling dissolving operation. These discharges are processed by washing in a gas treatment unit. Certain residual

radioactive gases, in particular krypton, are checked before being discharged into the atmosphere.

The liquid effluents are processed and generally recycled. Certain radionuclides, such as iodine and less active products are, after checking, sent to the marine discharge pipe. The others are sent to shops for encapsulation (glass or bitumen).

Solid waste is packaged on the plant site. Two methods are used: compacting and encapsulation in cement.

In accordance with article L.542 of the Environment Code concerning radioactive waste management, radioactive waste from irradiated fuels of foreign origin must be shipped back to its owners. Radioactive waste from irradiated fuels of French reactors is sent to the Soulaines (Aube) repository or stored pending a final disposal solution.



Plutonium box carousel at La Hague site

The La Hague plant shops

• UP2 400 plant	
HAO/North:	underwater unloading and spent fuel interim storage;
HAO/South:	shearing and dissolving of spent fuel elements;
HA/DE:	separation of uranium and plutonium from fission products;
HAPF/SPF (1 to 3):	fission product concentration and interim storage; uranium and plutonium separation, purification and interim storage of uranium in the form of uranyl nitrate;
MAPu:	purification, conversion to oxide and initial packaging of plutonium oxide;
LCC:	product central quality control laboratory.
• STE2 installation :	collection, treatment of effluent and interim storage of precipitation sludges.
• UP2 800 plant	
NPH:	underwater unloading and interim storage of spent fuel elements in pit;
C pit:	pit for interim storage of spent fuel elements;
R1:	shearing of fuel elements, dissolving and clarification of solutions obtained;
R2:	separation of uranium, plutonium and fission products (FP), and concentration of FP solutions;
R4:	purification, conversion to oxide and first packaging of plutonium oxide;
SPF (4, 5, 6):	interim storage of fission products;
BST1:	shop for secondary packaging and interim storage of plutonium oxide;
R7:	fission products vitrification shop.
• UP3 plant	
T0 shop:	dry unloading of spent fuel elements;
D and E pits:	interim storage pits for spent fuel elements;
T1:	shearing of fuel elements, dissolving and clarification of solutions obtained;
T2:	separation of uranium, plutonium and fission products, and concentration/interim storage of FP solutions;
T3/T5:	purification and interim storage of uranyl nitrate;
T4:	purification, conversion to oxide and packaging of plutonium;
T7:	vitrification of fission products;
BSI:	plutonium oxide interim storage;
BC:	plant control room, reagent distribution shop and process control laboratories;
ACC:	hull and end-piece compacting shops.
• STE3 shop :	effluent recovery and treatment and interim storage of bituminised packages.

MFinal shutdown of old shops

Most of the old shops on the site will have to be finally closed down prior to dismantling. After equipment rinsing, the units on the main treatment processing lines in the UP2 400 have been withdrawn from operation. The operator has taken the organisational measures necessary for making the transition of these installations to the surveillance phase, pending initiation of the final shutdown procedures.

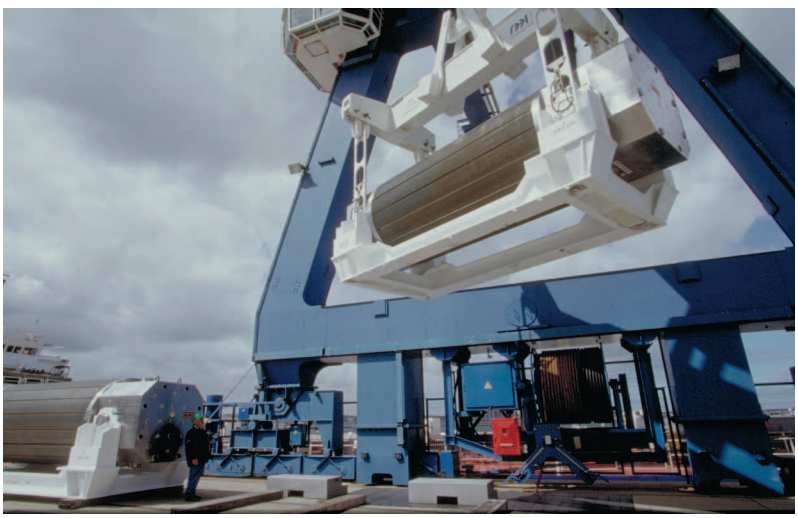
Within this framework, on 30 December 2003, the operator notified its decision for 1 January 2004 cessation of processing of spent fuel in the UP2 400 shop. This notification was accompanied by a dossier presenting the operations planned for the final decommissioning phase in the various shops concerned in this plant. This dossier is currently being examined by the ASN.

COGEMA confirmed its intention to submit an application in 2005 for authorisation to proceed with final shutdown and dismantling of this plant under application of article 6 ter of the decree of 11 December 1963.

2 | 4 | 3

Regulatory framework for the facilities

The revision of the La Hague site authorisation decrees, which was completed in January 2003, is a technical decision designed to allow changes to the activities in the installations in satisfactory conditions of safety and environmental protection, and in conformity with the regulations. The reference fuel elements for which processing was envisaged at the time of publication of the old decrees were relatively unrepresentative of the new fuel elements loaded into the reactorsThis difference will be accentuated in the future. This revision was thus necessary to be able to handle the current fuel throughput. The authorised modifications combine improved nuclear safety with greater environmental protection through use of the best available techniques.



Loading of mox fuel transport flask

Furthermore, the greater diversity in the nature and origin of the materials and substances to be processed, exploiting the potential of each of the UP2 800, UP3 and STE3 facilities for recycling, processing, packaging or storing radioactive substances (effluent, waste, scrap, etc.) and nuclear materials (uranium, plutonium, new fuels) from other facilities, could prove to be of benefit during dismantling or when retrieving waste from past practices.

The decrees published on 11 January 2003 in the Official Gazette define a new operating framework for the facilities and article 5 requires that any extension of the current operating framework within this new framework, receive specific authorisation issued by interministerial order. The actual operations to process the fuels, substances and materials authorised by interministerial orders must, as presently , be the subject of an operational agreement for each particular processing campaign outside the previously authorised domain. This enables account to be taken of the time elapsed between the authorisation to extend the domain and the actual processing operation performance and checks to be made on the compatibility of the performance conditions envisaged by the operator with installation safety and protection of persons and the environment. The interministerial orders specify that the operational agreement will be issued by the Director General for Nuclear Safety and Radiation Protection.



Glass canister cutaway at La Hague site

A number of complaints filed by environmental defence associations called into question the decrees and the order authorising discharges from the La Hague installations. However, for the disputes under its jurisdiction, the administrative court rejected the requests for cancellation of these regulatory texts.

The main authorisations issued

The ASN has issued COGEMA La Hague with various authorisations, some of which are recalled below..

· UP2 400

HAO/North shop

On 7 April, the operator obtained authorisation to receive and unload FS65JB packagings in the HAO/North shop, containing cans of rods consisting of non-irradiated UO2-PuO2 (MOX) mixed oxide pellets with a ratio Pu/U + Pu ≤ 12.5%.

· UP3 and UP2 800 plants

By delegation of the Ministers for Industry and for the Environment, the Director General of Nuclear Safety and Radiation Protection signed the following interministerial orders:
- 16 January 2004 authorising the reception, unloading, storage and processing of UOX fuel assemblies with a maximum initial enrichment of 4.5% and maximum burnup fraction of 60 GWd/t (published in the *Official Gazette* on 4 February 2004);
- 22 March 2004 and 26 April 2004 authorising the reception, unloading, storage and processing of irradiated MOX fuel assemblies, with a maximum burnup fraction of 55 GWd/t and a maximum plutonium and americium content by mass of 8.65% before burnup (published in the *Official Gazette* on 30 March 2004 and 15 June 2004 respectively);
- 8 November 2004 authorising storage and processing in the UP2 800 plant of non-irradiated MOX fuel elements, intended for the German SNR 300 fast reactor which has never been started up (published in the *Official Gazette* on 23 November 2004).

Operational approval for reprocessing of fuel assemblies based on enriched natural uranium oxide taken from light water reactors (UOX) with a maximum average assembly burnup fraction of 60 GWd/t and an average uranium 235 content not in excess of 4.5%, was given on 22 June.

2 | 4 | 4

Site discharges and environment monitoring

Discharge from La Hague, notably liquid discharge, has, on the whole, been decreasing over the last ten years, whereas production has increased. This decrease was obtained thanks to technical enhancements within the plants.

The effluents discharged in this case differ from those from a nuclear reactor and the quantities are larger, as it must be remembered that:
- the La Hague plant reprocesses fuel from about a hundred nuclear reactors;
- this reprocessing involves spent fuel shearing, followed by nitric acid immersion, whereas maximum fuel containment is assured in a reactor. The processing of the radioactive materials contained in these fuels consequently produces different effluents.

The order of 10 January 2003 includes clauses setting deadlines for reducing the impact of chemical and radioactive substances, thus meeting the targets of the Sinta declaration issued in 1998 during the OSPAR convention. It should be noted that the new limits contained in the 2003 order already entail a significant drop in the impact on the most exposed population groups: the maximum dose calculated for these groups is in fact brought down to 0.02 mSv per year.

In addition, the COGEMA La Hague complex publishes a quarterly record of results of measurements carried out in the context of environmental surveillance. This document is sent to the French and British authorities and to the special standing information committee for the COGEMA La Hague complex.

The quantity of fuel reprocessed rose from about 400 tons in 1987 to about 1100 tons in 2004, with a maximum of about 1670 tons in 1996 and 1997.

The following table evaluates the maximum impact of the annual discharges, in terms of effective dose, on the "reference groups", in other words the groups of persons among the population for

The effluent discharges for the year 2004 plus a reminder of those for 1999 are presented below

<table>
<tr><th>Gaseous discharges
(TBq per year)</th><th>Limits in order of 1984</th><th>Limits in order of 2003</th><th>1999[1] discharges</th><th>2004[2] discharges</th><th>Forecast for 2005[3]</th></tr>
<tr><td>Tritium</td><td>2200</td><td>150</td><td>80</td><td>71.3</td><td>87</td></tr>
<tr><td>Iodes</td><td>0.11
(halogens)</td><td>0.02</td><td>0.008
(halogens)</td><td>0.00521</td><td>0.007</td></tr>
<tr><td>Rare gases
including krypton 85</td><td rowspan="2">480 000
(gases other than tritium)</td><td>470 000</td><td>295 000</td><td>263 000</td><td>298 270</td></tr>
<tr><td>Carbone 14</td><td>28</td><td>18.8</td><td>17.3</td><td>18</td></tr>
<tr><td>Others
β et γ emitters</td><td rowspan="2">0.074
(alpha and beta emitter aerosols)</td><td>0.001[4]</td><td rowspan="2">0.000 12
(alpha and beta emitter aerosols)</td><td>0.000 143</td><td>0.000 5</td></tr>
<tr><td>α emitters</td><td>0.000 01</td><td>0.000 00185</td><td>0.000 0018</td></tr>
</table>

[1] For 1562 tons of fuel reprocessed.
[2] For 1115 tons of fuel reprocessed.
[3] For 1090 tons of fuel reprocessed.
[4] This limit is applicable from 12 January 2005, until which time the annual limit remains set at 0.074 TBq.

Liquid discharges (TBq per year)	Limits in order of 1984	Limits in order of 2003	1999 discharges	2004 discharges	Forecast for 2005
Tritium	37 000	18 500	12 900	13 900	13 998
Iodines	/	2.6	1.83	1.40	1.51
Carbon 14	/	42[1]	9.93	8.90	9.03
Strontium 90	220	12[2]	2.16	0.138	0.4
Caesium 137		8[3]		0.787	0.75
Ruthenium 106	/	15	7	6.45	5.5
Cobalt 60	/	1.5[4]	0.32	0.256	0.4
Caesium 134	/	2	0.058	0.0641	0.09
Others β and γ emitters	1700	60[5]	29.6	6.78	6.2
α emitters	1.7	0.17[6]	0.040	0.0174	0.02

1 This limit value takes account of total carbon 14 discharges in the liquid effluent, assuming elimination of all gaseous discharges.
2 The limit is 2 for normal discharges and 10 for discharges linked to shutdown and dismantling (MAD) and recovery of waste from past practices (RCD).
3 The limit is 2 for normal discharges and 6 for MAD and RCD discharges.
4 The limit is 1 for normal discharges and 0.5 for MAD and RCD discharges.
5 The limit is 30 for normal discharges and 30 for MAD and RCD discharges.
6 The limit is 0.1 for normal discharges and 0.07 for MAD and RCD discharges.

whom exposure from a given source is relatively uniform and who are representative of the persons who receive the highest doses from this source.

Evaluation of annual impact of releases on the reference groups				
Limits in Orders of 1984	Limits in Order of 2003	Actual 1999 discharges	Actual 2004 discharges	Forecast for 2005
0.120 mSv	0.020 mSv	0.011 mSv	0.010 mSv	0.010 mSv

3 OUTLOOK

In 2004, the installations in the front-end of the cycle experienced no safety problems. However, they did experience radiation protection related incidents .

As regards the consistency of the fuel cycle, examination of the dossier transmitted by EDF for GALICE fuel management confirms the need for updating of the elements transmitted by EDF, at regular intervals as well as for each new fuel management system, in particular to demonstrate the compatibility of the options presented with the cycle installations and to anticipate future fuel cycle installation developments envisaged by the manufacturers.

The authorisation decree of the COGEMA La Hague site and the discharge license issued on 10 January 2003, set a specific framework for operation of the establishment in the forthcoming years.

The ASN still has a positive opinion of the rigorous and responsible attitude of COGEMA's operation of the La Hague installations. It continues to attach considerable importance to supervision of safety and radiation protection of this establishment by devoting nearly 10% of all its inspections to it. This is in particular justified by the nature and quantity of the radioactive materials stored in the establishment. The organisation set up to improve the establishment competitiveness was monitored

throughout its implementation period, in particular concerning human factors. Finally, among the priority subjects, The ASN do and will keep a close attention on the legacy waste recovery and the shutdown and dismantling of a certain number of old shops in the UP2 400 plant.

Following public inquiries, the effluent discharge licence applications for the Tricastin site facilities were approved. The technical specifications are now ready for submission to the ministers for signature.

Finally, the Romans-sur-Isère nuclear site safety review should continue with incorporation of the ASN's requests about the fuel element fabrication plant (BNI 98) and the safety review of the CERCA company's shops (BNI 63) in 2005.

CHAPTER 14
THE NUCLEAR FUEL CYCLE INSTALLATIONS

THE SAFETY OF FINAL SHUTDOWN AND DISMANTLING OF BASIC NUCLEAR INSTALLATIONS

CHAPTER 15

1 TECHNICAL AND ADMINISTRATIVE PROVISIONS

2 THE SITUATION OF NUCLEAR INSTALLATIONS BEING DISMANTLED IN 2004

2 | 1 EDF power reactors
2 | 1 | 1 Monts d'Arrée plant
2 | 1 | 2 Gas cooled reactors (GCR)
2 | 1 | 3 Chooz A D reactor (Ardennes nuclear power plant)
2 | 1 | 4 Superphénix reactor

2 | 2 CEA installations
2 | 2 | 1 Fontenay-aux-Roses site
2 | 2 | 2 Grenoble site
2 | 2 | 3 The Cadarache site installations being dismantled
2 | 2 | 4 The Saclay site installations being dismantled
2 | 2 | 5 The La Hague site installations being dismantled

2 | 3 The other installations
2 | 3 | 1 The Société Normande de Conserve et Stérilisation (SNCS) irradiator
2 | 3 | 2 The Strasbourg University reactor
2 | 3 | 3 SICN plant in Veurey-Voroize
2 | 3 | 4 COGEMA interim storage facility at Miramas

3 OUTLOOK

4 LIST OF BASIC NUCLEAR INSTALLATIONS DECLASSIFIED AS AT 31.12.2004

5 LIST OF BASIC NUCLEAR INSTALLATIONS FINALLY SHUTDOWN AS AT 31.12.2004

LTHE SAFETY OF FINAL SHUTDOWN AND DISMANTLING OF BASIC NUCLEAR INSTALLATIONS

Upon completion of their operating period, BNIs undergo a series of decontamination and transformation operations prior to their decommissioning. The work thus performed may result, from the administrative standpoint and depending on the subsisting activity level, in the creation of a new BNI, in the declassification of the BNI concerned into an installation classified on grounds of environmental protection (ICPE) which has to be licensed or registered, or simply in a return to the public sector, subject to possible adjusted easements.

The first steps lead to removal of the fuel or nuclear materials present in the facility, which already helps reduce the risk from the nuclear safety viewpoint. Then, this is replaced by radiation protection and conventional safety-related risks owing to operations close to residual nuclear material and the numerous waste removal handling operations generated by dismantling.

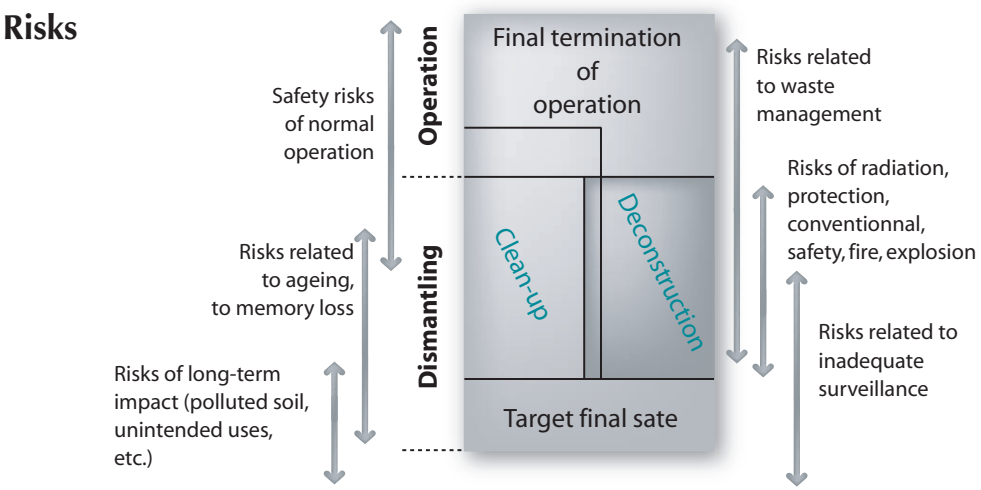
The Nuclear Safety Authority (ASN) now strives to integrate relevant experience feedback from past dismantling projects in France and abroad. The ASN encourages complete dismantling either immediately or after slight postponement, provided that upstream of the regulatory processes, the operator is able to present and justify the chosen dismantling scenario, from the final cessation of production up to the final dismantling of the installation. Regulatory practices concerning BNI dismantling operations were updated along these lines in early 2003.

The ASN considers the current dismantling operations as test cases, providing an opportunity for the operators, on the one hand, to define and implement a dismantling strategy (dismantling level to be reached, detailed operating schedule), and, on the other hand, a management policy for the large amounts of radioactive waste that will be generated (notably the very low level waste). If carried through to their conclusion, they would also constitute examples demonstrating the technical and financial feasibilities of an entire dismantling operation.

1 TECHNICAL AND ADMINISTRATIVE PROVISIONS

The technical provisions applicable to installations to be decommissioned must obviously be in compliance with general safety and radiation protection rules, notably regarding worker external and internal exposure to ionising radiation, criticality, the production of radioactive waste, release to the environment of radioactive effluents or measures designed to limit accident hazards and mitigate their consequences.

Safety issues, in other words protection of persons and the environment, can be significant, during clean-up or dismantling operations, as well as during passive surveillance phases. The rapidly changing nature of the installation is a non-negligible risk factor in that it is harder than for an operating installation to guarantee that all potential risks have been consistently and exhaustively taken into account.



The above figure attempts to summarise the main risks encountered when decommissioning an installation and the periods during which these risks are highest.

The risks linked to waste management (radioactive waste disposed of inappropriately in a conventional channel, etc.) are present throughout all phases producing large quantities or a wide variety of waste.

As dismantling proceeds, the risks identified during operation of the installation, primarily linked to the radioactive nature of the materials handled, are gradually replaced by risks more linked to radiation protection and conventional safety (dismantling requires that the workers go into areas they were not used to visiting during operation) or risks linked to the technologies used for dismantling and cutting the structures (often involving hot points with the concurrent risk of fire or explosion). The risks linked to the problem of the stability of partially dismantled structures must also be taken into account, along with those linked to the obsolescence of the equipment (in particular concerning the possibility of fires breaking out in ageing electrical installations).

For complex nuclear installations, dismantling work often lasts more than a decade, frequently coming after several decades of operation. There is thus a considerable risk linked to loss of knowledge of the design and operation of the installation, especially when the former operators leave the installation, and it is vital to be able to collect and record the recollections of the persons involved in these phases, all the more so as the traceability of the design and operation of old installations is frequently less than rigorous.

With each subsequent phase in dismantling, arises the question of the surveillance of the installation being at all times appropriate to its state and the risks entailed. It is often necessary to replace the in-service means of surveillance with other (radiological, fire) more appropriate means, either temporarily or more permanently. As it is hard to constantly check that surveillance is appropriate to the constantly changing state of the installation, there is a risk of failure to detect an incipient hazardous situation.

Once the final installation state is reached, there is still the risk of pollution being inadequately or not at all identified or poorly characterised, having a significant long-term impact on the site or its environment.

The dismantling scenario (immediate or deferred) is selected by the operator on a case by case basis, generally in the light of comparative studies. The strategies today adopted by CEA or EDF are presented in § 2|1 and 2|2.

Similarly, the various technical provisions chosen for each stage in dismantling of a nuclear installation are chosen by the operator on a case by case basis. However, to avoid splitting up the dismantling projects and to improve overall consistency, the ASN asks that as of final shutdown of an installation, a file be submitted, explicitly presenting all the various works envisaged from final shutdown to attainment of the target final state, and demonstrating at each step the nature and scale of the risk presented by the installation and the steps taken to control it.

Finally, in the current context regarding management of industrial sites being dismantled, it seems necessary in most cases that there should be a means of preserving the memory of the past existence of a basic nuclear installation on a site, along with any utilisation restrictions corresponding to the condition of the site. The procedures for downgrading after clean-up are mentioned in chapter 16.

The ASN specified the regulatory framework for BNI dismantling operations in a note signed on 17 February 2003, following extensive work to clarify and simplify the administrative procedures, while improving the extent to which safety and radiation protection are taken into account.

New practical measures for application of article 6 ter of the amended decree of 11 December 1963 are now in place in order to:
- clarify the definition of the leading technical and administrative stages in dismantling to ensure that it is better tailored to the diversity of nuclear installations ;
- encourage complete dismantling initiated either immediately or after slight postponement ;
- encourage presentation and justification by the operator of the dismantling scenario chosen before initiating the regulation process, from the decision to cease operations up to complete dismantling;

- clarify the administrative notion of downgrading of a basic nuclear installation and the related criteria.

This revision leads to a clearer definition of the two main phases in the life of an installation, each of which is associated with a single authorisation decree, the authorisation decree for the operating phase and the final shutdown and dismantling decree for the dismantling phase. This creates a more balanced picture, both technically and administratively, between the importance given to the dismantling phase and that given to the operating phase.

All of these provisions are detailed in note SD3-DEM-01 of 17 February 2003, available on the ASN's web site.

2 THE SITUATION OF NUCLEAR INSTALLATIONS BEING DISMANTLED IN 2004

2|1

EDF power reactors

Until recently, the generic strategy adopted by EDF for dismantling of its power reactors, was that of deferred complete dismantling. This strategy consisted in extracting the fissile material, removing the easily recoverable parts, reducing the contained zone to a minimum and fitting out the external barrier. Complete dismantling of the installation was then envisaged by EDF after several decades of containment, to take advantage of the natural radioactive decay. An approach of this type had its drawbacks, notably in that it could lead to a gradual loss of knowledge of the installation, as its operators departed, which could be prejudicial to the dismantling operations. The ASN asked EDF to review this strategy and to evaluate the feasibility of reducing the time needed to undertake complete dismantling work.

After an initial evaluation submitted in November 1999, EDF decided to revise its strategy for the EL4 reactor, undertaking to carry out complete dismantling of the reactor soon after completion of the partial dismantling operations currently in progress.

Then in April 2001, EDF decided to adopt this new dismantling strategy for all its decommissioned nuclear installations (Brennilis, Bugey 1, Saint-Laurent A, Chinon A, Chooz A and Superphénix), based on complete dismantling of the reactors, with no standby period. It thus provides for complete dismantling of these reactors by 2025.

To ensure the success of the new complete dismantling programme for these 9 first generation reactors, EDF is relying on the CIDEN (Deconstruction-Environment Engineering Centre), an engineering unit based in Lyons and dependent on the DIN (nuclear engineering division), which has been operational since 2001.

In January 2003, EDF sent to the ASN a document, presenting its overview regarding dismantling of these 9 reactors, and the associated technical justifications (installation safety case, radiation protection, management of associated waste, particularly graphite, organisation, set-up, maintaining skills, description of the target final state). After obtaining the opinion of the Advisory Committee for laboratories and plants, which met to discuss this subject on 24 and 31 March 2004, the ASN adopted a position in June 2004 about the pertinence of the EDF first-generation reactor dismantling strategy proposed and:
- reckoned that the dismantling strategy for the first-generation reactors chosen by EDF and the associated programme and schedule are acceptable in terms of safety and radiation protection;
- identified no major point calling into question the technical feasibility of the envisaged dismantling scenarios, and consequently the proposed schedule;
- observed that the active waste storage facilities and the graphite waste disposal that would be required to perform the dismantling programme, would not be available on the scheduled dates and required EDF to do everything necessary to assume its responsibility as waste producer.

2 | 1 | 1

Monts d'Arrée plant

The Monts d'Arrée plant (EL 4 reactor), located on territories of the villages of Brennilis and Loqueffret in Brittany, was a heavy water moderated 70 MWe prototype, with carbon dioxide cooling. It was operated by the CEA between 1966 and 1985.

The decree authorising partial dismantling of the former EL4 reactor and its transformation into a storage facility (EL4D) for its own equipment was signed on October 31, 1996. Work is proceeding on the total dismantling of the spent fuel building and effluent treatment station and the partial dismantling of the reactor building.

In addition, a decree authorising transfer of operation of the EL 4 D nuclear power plant from the CEA to EDF was signed on September 19, 2000.

Finally, the decree modifying some requirements of the decree of 31 October 1996, in order to take account of the changes to the dismantling strategy for this reactor and pave the way for complete dismantling was signed on 12 January 2004. The application for authorisation for complete dismantling of the reactor was submitted by EDF in July 2003 and is currently being investigated.

In 2004, the main activity on the site was the completion of the clean-up work on the effluent treatment station (STE) and the spent fuel building (BCI). Downgrading of these buildings from a nuclear waste zone to a conventional waste zone was approved by the DGSNR, and these buildings (excluding basements) were demolished.



Brennilis – a room of the spent fuel building (BCI) cleaned-up

2 | 1 | 2

Gas cooled reactors (GCR)

The six GCRs which formed the first EDF nuclear power reactor population, located respectively at the Chinon, Saint-Laurent-des-Eaux and Bugey nuclear power plants, are currently at various stages of dismantling.

· Chinon A1D, A2D and A3D reactors

The old Chinon A1, Chinon A2 and Chinon A3 reactors were partially dismantled and transformed into storage facilities for their own equipment. These operations were authorised by the decrees of

11 October 1982, 7 February 1991 and 27 August 1996, respectively. These installations are currently under care and maintenance phase stage.

After observing non-compliance with certain obligations of the decree of 27 August 1996, the ASN on 24 December 2001 gave the Chinon A3 operator formal notice to comply with the regulations. Subsequent to this, and after carrying out the remaining work to recover waste and treat effluent in 2002, the operator updated the safety reference framework for its installation in June 2003 and on 18 December 2003 submitted an application for modification of the decree of 27 August 1996 to regularise the legal status of the pits that are to be cleaned up. This dossier is being reviewed. In 2004, the main operations were the continuation of nuclear waste removal and the storage condition improvements of the nuclear waste in the installations.



Chinon A – removal of oils

· Saint-Laurent-des-Eaux A1 and A2 reactors

The decree authorising final shutdown operations for the two reactors was signed on 11 April 1994. In 2004, the main activities concerned the continued removal and dismantling of conventional equipment and the resumption of evaporation of the pool waters and clean-up of the pools.



Saint-Laurent A2 – decontamination of the storage pool

· Bugey 1 reactor

The decree authorising final shutdown operations was signed on 30 August 1996. Most of the work done in 2004 consisted in carrying on the graphite sleeve container packaging for transfer to the Aube repository centre, sampling of the concrete from the caisson and completing the pumping plant demolition operations.



Bugey 1 – sampling operations of concrete from the caisson

2 | 1 | 3

Chooz A D reactor (Ardennes nuclear power plant)

The Ardennes nuclear power plant was the first French PWR plant. It was power operated until 1991 by SENA (Franco-Belgian nuclear energy company in the Ardennes). On 16 October 1996, a decree was signed authorising operation of the plant to be transferred to EDF.

By a decree of 19 March 1999, EDF was authorised to proceed with partial dismantling of its reactor and its transformation into a storage facility for its own equipment.

In addition and to take account of the dismantling strategy change for this reactor and prepare for complete dismantling, the decree modifying certain provisions of the decree of 19 March 1999 was



Chooz A – demolition of the "hill" buildings

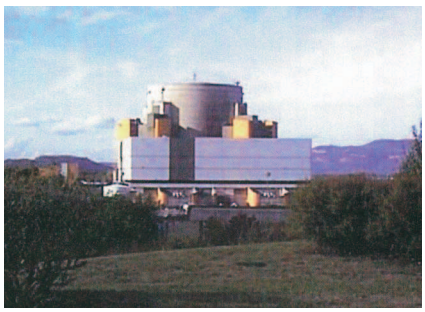
signed on 27 October 2004. In 2004, clean-up work on the "hill" buildings ended. Downgrading of these buildings from a nuclear waste zone to a conventional waste area was approved by the DGSNR. Then, these buildings were demolished. Removal of the electrical cables also further reduced the combustible sources still present in the installation.

2 | 1 | 4

Superphénix reactor

The Superphénix fast neutron reactor, a sodium-cooled industrial prototype, is located at Creys-Malville. In accordance with the Government decision of February 1998, this reactor, with its rated thermal power of 3000 MW and net electrical output of 1200 MWe, is currently in its final shutdown stage. This installation is associated with another BNI, the onsite spent fuel storage unit (APEC), consisting mainly of an interim storage pool for fuel removed from the reactor vessel.

Final shutdown of the reactor was the subject of decree 98-1305 of 30 December 1998.



View of the reactor

In early 2003, all the fuel assemblies had been removed from the reactor and stored in the APEC. At present, the reactor vessel only contains special assemblies and the lateral neutron protections which present no criticality risk. The final decommissioning operations continued and the turbine hall is now almost completely empty. To allow treatment of the sodium contained in the reactor's systems, interim storage of the existing new core in the APEC and dismantling of the reactor installations, EDF in 2003 submitted an application for authorisation for complete dismantling of the reactor. It also submitted an application for a water intake and effluent release licence for the site. In 2004, these various applications were the subject of an administrative procedure, a technical investigation and a public inquiry. They should end in the publication of a dismantling decree covering the entire period necessary for reactor dismantling, while specifying hold points for the technical subjects felt to be the most sensitive.

Spent fuel removal facility (APEC)

This facility was commissioned on 25 July 2000 by the Ministers for Industry and the Environment. Spent fuel removed from the Superphénix reactor and washed is placed in the APEC pool.

In 2003, EDF submitted an application for modification of the installation's authorisation decree for storage of unused Superphénix fuel and for storage within the boundary of this BNI of the blocks of sodium impregnated concrete resulting from the destruction of the sodium in this same reactor. This application should lead to publication of a decree modifying the installation's authorisation decree.

2 | 2

CEA installations

Following a request from the ASN, the CEA in June 2004 forwarded several documents enabling the ASN to assess the overall dismantling strategy for the CEA's civil installations, particularly with respect to consistency and management of the waste. The ASN envisages referring the matter to the Advisory Committee for laboratories and plants.

2 | 2 | 1

Fontenay-aux-Roses site

The CEA research centre is located in the town of Fontenay-aux-Roses, bordering on the towns of Châtillon and Plessis-Robinson, in the Hauts-de-Seine department. It covers an area of 13.8 hectares.

This centre comprises four BNIs, which pursued research activities in the fields of chemical engineering, analytical chemistry, storage of radioactive waste and transuranic elements. The laboratory for plutonium-based fuel studies (RM2) and the plutonium chemistry laboratory (LCPu) are currently being dismantled. The activities of this latter unit have been transferred to Marcoule's Atalante installation. Only the radioactive liquid effluent and solid waste treatment station and the interim storage facility for radioactive solid waste are still operating.

The Fontenay-aux-Roses research centre will be decommissioned in around 2010. In view of this decision and the accompanying clean-up operations, the CEA is preparing to group its nuclear activities in the Fort part of the installation, which presupposes modification of the existing BNI perimeters , a process which has already been started. The final shutdown, dismantling and perimeter modification application dossier for the basic nuclear installations at the Fontenay-aux-Roses centre was sent to the ASN in December 2003. A public inquiry from May to June 2004 was carried out accordingly. The Inquiry Commissioner issued a favourable opinion on the matter on 30 June 2004. The administrative procedure which is to lead to decrees creating two BNIs in place of the original four BNIs mentioned above, is in progress

· Radioactive effluent and solid waste treatment station and solid waste interim storage station

Despite the closure of some workshops (incineration, evaporation), the Radioactive effluent and solid waste treatment station (BNI 34) continues to evacuate radioactive effluent from the site and to treat solid waste, in particular as part of the site dismantling operations. BNI 34 also stores effluent from past practices, for which the disposal channel is not yet operational. The solid waste interim storage station (BNI 73) stores irradiating drums in decay pits, pending removal, and provides interim storage of low and very low level waste drums waiting for shipment to a repository. BNI 73 is carrying on the removal of the irradiating drums of solid waste from the decay pits. Shutdown of these BNIs is included in the dismantling dossier for the CEA's Fontenay-aux-Roses site (see § 2|2|1).

· Plutonium chemistry laboratory (LCPu)

Until July 1995, the plutonium chemistry laboratory (LCPu) at the CEA Centre in Fontenay-aux-Roses was used for research and development work on spent fuel reprocessing and waste treatment methods.

In July 1995, the operator began winding down operations in this installation, consisting in the recovery, treatment and removal of radioactive materials contained in the laboratory.

The operations, which had been designed to allow characterisation of the Petrus high-level tanks and went through an internal authorisation process at the end of 2003, were carried out in June 2004. They confirmed that the content of these tanks was indeed liquid.

· Laboratory for plutonium-based fuel studies

This radio-metallurgical laboratory, located on the CEA site at Fontenay-aux-Roses, comprised two units, RM1 and RM2, located in two separate buildings. The activities of the spent fuel analysis laboratory ended in 1984.

Cleanup operations took place from 1991 to 1995.

In 1999, the CEA provided an end-of-cleanup report for the RM1 part and a more detailed decontamination plan for the RM2 part. The CEA sent the ASN a clean-up report concerning the floor in the filters room as experience feedback.

2 | 2 | 2

Grenoble site

The Grenoble research centre (Isère) is located in an industrial zone north-west of the town, at the confluence of the Drac and the Isère rivers. It covers an area of 128 hectares.

The main activities of this Centre are fundamental and applied research in non-nuclear fields (condensed state physics, biology, electronics and materials) and applied research into development of nuclear reactor technologies, mainly focused on safety (thermo-hydraulic aspects). The Centre also houses a unit of the INSTN (national teaching institute for nuclear science and techniques).



Clean-up of a glove-box in contained room

· Effluent and solid waste treatment station and decay storage

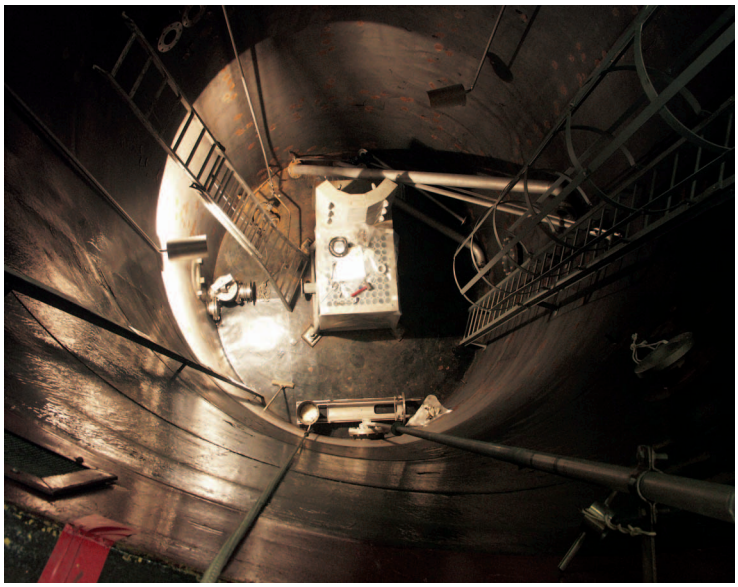
The effluent and solid waste treatment station (STEDS – BNI 36) is phasing its activities out until the end of 2010. The solid waste and liquid effluent treatment and packaging functions have ceased. The STEDS is still taking in and providing interim storage for waste, primarily that resulting from clean-up of the BNIs in the centre, before taking them away to alternative disposal routes. Removal of the high-level drums from the decay pit (BNI 79) should be carried out from 2005 to 2010.

· Active material analysis laboratory (LAMA)

This laboratory ended its scientific research duties in 2002. It takes part in the clean-up operations for the Mélusine reactor and is engaged in its own clean-up work. Updating of the safety report and the general operating rules to take account of modifications to the installation, particularly shutdown of the non-irradiated uranium interim store, is currently being examined.

· Siloette reactor

Siloette is a pool-type 100 kWth reactor, primarily used to train operational personnel for the nuclear power generating plants. This reactor has been in the decommissioning phase since mid-2002. All the fuel and the beryllium still present in the installation were removed and the two pools in the installation were drained. The decree authorising final shutdown and dismantling of the reactor is under preparation.



Siloette: empty pool

· Mélusine and Siloé reactors

Mélusine is a pool reactor operated by the CEA at its Grenoble Centre. It was decommissioned in 1994.

The decree authorising the CEA to modify the Mélusine reactor prior to its dismantling and downgrading was published in the *Official Gazette* in January 2004. The installation's pool is now empty and the its ceramic tiles and the ends of the neutron channels were removed as well.

The Siloé reactor, located on the CEA site in Grenoble, has been shut down since 23 December 1997. In 2004, the CEA forwarded a summary of the decommissioning operations which had begun in 1999. All objects have now been removed from the pool and pool drainage authorised by the ASN is in progress. The decree authorising final shutdown and dismantling of the reactor is under preparation.

2 | 2 | 3

The Cadarache site installations being dismantled

· Rapsodie reactor and Fuel assembly shearing laboratory (LDAC)

Rapsodie, a fast neutron experimental reactor, was shut down on 15 April 1983. Final shutdown was declared on 28 May 1985. As from 1987, this installation has been undergoing work, which led to its partial dismantling.

This work was interrupted in 1994, further to a fatal accident which occurred during the cleaning of a sodium tank. This accident, which emphasizes the risks involved in dismantling operations, necessitated rehabilitation and partial cleanup processes, which were completed by the end of 1997. Since then, the clean-up, limited dismantling and waste removal work has resumed and the installation has

now reached the SENEX phase (Care and maintenance stage). Renovation and refurbishment work has also been carried out.

Installed at Cadarache, the LDAC, which is part of the BNI comprising the Rapsodie reactor, carried out tests and examinations on spent fuel irradiated in Rapsodie or in other fast neutron reactors. This laboratory has been shut down since 1997. It has been cleaned-up, is under surveillance and is awaiting dismantling.

In 2004, the CEA sent the ASN updated General Operating Rules (RGE) and an updated safety case covering the Rapsodie reactor, the LDAC and the neutron radiography reactor. These documents are under review.

· Harmonie reactor

The Harmonie reactor, a source of graded neutrons, mainly used for detector calibration and investigation of the properties of certain materials, installed on the CEA Cadarache site, has been shut down since 1996. After removal of the depleted uranium, the experimental rigs, the fuel and the sources it contained, it was decommissioned on 18 December 1997.

The decree authorising the CEA to proceed with final shutdown and dismantling was published on 8 January 2004. The operations covered by this decree are in progress.

· Enriched uranium processing shops (ATUE)

The ATUE at the CEA Cadarache Centre provided conversion into sinterable oxide of the uranium hexafluoride from the isotopic enrichment plants. They were also used for the chemical reprocessing of fuel element fabrication rejects to recover the enriched uranium they contain. The facility was also equipped with a low level organic fluid incinerator. Production in the shops ended in July 1995 and the incinerator was shut down at the end of 1997. In April 2002, the ASN authorised the clean-up of the incineration line.

In March 1998, the CEA provided a request for final shutdown and dismantling of this BNI. This request was updated in 2003 and examination of it is pending. The ASN also authorised dismantling of the installation's incinerator. The decommissioning operations are now over and a report of these operations has been forwarded to the ASN.

· Cadarache irradiator (IRCA)

The Cadarache irradiation installation was designed to test the resistance of PWR safety-related electrical equipment to gamma radiation. Since the installation has not functioned since June 1995, the operator decided to shut it down in March 1996. The sources it contained were removed and sent to the Grenoble centre in April 1996.

The decree authorising the CEA to carry out final shutdown and dismantling of the installation was published in the *Official Gazette* on 12 January 2004. The operations covered by this decree were carried out during 2004, after which, the CEA sent the ASN a BNI downgrading application based on a residual environmental impact assessment. This application is currently being examined.

2 | 2 | 4

The Saclay site installations being dismantled

· High activity laboratory (LHA)

The high activity laboratory (LHA) comprises several units equipped for research and production assignments on various radionuclides.

The ASN was informed of clean-up work end on cells 12 and 16. Clean-up work is on going on cells 3, 5, 11, 12, and 15.

· CELIMENE cell

The CELIMENE cell, adjoining the EL3 reactor, was commissioned in 1965 for examination of the fuel from this reactor. This cell is now attached to the spent fuel analysis laboratory. The last fuel rods were removed in 1995 and a number of partial clean-up operations conducted until 1998. Dismantling of the installation, currently under surveillance, is not planned before about 2010.

· Saturne accelerator

Saturne is a particle accelerator, located at the CEA Saclay Centre, dedicated to fundamental or applied research, circulating proton, deuteron, helium, or even heavier ion beams.

The 8 October 2002 decree authorising final shutdown and dismantling of this installation appeared in the *Official Gazette* on 15 October 2002. The operations covered by this decree ended in February 2004. A BNI downgrading application was sent to the ASN and is currently being examined. Downgrading should be pronounced by the end of 2004 and will be accompanied by the usual easements on behalf of the State, in order to preserve a future trace of the past activities on the site.

· Saclay linear accelerator (ALS)

The Saclay linear accelerator is located on the Orme des Merisiers site on the Saclay plateau. It is operated by the CEA. It has been shut down since 1996 and is currently in a "closure of operation" stage.

The decree authorising the CEA to carry out the shutdown and dismantling operations on the ALS installation was published in the *Official Gazette* on 12 January 2004. The operations covered by this decree were completed in March 2004.

2 | 2 | 5

The La Hague installations being dismantled

· AT1 pilot reprocessing shop

The AT1 pilot reprocessing shop, operated by the CEA, on the COGEMA La Hague site, was used to reprocess spent fuel from the Rapsodie and Phenix fast neutron reactors, between 1969 and 1979. It forms part of BNI 33 (UP2 400 plant).

Dismantling of this installation began in 1982, and was completed in 2001. In 2001, the ASN duly took note of the end of clean-up, exclusive of civil works, and of transition to the surveillance stage.

· Caesium 137 and strontium 90 source fabrication shop (Élan IIB)

The ELAN II B installation, operated by the CEA on the COGEMA La Hague site, until 1973 manufactured caesium 137 and strontium 90 sources.

The initial dismantling operations undertaken by the Technicatome firm ended in November 1991.

A large number of renovation and maintenance operations took place during 2002 and 2003 (upgrading of the ventilation system, radiological mapping, etc.) with a view to dismantling operation resumption. All the installation upgrade work and the work preparatory to decommissioning of the installation was carried out during 2004. The operator also sent to the ASN the decommissioning file at the end of 2004. The CEA's provisional target is to complete dismantling in 2013.

· UP2 400

COGEMA announced its decision to no longer reprocess spent fuel in the UP2 400 as of 1 January 2004 and to effect final shutdown (see chapter 13). The application for the final shutdown and dismantling decree should be submitted by COGEMA in 2006.

2 | 3

The other installations

2 | 3 | 1

The Société Normande de Conserve et Stérilisation (SNCS) irradiator

The SNCS ionisation plant, located at Osmanville (Calvados), authorised by decree on 17 October 1990, was used for the sterilization of foodstuffs and medico-surgical equipment.

In 1995, the cobalt 60 sources contained in the installation were transferred to ionisers operated by the Ionisos company.

The operator presented an application for final shutdown and dismantling of the installation, with the ultimate aim of removing the installation from the list of BNIs. The corresponding decree was signed on 27 March 2002, and published in the *Official Gazette* on 4 April.

The decision to declassify the installation was signed in late 2002 by the Director General for Nuclear Safety and Radiation Protection. This decision should be followed by a number of easements on behalf of the State, which have not yet been signed.

2 | 3 | 2

The Strasbourg University reactor

Very similar in design and characteristics to the Ulysse reactor at Saclay, the Strasbourg University reactor (RUS-Université Louis Pasteur) was mainly used for experimental irradiations and the production of short-lived radioisotopes.

The ASN asked the Université Louis Pasteur to provide it with considerable data by June 2003, to supplement the files transmitted for the formal notice of November 2001 and concerning the provision of a final shutdown and dismantling file.

At the end of 2003, the ASN informed the Minister for Youth Affairs, National Education and Research, with responsibility for this reactor, of the need to finance complete dismantling in the very near future. In 2004, he informed the ASN that he agreed to immediate dismantling. In response to a request from the ASN, the final shutdown and dismantling dossier is currently being updated.

2 | 3 | 3

SICN plant in Veurey-Voroize

Two nuclear installations, BNIs 65 and 90, grouped together on the site of the SICN site in Veurey-Voroize, make up this establishment. Work involving the fuel elements used in experimental reactors and fabrication of fuel pellets with all enrichment levels has now finally ceased. The establishment is now being wound down. In 2003, SICN forwarded a final shutdown and dismantling dossier and the initial results of the radiological and chemical characterisation programmes. Further to a request from

the ASN, supplements to these two dossiers were forwarded. The dossier review was in progress at the end of 2004, and should allow the publication of the final shutdown and dismantling decree during 2005. The decommissioning operations continued in 2004 (mainly removal of nuclear materials to the appropriate channels).

2 | 3 | 4

COGEMA interim storage facility at Miramas

The COGEMA Miramas establishment (BNI 134) was created in 1983. It is an interim store for solid and stable compounds of natural enriched or depleted uranium, and uranium hexafluoride (UF6). Store clearance operations took place from the end of 2002 to the end of 2003 and the warehouse was completely empty of nuclear materials by 1 January 2004. A final shutdown and dismantling dossier was sent to the ASN in 2004 and is currently being reviewed.



COGEMA Miramas: storage of uranium containers



After the removal of uranium containers

3 Outlook

The new regulatory framework for BNI dismantling operations was issued at the beginning of 2003. It resulted from a process kicked off several years ago.

Since the beginning of 2003, the nuclear operators have submitted numerous dossiers in accordance with the guidelines of this new regulatory practice. These dossiers are currently being reviewed by the ASN. Mainly, they are about facilities shut down for several years, but for which the operators have not yet begun the regulatory dismantling authorisation procedures. This also corresponds to a considerable effort on the part of several operators to downgrade these closed installations as rapidly as possible.

In this context, the ASN asked EDF and the CEA to produce dossiers giving an overall description and a safety and radiation protection justification of their strategy and schedule for dismantling their many closed installations. These dossiers have been and will be the subject of in-depth examination. In 2004 in particular, the ASN took a stance on the dismantling strategy for EDF's first generation reactors. The ASN reckons that the programme and corresponding schedule are acceptable from the safety and radiation protection standpoint and identified no major points likely to call into question the technical feasibility of the scenarios envisaged. The first individual dossiers for the first-generation EDF reactors should be assessed during 2005.

Similarly, in 2005, the ASN will give its position regarding the CEA's dismantling strategy.

The authorisation application for complete dismantling of Superphénix will be examined in 2005.

The coming years will therefore be devoted to intense regulatory and supervisory activity with regard to BNI dismantling, consistent with the considerable efforts made by the operators in this area.

Furthermore, the prospect of partial privatisation of EDF and AREVA requires that a system be implemented to guarantee that sufficient funds will be available in due course in order to finance dismantling of the installations and management of the waste. The ASN will exercise particular vigilance on this point.

4 List of basic nuclear installations declassified as at 31.12.2004

Plant and site	BNI N°	Type of installation	Startup	Final shutdown	Last regulatory acts	Current status
NÉRÉIDE FAR*	(formerly BNI n° 10)	Reactor (500 kWth)	1960	1981	1987 : Removed from BNI list	Dismantled
TRITON FAR*	(formerly BNI n° 10)	Reactor (6,5 MWth)	1959	1982	1987 : Removed from BNI list and classified on environmental protection grounds	Dismantled
ZOÉ FAR*	(formerly BNI n° 11)	Reactor (250 kWth)	1948	1975	1987 : Removed from BNI list and classified on environmental protection grounds	Contained (museum)
MINERVE FAR*	(formerly BNI n° 12)	Reactor (0,1 kWth)	1959	1976	1977 : Removed from BNI list	Dismantled at FAR and reassembled at Cadarache
EL 2 Saclay	(formerly BNI n° 13)	Reactor (2,8 MWth)	1952	1965	Removed from BNI lsit	Sealed source
EL 3 Saclay	(formerly BNI n° 14)	Reactor (18 MWth)	1957	1979	1988 : Removed from BNI list and classified on environmental protection grounds	Partially dismantled, parts still contained
PEGGY Cadarache	(formerly BNI n° 23)	Reactor (1 kWth)	1961	1975	1976 : Removed from BNI list	Dismantled
CÉSAR Cadarache	(formerly BNI n° 26)	Reactor (10 kWth)	1964	1974	1978 : Removed from BNI list	Dismantled
MARIUS Cadarache	(formerly BNI n° 27)	Reactor (0,4 kWth)	1960 in Marcoule, 1964 in Cadarache	1983	1987 : Removed from BNI list	Dismantled
LE BOUCHET	(formerly BNI n° 30)	Ore processing	1953	1970	Removed from BNI list	Dismantled
GUEUGNON	(formerly BNI n° 31)	Ore processing		1980	Removed from BNI list	Dismantled
ATTILA** FAR*	57	Reprocessing pilot	1966	1975		Dismantled
BAT 19 FAR*	(formerly BNI n° 58)	Plutonium metallurgy	1968	1984	1984 : Removed from BNI list	Dismantled
LCAC Grenoble	(formerly BNI n° 60)	Fuel analysis	1968	1984	1997 : Removed from BNI list	Dismantled
ARAC Saclay	(formerly BNI n° 81)	Fuel assembly fabrication	1975	1995	1999 : Removed from BNI list	Cleaned-up
FBFC Pierrelatte	(formerly BNI n° 131)	Fuel fabrication	1983	1998	2003 : Removed from BNI list	Cleaned-up easements(***)
SNCS Osmanville	(formerly BNI n° 152)	Ioniser	1990	1995	2002 : Removed from BNI list	Cleaned-up

(*) Fontenay-aux-Roses - (**) Attila: reprocessing pilot workshop located in a cell of BNI 57 - (***) Easements on behalf of the State have been established on the related parcels.

5 LIST OF BASIC NUCLEAR INSTALLATIONS FINALLY SHUTDOWN AS AT 31.12.2004

Plant and site	BNI N°	Type of installation	Startup	Final shutdown	Last regulatory acts	Current status
CHOOZ AD (formerly-CHOOZ A)	163 (formerly BNI nº 1, 2, 3)	REACTOR (1040 MWth)	1967	1991	1999 : Decree authorising partial dismantling of Chooz A and creation of the Chooz AD interim storage BNI	Partially dismantled, transformed into BNI for storage of in situ waste
CHINON A1D (formerly-CHINON A1)	133 (formerly BNI n° 5)	REACTOR (300 MWth)	1963	1973	1982 : Decree authorising containment of Chinon A1 and creation of the Chinon A1D interim storage BNI	Partially dismantled, transformed into BNI for storage of in situ waste (museum)
CHINON A2D (formerly-CHINON A2)	153 (formerly BNI n° 6)	REACTOR (865 MWth)	1965	1985	1991 : Decree authorising partial dismantling of Chinon A2 and creation of the Chinon A2D interim storage BNI	Partially dismantled, transformed into BNI for storage of in situ waste
CHINON A3D (formerly-CHINON A3)	161 (formerly BNI n° 7)	REACTOR (1360 MWth)	1966	1990	1996 : Decree authorising partial dismantling of Chinon A3 and creation of the Chinon A3D interim storage BNI	Partially dismantled, transformed into BNI for storage of in situ waste
MÉLUSINE GRENOBLE	19	REACTOR (8 MWth)	1958	1988		Final shutdown
SILOÉ GRENOBLE	20	REACTOR (35 MWth)	1963	1997		Cessation of operation work in progress
SILOETTE GRENOBLE	21	REACTOR (100 kWth)	1964	2002		Cessation of operation work in progress
RAPSODIE CADARACHE	25	REACTOR (40 MWth)	1967	1983		Dismantling in progress
EL 4D (EX-EL4 BRENNILIS)	162 (ex INB n° 28)	REACTOR (250 MWth)	1966	1985	1996 : Decree authorising dismantling and creation of the EL-4D interim storage BNI	Dismantling in progress
AT1 LA HAGUE	33	Fast breeder fuel reprocessing	1969	1979		Cleaned-up
HARMONIE CADARACHE	41	REACTOR (1 kWth)	1965	1996		Cessation of operation work in progress
ALS SACLAY	43	Accelerator	1965	1996		Cessation of operation work in progress
STRASBOURG UNIVERSITY REACTOR STRASBOURG	44	REACTOR (100 kWth)	1967	1997		Cessation of operation work in progress
BUGEY 1	45	REACTOR (1920 MWth)	1972	1994	1996 : Decree authorising final shutdown	Final shutdown in progress

5 List of basic nuclear installations finally shutdown as at 31.12.2004 (continuation)

Plant and site	BNI N°	Type of installation	Startup	Final shutdown	Last regulatory acts	Current status
ST-LAURENT A1	46	Reactor (1662 MWth)	1969	1990	1994 : Decree authorising final shutdown	Final shutdown in progress
ST-LAURENT A2	46	Reactor (1801 MWth)	1971	1992	1994 : Decree authorising final shutdown	Final shutdown in progress
ÉLAN II B La Hague	47	Fabrication of Cs 137 sources	1970	1973		Dismantling in progress
SATURNE Saclay	48	Accelerator	1958	1997	2002 : Decree authorising final shutdown and dismantling	Shut down
High activity laboratory (LHA) Saclay	49	Laboratory	1960	1996		Cessation of operation work in progress - some cells still active
ATUE Cadarache	52	Uranium processing	1963	1997		Clean-up in progress
LCPu FAR*	57	Plutonium chemistry laboratory	1966	1995		Final shutdown in progress
RM2 FAR*	59	Radiometallurgy	1968	1982		Dismantling in progress
SUPERPHÉNIX Creys-Malville	91	Reactor (3000 MWth)	1985	1997	1998 : Decree authorising final shutdown	Final shutdown in progress

(*) Fontenay-aux-Roses

RADIOACTIVE WASTE, CLEAN UP AND POLLUTED SITES

CHAPTER 16

INTRODUCTION

1 RADIOACTIVE WASTE MANAGEMENT PRINCIPLES
1|1 Radioactive waste management channels
1|2 The regulatory framework for radioactive waste management
1|3 Organisation and responsibilities
1|4 ANDRA radioactive waste inventories
1|5 The national radioactive waste management plan

2 MANAGEMENT OF VERY LOW LEVEL WASTE
2|1 VLL waste management principles
2|2 The particular case of clean-up when dismantling installations
2|3 Morvilliers VLL waste repository

3 MANAGEMENT OF RADIOACTIVE WASTE BY THE PRODUCERS
3|1 Waste management in basic nuclear installations
3|1|1 CEA waste management
3|1|2 Management of COGEMA waste
3|1|3 EDF waste management
3|1|4 Other operators
3|2 Radioactive waste management in medical, industrial and research activities
3|2|1 Origin of waste and radioactive effluent
3|2|2 Management and disposal of radioactive waste and effluent produced by biomedical research and nuclear medicine
3|3 Management of waste containing enhanced natural radioactivity
3|3|1 Uranium mining waste
3|3|2 Waste resulting from other activities

4 INTERIM STORAGE OF RADIOACTIVE WASTE AND SPENT FUEL
4|1 Basic nuclear installations intended for interim storage of radioactive waste and spent fuel
4|2 Waste from past practices
4|3 The interim storage basic safety rule (RFS)
4|4 Management of radioactive waste for which the producer is unknown or insolvent: a public service duty
4|4|1 Organisation of the public authorities and their various responsibilities
4|4|2 The types of waste concerned and special actions in progress
4|4|3 Public service storage facilities

5 POLLUTED SITES
5|1 The regulatory framework of action by the public authorities
5|1|1 Interministerial circular of 16 May 1997
5|1|2 The law of 30 July 2003
5|2 The inventories of polluted sites in France
5|2|1 The ANDRA national inventory
5|2|2 Databases of the Ministry for Ecology and Sustainable Development
5|3 Actions performed and dossiers in progress
5|3|1 General
5|3|2 Actions performed
5|3|3 Some of the dossiers in progress

5 | 3 | 4 Management of incidental contamination

6 LONG-TERM MANAGEMENT OF RADIOACTIVE WASTE BY DISPOSAL

6 | 1 Long-term management by surface or subsurface disposal of radioactive waste
6 | 1 | 1 Manche waste repository
6 | 1 | 2 Aube waste repository
6 | 1 | 3 Package acceptance rules
6 | 1 | 4 Surface or subsurface disposal projects
6 | 2 High level long-lived waste disposal: application of article L.542 of the Environment Code (law of 30 December 1991)
6 | 2 | 1 Separation/transmutation
6 | 2 | 2 Underground laboratories
6 | 2 | 3 Long-term storage
6 | 2 | 4 Specifications and approval certificates for waste packages unsuitable for surface disposal

7 OUTLOOK

INTRODUCTION

Overall, this chapter deals with management of objects and sites after they have been used for an activity involving radioactive substances, when their owner intends to abandon them or wishes to alter their utilisation.

This chapter therefore is about:

- how radioactive waste is managed in operational activities;
- how clean-up of sites and installations is regulated, to prevent pollution;
- how legacy or current pollution (polluted sites) is dealt with to guarantee the environment and the public protection.

Finally, certain installations designed for radioactive waste disposal intentionally concentrate radioactivity in a single place; how the surrounding public and environment are protected falls within the ambit of waste repository safety, which must be dealt with consistently with polluted site practices.

1 RADIOACTIVE WASTE MANAGEMENT PRINCIPLES

Like any human activity, nuclear activities produce waste. This waste is of two types, radioactive and non-radioactive. Waste containing high levels of natural radioactivity, sometimes resulting from use of a process leading to concentration of this radiation, can be produced by non-nuclear activities, in which the radioactive substances are not used for their radioactive or fissile properties.

Non-radioactive, or “conventional”, waste comprises ordinary industrial waste and special industrial waste.

Radioactive waste management begins with the design of installations using radioactive substances, and proceeds during the operating life of these installations through concern for limitation of the volume of waste produced, of its harmfulness and of the quantity of residual radioactive materials contained. It ends with waste elimination (recycling or final disposal) via the intervening stages of identification, sorting, treatment, packaging, transport and interim storage. All operations associated with management of a category of waste, from production to disposal, constitute a waste management channel, each of which must be adapted to the type of waste concerned.

The operations within each channel are interlinked and all the channels are interdependent. These operations and channels form a system which has to be optimised in the context of an overall approach to radioactive waste management addressing safety, radiation protection, traceability and volume reduction issues. This management must also be completely transparent to the public.

1 | 1

Radioactive waste management channels

Radioactive wastes vary considerably by their activity level, their half-lives, their volume or even their nature (scrap metal, rubble, oils, etc.). The treatment and final disposal solution must be adapted to the type of waste considered in order to overcome the risk involved, notably radiological hazards.

The latter can be assessed on the basis of two main parameters: the activity level, which contributes to the toxicity of the waste, and the radioactive half-life, which depends on the radioactive decay periods of the radioelements it contains. Therefore, on the one hand we have very low, low, medium or high level waste and, on the other hand, waste known as very short-lived, resulting mainly from medical activities (activity level halved in less than 100 days), short-lived (activity level halved in less than 30 years) and long-lived, containing a large quantity of long-lived radioelements (activity level halved in more than 30 years).

The table below shows the stage reached in implementation of the different waste management channels, notably the final disposal channel adopted.

– Very short-lived waste

Medical uses of radioactivity, whether for diagnostic or therapeutic purposes, generally involve very short-lived radioelements (their radioactivity is halved in less than a few days). The waste produced by these diagnostic or treatment activities is collected and stored for a time enabling virtual disappearance of the radioactivity, generally about ten times the half life of the radioactive element. This waste, now conventional, is then disposed of as such in the conventional hospital waste disposal channels.

Table 1: Existing or future disposal channels for the main radioactive solid wastes

<table>
<tr><th>Period
Activity</th><th>Very short-lived</th><th>Short-lived</th><th>Long-lived</th></tr>
<tr><td>Very low level</td><td rowspan="4">Management by radioactive decay</td><td colspan="2">Dedicated surface repository
Recycling channels</td></tr>
<tr><td>Low level</td><td>Surface disposal
(Aube repository)</td><td>Dedicated subsurface disposal facilities under investigation</td></tr>
<tr><td>Medium level</td><td>except tritiated waste, sealed sources (under investigation)</td><td>Channels under investigation of article L.542 of the Environment Code (law of 30/12/91)</td></tr>
<tr><td>High level</td><td colspan="2">Channels under investigation under the terms of article L. 542 of the Environment Code (law of 30/12/91)</td></tr>
</table>

– Very low-level waste (VLL)

Apart from the waste originating from former operation of uranium mines in France, most very low-level waste today comes from nuclear installation dismantling, from conventional industrial or research sites which use low-level radioactive substances, or from clean-up of sites polluted by radioactive substances. The quantity produced will grow considerably when the time comes for the large-scale complete dismantling of the power reactors and plants currently in operation. Radioactivity of this waste is about a few Becquerels per gram.

– Short-lived medium and low level waste

The technical solution generally adopted for this type of waste is its removal, either directly or after incineration or fusion, to a surface repository, where the waste packages are stored in concreted structures. This provides for containment of the radionuclides for a sufficient length of time to take full advantage of the radioactive decay phenomenon (see § 6|1 below). This disposal channel has been operational since 1969, when France decided to cease its participation in the VLL waste immersion operations organized by the OECD. At that time, 14,300 m³ of radioactive waste of French origin had already been immersed in the Atlantic Ocean.

– Special case of short-lived medium and low-level waste for which no disposal channel is currently available

Short-lived medium and low-level waste includes certain categories which have characteristics making them currently unsuitable for acceptance at the Aube repository in Soulaines, without additional authorisation from the ASN.

Most sealed sources fall into this category: in industrial or medical activities, the radioactive elements used are frequently contained in perfectly leaktight containers. The tightness of the container is guaranteed by periodic leak tests and by a strictly limited source operational life. Consequently, it is certain that the elements in contact with it cannot be contaminated by radioactivity and they can thus be disposed of as conventional waste. After use, the sources must be returned to their manufacturer.

A specific feature of these sources is that they contain often highly concentrated radioactivity. Consequently, even when the radioactive elements concerned have a relatively short life, they cannot always be accepted as such by a surface waste repository, because even after 300 years, they would still have significant radioactivity. In addition, their envelope is often made of stainless metals, making them tempting for people digging into the repository. The future of used sources is being examined by a special working group headed by the ASN and is intending to draft the national radioactive waste management plan.

In addition, some waste contains significant quantities of tritium, a short-lived radionuclide but one that is hard to confine owing to its mobility, unlike the other radionuclides.

– Long-lived low-level waste

This waste usually comes from industrial activities leading to concentration of naturally occurring radioelements (the former radium industry for example), or from the nuclear industry (such as the irradiated graphite contained in the structures of the old gas cooled reactors (GCR).

Owing to its long life, this waste cannot be disposed of in a surface repository as it is impossible to take advantage of its radioactive decay within a time-frame compatible with permanent institutional surveillance. However, its low intrinsic hazard could enable it to be disposed of in a subsurface repository about fifteen metres deep.

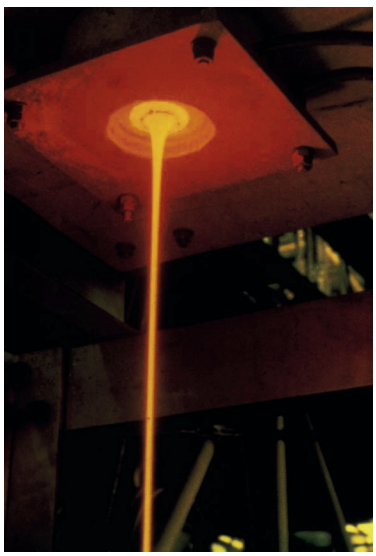
A working group, led jointly by the ASN and the services of the DSND, brings together the ANDRA and the producers of the waste concerned.

– High-level waste and long-lived medium level waste

This waste contains long half-life radionuclides, notably alpha emitters. The vast bulk of it comes from the nuclear industry. It comprises both medium level and high-level waste.

The medium level waste is mainly processed waste (hulls and end-pieces of irradiated fuel, effluent treatment sludge) and in-service maintenance waste from reprocessing facilities and research centres, or certain waste from the dismantling of nuclear installations. In this waste, the alpha emitters can often reach significant quantities.

The high level waste generally originates from fission and activation products deriving from spent fuel processing. Vitrified waste is characterised by significant release of heat (up to 4 kW per 150-litre container), making the use of cooling systems necessary. This high level waste also



Radioactive liquor vitrification

includes fuel irradiated in CEA research reactors, together with EDF spent fuel which is not to be reprocessed.

At present, there is no disposal channel for this waste, which is for the time being stored in the nuclear installations. Research into possible disposal is being conducted along the lines defined by Article L. 542 of the Environment code (see § 6|2).

1 | 2

The regulatory framework for radioactive waste management

Radioactive waste management falls within the general scope of Law 75-633 of 15 July 1975 (Art. L.541 of the Environment code) and its implementation decrees, concerning waste disposal and the recovery of materials. The basic principles of this law are the prevention of waste production, the responsibility of the waste producers, the traceability of this waste and the need to inform the general public.

– Production of radioactive waste in basic nuclear installations

Management of radioactive waste from basic nuclear installations is structured within a strict regulatory framework, defined by a ministerial order of 31 December 1999 stipulating the general technical regulations intended to prevent and limit the detrimental effects and external hazards resulting from the operation of basic nuclear installations. This order requires drafting of a study specifying how the waste produced in basic nuclear installations is to be managed. One part of this study is submitted for approval to the Director General for Nuclear Safety and Radiation Protection.

– Production of radioactive waste in other activities using radioactive substances

The provisions mentioned in the decree of 4 April 2002 concerning the general protection of persons against ionising radiation have been incorporated into the public health code. Article R.1333-12 of this code states that management of waste contaminated by radioactive substances originating in any activity comprising a risk of exposure to ionising radiation must be examined and approved by the public authorities, in conditions and according to technical rules which have yet to be defined.

Circular DGS/DHOS n°2001/323 of 9 July 2001 sets the technical aspects to be taken into account when ensuring good management of radioactive waste, mainly in health institutions, but also in biomedical research laboratories. This circular requires that each institution draw up an individual on-site management plan for radioactive waste, based on the following main principles: sorting of the waste as early as possible in the process, separate storage areas according to the type of waste, disposal of the waste through identified channels.

Since July 2003, presentation of the institution's waste management plan will be a pre-requisite to renewal of the radioelement possession licences.

– Radioactive waste generated by clean-up of polluted sites

When clean-up of a polluted site is justified in terms of protection against ionising radiation, the waste resulting from the work must be correctly characterised in order to determine which disposal channels are necessary. The ANDRA in general takes part in these rehabilitation operations and conducts these investigations directly.

– Waste management channel supervision

Supervision of the waste management channels requires on the one hand traceability of radioactive waste treatment and disposal operations, and on the other detection of the presence of radioactive waste upstream of any treatment in installations not authorised to receive them.

As regards waste traceability, whether the waste is radioactive or not, a draft decree concerning the monitoring of waste treatment channels is in preparation at the Directorate for the Prevention of Pollution and Risks. This text aims to provide improved supervision and better monitoring of the waste throughout the treatment and disposal channel, by requiring the creation of traceability systems (registers, periodic declarations to the Administration and waste monitoring forms). This draft decree was examined by the CIINB on 27 January 2004.

With regard to waste treatment or disposal installations not authorised to receive radioactive waste, the action taken by the authorities led to radioactivity detection systems being installed at the entrances to the sites (landfills, foundries, incineration plants, etc.). These systems constitute an extra line of defence in the supervision of radioactive waste management channels.

1 | 3 Organisation and responsibilities

The waste producer remains responsible for the waste produced until its disposal in an installation authorised for this purpose (in the case of a polluted site, the owner of the land is considered to be the producer of the waste). However, many different organisations also play an active part in waste management: the carriers (COGEMA Logistics, BNFL SA), the processing contractors (SOCODEI, COGEMA), the interim storage or disposal centre operators (CEA, COGEMA, ANDRA), the organisations responsible for research and development to optimise these activities (CEA, ANDRA...). Each is responsible for the safety of its activities.



ANDRA – receipt of parcels at very low level waste repository centre in Morvilliers

Waste producers must also constantly endeavour to minimise the volume and activity of their waste, upstream through design and operating provisions and downstream through appropriate waste management. Packaging quality must also be assured.

The waste treatment (compacting, incineration, melting, etc.) contractors may act on behalf of the producers, who remain the owners of their waste. The contractors are responsible for the safety of their installations.

The interim storage or repository operators are responsible for the medium and long-term safety of their installations.

The ANDRA has a long-term assignment to manage repositories. The ANDRA also has a public service duty to store waste for which no disposal channel is available and whose owners cannot safely store it, or for which the owner cannot be identified (see § 4|4).

Research organisations (CEA, ANDRA) contribute to the technical optimisation of radioactive waste management, with regard to both production and development of treatment, packaging and characterisation processes. Efficient coordination of the research programme is necessary to ensure overall safety optimisation in this area.

In this context, the Nuclear Safety Authority (ASN) drafts regulations governing radioactive waste management, supervises the safety of the basic nuclear installations which give rise to this waste or play a part in its disposal and conducts inspections in the facilities of the various waste producers

(EDF, COGEMA, CEA, hospitals, research centres, etc.) and of the ANDRA. It directly supervises the ANDRA's overall organisational provisions for waste acceptance from the producers. It directly assesses the waste management policy and practices of the radioactive waste producers.
The ASN has three priorities:
- safety at each stage in radioactive waste management (production, treatment, packaging, interim storage, transportation and disposal);
- safety of the overall radioactive waste management strategy, ensuring overall consistency;
- the setting up of channels tailored to each category of waste. Any delay in identifying waste disposal solutions increases the volume and size of the onsite interim storage facilities, and the inherent risks.

1 | 4

ANDRA radioactive waste inventories

The ANDRA has periodically published since 1993 a "national radioactive waste inventory". This document, which is based on data provided by the waste producers and on historical studies, presents data on the condition and location of radioactive waste nationwide. On 9 December 1998, the government asked the ANDRA chairman to "propose reforms to improve the reliability of this waste inventory, in particular with extrapolation of the medium and long-term inventory". Following this assignment, the ANDRA chairman in June 2000 recommended producing a national reference inventory based on a broad definition of the notion of waste (including spent fuel without further use) and giving assessments of the future waste "committed" in the existing installations. In this way, the simple geographic approach would give way to a prospective accounting concept, better suited as a basis for a national discussion on the overall management strategy to be adopted. In July 2001, the government confirmed its decision to launch the national reference inventory of radioactive waste and to finance it via the budget of the State Secretariat for Industry. This is one of the elements of

Tables 2 and 3 : Stocks of waste and spent fuels, both existing and anticipated by 2010 to 2020 as a result of operation of the installations

Waste categories	Existing volumes in 2002 disposed of or stored (m^3)	Anticipated volumes 2010 disposed of or stored (m^3)	Anticipated volumes 2020 disposed of or stored(m^3)
Very low level	108,219	247,981	515,991
Low and medium level short-lived	778,322	913,900	1,196,880
Low level - long-lived	44,559	46,581	87,431
Medium level - long-lived	45,359	50,207	54,509
High level	1,639	2,521	3,621

	Existing quantity in 2002 (t)	Existing quantity in 2010 (t)	Existing quantity in 2020 (t)
EDF uranium oxide spent fuel waiting for processing	10,350	11,250	10,850
PWR reactor MOX fuels	520	1300	2350

(source: national inventory of radioactive waste and recoverable materials – ANDRA 2004)

the four-year contract signed between the State and the ANDRA. The first national inventory of radioactive waste and recoverable materials was published in November 2004. An updated version is scheduled for publication in 2006. The ASN took part in the steering committee for this new inventory.

The following table presents some data extracted from the national inventory published in 2004. The largest volumes concern very low level or short-lived low and medium level waste, representing only a few teraBecquerels, which is a minute fraction of the total activity. On the other hand, long-lived, high level waste will in 2020 represent more than a billion teraBecquerels, for a total volume of just a few thousand cubic meters.

1 | 5 The national radioactive waste management plan

The preceeding paragraphs show the various technical and regulatory aspects of radioactive waste management: categories (according to the disposal method), inventory, regulations at source, and role of the various players. These elements were gradually implemented over the years, as and when inadequacies in various areas were highlighted.

It is clearly obvious that a general framework is needed which, for all radioactive waste and whatever the producers, would guarantee safe and consistent management with the corresponding financing, in particular by defining priorities.

The guidelines of the National radioactive waste management plan

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

• compliance with the main principles of protection against ionising radiation (justification, optimisation, limitation) and environmental protection (precaution principle, polluter-pays principle, etc.);

• prevention or reduction at source of waste production and harmfulness;

• responsibility of waste producers, who are required to ensure disposal in conditions such as to rule out any prejudice to human health and the environment;

• information and active involvement of the citizens;

• waste management traceability (with regard to the radioactive nature of the waste and during waste management operations) with definition of any associated restrictive measures;

• incorporation of the risks linked to the transport of radioactive waste, as part of the process to optimise all waste management aspects;

• definition of management and disposal channels suited to the characteristics of the various types of waste, in particular with regard to interim storage of waste for which there is as yet no disposal channel, or handling by the local authority of "stray" waste, usually resulting from past activities;

• optimisation of each channel from beginning to end, and definition of associated checks;

• quantifiable ways of ensuring progress concerning methods and techniques.

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

The Minister for Ecology and Sustainable Development officially stated his intention of drafting such a plan during the Cabinet meeting of 4 June 2003.

Several meetings of the plenary working group responsible for drawing up this plan have since then been held. A number of technical entities such as waste producers (including all sectors), waste disposal facilities, the ANDRA, the directorates of the ministries concerned, were invited to attend these meetings, along with environmental protection associations and representatives of elected representatives. An initial version of the National radioactive waste management plan was distributed to the members of the working group responsible for drafting it in September 2004. A second version, taking account of all the comments made by the participants was distributed at the end of December 2004.

The plan is based on work designed to identify the waste that exists throughout the country. This mainly concerns the ANDRA national inventory. Interfaces with existing work to designate management channels for long-lived high-level waste, in accordance with the provisions of article L. 542 of the Environment Code, are also specified.

2 Management of very low level waste

The level of risk from radioactivity is very hard to determine for very low level (VLL) waste. In addition, this level of risk from the waste can be very close to that inherent in its chemical toxicity or possible infectiousness. The procedures for managing VLL waste must therefore take account of this difficulty.

2 | 1

VLL waste management principles:

Some countries, such as Germany, have implemented a policy for the release of VLL waste based on activity thresholds. The German administration has therefore put into practice an option offered by European radiation protection supervision directive 96/29.

French doctrine does not provide for unconditional release of VLL waste simply on the basis of universal thresholds. This leads to specific management of this waste and disposal of it in a dedicated repository.

Waste management in the BNIs is mainly regulated by the order of 31 December 1999. Any basic nuclear installation must be mapped out, with “zoning” of its buildings in which there is a risk of contaminated, activated or non-radioactive waste being produced. The zones likely to lead to the production of radioactive waste are referred to as “nuclear waste zones”. The waste originating from nuclear waste zones has to be managed in dedicated channels. The waste from the other zones is, after checking that there is no radioactivity, routed to conventional waste channels (non-specific or special industrial waste). The ASN has published a guide, revised in 2002, for the production of BNI waste studies. It is available from the ASN web site.

Recycling of waste from nuclear waste zones is possible. However it would be preferable for such recycling to take place in a channel that is already nuclear, such as the lead recycling from the Marcoule installations to produce biological protections. The reuse of recycled materials in consumer

goods and construction products may be authorised by waiver to article R 1333-3 by order of the Minister for Health. A procedure of this type was examined with a view to recycling scrap decontaminated by the SOCATRI Company, and processed by the Feursmétal Company to produce industrial parts, such as tractor-shovel buckets. The prefect of the Loire department in 2004 authorised an experimental approach designed to check that the practice entailed no risk and that there was no contamination of the parts resulting from this process. The Commission for sources and ionising radiation in the radiation protection section of the French High Council on Public Health examined the dossier submitted by SOCATRI on 29 June 2004. It asked to re-examine this dossier at a future session, particularly so that it could take account of the experimental testing results. This project was opposed by some of the company's trade unions and environmental protection associations, forcing the company behind the project to abandon it at the beginning of 2005.

2 | 2 The particular case of clean-up when dismantling installations

Dismantling operations can pose safety issues dealt with in Chapter 15. This section only deals with operations designed to separate the nuclear parts (which could have been in contact with radioactive substances) from conventional parts (which could not have been in contact with radioactive substances).

a. Basic nuclear installations

The clean-up method today preferred by the ASN for nuclear installations is based on a waste zoning methodology. Using a demonstration based on the design of the installation, its operating methods, an analysis of its history (incidents, modifications, periodic radiological checks, etc) or any other empirical type of demonstration, the operator must determine the waste zoning in its installation by accurately defining the boundary between conventional waste zones and nuclear waste zones. In the particular case of building walls, this boundary can correspond to a minimum clean-up thickness. The operator then removes all nuclear waste from the nuclear waste zones, before implementing an appropriate inspection programme on the remaining elements, to confirm that there is no contamination or activation. It then proposes to the Director General for Nuclear Safety and Radiation Protection, that this zone be downgraded to a conventional waste zone. After approval of this final waste zoning modification, the remaining conventional waste is disposed of in conventional channels and can be dealt with in the same way as normal industrial waste.

On the basis of this doctrine, the operator of the Monts d'Arrée plant in Brennilis defined a general clean-up methodology based on determination of a minimum depth of concrete to be removed from the walls of the building, by analysing the operating history of this building, combined with modelling of migration of radionuclides through the concrete. After removal of this concrete thickness, a programme to confirm the conventional nature of the remaining walls was implemented.

In 2003 and 2004, EDF used this methodology to clean-up several nuclear buildings: the spent fuel building (BCI) and the effluent treatment station (STE) on the Monts d'Arrée site and all the hillside buildings at Chooz A. The requests for downgrading the nuclear waste zones in these buildings to conventional waste zones were approved by the ASN in 2004. These buildings were demolished using conventional demolition techniques and the resulting products are considered as conventional waste. Furthermore, in the current context of managing industrial sites being dismantled, the need became apparent for conservation of a trace of the past existence of a basic nuclear installation on a site, along with any utilisation restrictions appropriate to the condition of the site. A conventional constraint on behalf of the State is established by the ASN, together with the local State representatives concerned, and proposed to the owner of the land. This constraint is recorded in the mortgage register to guarantee its permanence. These procedures were implemented for the first time in the case of the FBFC installation in Pierrelatte on 15 May 2003: the operator and state representatives

signed a conventional constraint on behalf of the state, affecting the land within the BNI boundary, at the same time as the decision was signed to remove the installation from the list of BNIs.

b. Medical, industrial and research installations

There are as yet few dossiers concerning clean-up of medical, industrial and research installations. In 2004, a dossier for complete dismantling of a former pharmaceutical laboratory owned by Aventis-Pharma was submitted to the ASN for its opinion by the prefect of Seine-Saint-Denis. From 1956 to 2003, this laboratory carried out radioactive labeling of molecules for pharmaceutical research, using carbon 14 and tritium. The clean-up and dismantling methodology chosen is similar to that employed for nuclear installations: the premises are defined according to waste zoning, based primarily on the history of activities on the site and differentiating between nuclear waste and conventional waste. The clean-up targets were set and the waste will be removed to duly authorised channels. The preliminary studies and the operations are carried out in cooperation with the ANDRA.

2 | 3

Morvilliers VLL waste repository

The move to rationalise management of VLL waste initiated by the ASN in 1994 showed that it was necessary to create a repository for this type of waste. At the request of the nuclear operators, technical studies had been conducted by the ANDRA and by SITA FD as of 1996 with a view to creating a repository intended for very low level radioactive waste. The site finally chosen is not far from the Aube waste repository. The procedures involved in the installation creation authorisation, including two public inquiries, were conducted in 2001 and 2002. The authorisation order was signed by the Aube prefect on 26 June 2003. This installation classified for environmental protection purposes (ICPE), with a capacity of 650,000 m^3, has been operational since August 2003. During its first year of operation, it received 10,000 m^3 of VLL waste.



Very low level waste repository centre

3 MANAGEMENT OF RADIOACTIVE WASTE BY THE PRODUCERS

3 | 1

Waste management in basic nuclear installations

Once produced and before final disposal, certain radioactive waste undergoes treatments to reduce its volume or harmfulness and, whenever possibly, to recover exploitable materials. These treatments can produce secondary waste. After processing, the waste is packaged and then, depending on its nature, placed in an interim storage facility or sent to a waste repository.

The following paragraphs examine the situation with regard to basic nuclear installations.

3 | 1 | 1

CEA waste management

The CEA operates treatment, packaging and interim storage facilities for the main types of waste it produces through its research and dismantling activities as well as through its industrial activities (manufacture of sources). In general, each CEA site operates its own treatment and packaging installations for the radioactive waste and effluent it produces. The solid wastes for which there are operational channels (reprocessing, elimination by incineration or melting, disposal in approved surface repositories) are removed accordingly (installations of the CEA, Centraco, repository, etc.). Waste subject to Article L.542 of the Environment code, in particular long-lived medium and high level waste, is generally stored by the CEA in installations with a lifespan limited to a few decades, pending creation of a disposal channel. Very low level waste, a significant volume particularly owing to dismantling of CEA former installations, are stored on site and then taken away to the VLL waste repository. Liquid waste is treated, solidified and packaged in drums. Depending on their activity, the resulting packages are either disposed of in the ANDRA's Aube waste repository, or stored by the CEA. Effluent waiting for a treatment channel is stored.

The CEA also possesses solid and liquid legacy waste for which there could be treatment problems (technical difficulties due to problems with bulk collection of effluents from their storage tanks and lack of constituent chemical product characterisation or for which there is no operational disposal channel. The ASN ensures that treatment of this waste is one of CEA's priorities within its waste management policy and that adequate surveillance is maintained on the storage facilities pending treatment.

Nuclear fuel without further use from the civil sectors of the CEA is placed in interim storage, either dry (in a decay pit) or in a pool, pending definition of a disposal channel (reprocessing or storage).

3 | 1 | 2

Management of COGEMA waste

In 2003, the ASN asked for a joint examination by the Advisory Committees for plants and for waste, of Cogema's waste management policy on the La Hague site. In 2004, Cogema forwarded a dossier to the ASN covering management of this waste. It will be examined by the Advisory Committee for laboratories and plants in the second half of 2005.

Fission products and minor actinides

After a decay period in stainless steel tanks, the fission product and minor actinide solutions resulting from spent fuel reprocessing are calcined then vitrified. The resulting molten glass, which contains the fission products and minor actinides, is poured into stainless steel containers. After the

glass solidifies, the containers are transferred to an interim storage facility pending disposal or until they are sent to the customer.

Waste from radioactive effluent treatment

The La Hague site operates two radioactive effluent treatment stations (STE 2 and STE 3). The effluents are treated by coprecipitation and the resulting sludge is bitumen encapsulated and poured into stainless steel drums in the most recent of these installations (STE 3). The drums are then stored on the site. Activity at these two installations has considerably lessened in recent years since most effluents are now evaporated in the various fuel reprocessing facilities and the concentrates are vitrified.

COGEMA also operates an organic effluent storage installation (MDSA). The effluents stored there are subsequently treated using a mineralisation process by pyrolysis in the MDSB facility. This installation produces cemented packages suitable for surface disposal.

Finally, the water in the fuel unloading and interim storage pools is continually purified by means of ion exchange resins. Once spent, these resins become process waste which must be treated. In September 2000, COGEMA was authorised to start operating the resin solidification shop (ACR), which uses a cementing process.

Technological waste and radioactive structural waste

The technological waste is sorted, compacted and encapsulated or blocked in cement in the AD2 facility. The packages complying with ANDRA technical specifications for surface disposal are sent to the Aube repository. If this can not be the case, they are kept in interim storage pending a final disposal solution.

Long-lived medium level structural waste (hulls and end-pieces) is stored at the DE/EDS facility, pending compaction at the ACC facility. This compaction produces standard compacted waste packages (CSD-C) which replace the cemented packages previously produced by COGEMA. This process could also be used for the packaging of technological waste. The authorisation for precommissioning of the ACC facility and the E unit for interim storage of CSD-C containers in E EV south-east was the subject of a ministerial decision in 2002.

Legacy waste

The La Hague site also stores waste produced during the early years of activity on the site. These storage areas are often silos.

Some of these storage areas do not meet currently required safety standards and waste will therefore have to be recovered from them, which could be very expensive.

An examination of these interim storages was conducted in 1998 by the Advisory Committees for laboratories and plants and for waste.

Following this examination, the ASN asked COGEMA to make provision for extra resources to package and retrieve the waste, as the initial times proposed by COGEMA were felt to be too long. The ASN in particular asked COGEMA to begin recovering the sludges stored in the STE2 silos, as of 2005. However, COGEMA currently has problems with characterising the sludges in these silos, which is a pre-requisite for approving the bituminized waste package specification and the packaging operations. The ASN is currently assessing Cogema's proposals on this subject.

3 | 1 | 3

EDF waste management

Waste resulting from PWR plant operation is mainly low or medium level waste. It contains beta and gamma emitters but few or no alpha emitters. The waste falls into three categories:
- processed waste from gaseous or liquid effluent treatment reducing the activity level prior to release. This includes ion exchange resins, water system filters, evaporator concentrates, liquid sludge, prefilters, absolute filters and iodine traps;
- technological waste from maintenance operations. It may be solid (rags, paper, cardboard, vinyl sheets or bags, wooden or metal parts, rubble, gloves, protective clothing, etc.) or liquid (oils, decontamination effluents, etc.);
- special waste from exceptional replacement and maintenance operations (valves, vessel heads, steam generators, fuel assembly storage racks, etc.).

EDF waste accounts for most of the activity delivered annually to the Aube waste repository: in 2001, 232 TBq for beta gamma emitters, or 94% of the total activity delivered, and a very small quantity of alpha emitters (less than 0.01%), for about 4500 m^3 of waste delivered. Most of the activity is concentrated in the ion exchanger resins and the water circuit filters, while the largest volume of waste to be stored is the technological waste packaged in metal drums or concrete overpacks.

Other waste is generally packaged in metal-lined reinforced concrete overpacks. Filters, evaporator concentrates and liquid sludges are encapsulated in a binder in fixed installations (in the nuclear auxiliaries building or the plant effluent treatment building) or mobile installations, depending on the plant series and the reactors.

In 2002, the waste management policy developed by EDF, both centrally and in the Nuclear Power Plants (NPP), both for operating waste and for legacy waste, was jointly reviewed by the Advisory Committees for reactors and for waste. On the basis of this review and the findings made during its own inspections in 2000 and 2001, the ASN asked EDF in December 2002 to improve the safety of the NPP buildings in which most waste management takes place, to start treatment and disposal of used steam generators, to look for channels for disposal of the waste stored in the pits, of chemical waste and of graphite waste. The ASN also asked EDF for clarification of its waste management organisation.

The future of EDF spent fuel

After unloading from the reactor, EDF stores its spent fuel in pits adjoining the reactor buildings. When cooled, the spent fuel is removed to the COGEMA reprocessing plant at La Hague. EDF's policy consists in maintaining an appropriate balance between the quantity of plutonium removed from its spent fuel during reprocessing and that required for MOX fuel fabrication. The number of spent fuel assemblies reprocessed annually at La Hague is defined on this basis.

The part of the spent fuel which is not reprocessed must be disposed of in the channels examined under application of article L. 542 of the Environment Code concerning radioactive waste management research.

The EDF fuel utilization policy, regarding both in-pile irradiation conditions and spent fuel management (see Chapter 12), has repercussions on the fuel cycle installations (see Chapter 14) and on the quantities and quality of the secondary waste produced. This subject was examined by the Advisory Committees for plants and for waste in late 2001 and early 2002.

In July 2002, the ASN asked EDF for further data, partly related to current and future fuel management systems and their repercussions on the fuel buildings or on the fuel cycle plants: MELOX in Marcoule, FBFC in Romans-sur-Isère and COGEMA at La Hague. In 2004, the ASN asked EDF to sup-

plement the safety case about the impact of the new "MOX parity" and "Galice" fuel management systems on the waste package specifications, on management of the waste and organic effluents produced in the various fuel cycle installations and on the "long-duration" dry interim storage project for MOX fuel.

3 | 1 | 4

Other operators

The waste management by other BNI operators is examined by the ASN on the basis of their waste surveys (see § 1|2).

3 | 2

Radioactive waste management in medical, industrial and research activities

3 | 2 | 1

Origin of waste and radioactive effluent

Many areas of human activity use radioactive sources; this is particularly the case with diagnostic and therapeutic activities. This activity may lead to the production of radioactive waste and effluent.

Sealed sources are mainly used for radiotherapy (telegammatherapy and brachytherapy) and for measurement. Given their characteristics (usually radionuclides with periods of several years and high activity levels) these sources must be recovered by their supplier once they are no longer needed, or by their manufacturer in the event of defaulting by the supplier. Decree 2002-460 of 4 April 2002 reinforced the sealed source recovery requirements previously adopted by the CIREA. These sealed sources are not likely to produce radioactive effluent in normal conditions of use and storage.

The use of unsealed sources in nuclear medicine, biomedical and industrial research is the reason for production of radioactive solid waste and liquid effluent: small laboratory equipment items used to prepare sources (tubes, gloves, etc.), medical equipment used for administration (syringes, needles, cotton swabs, compresses which could be soiled with biological products, etc.), remains of meals consumed by patients who had received diagnostic or therapeutic doses, and so on. The radioactive liquid effluents also come from source preparation (liquid radioactive residues, contaminated material rinsing water, scintillating products used to count certain radionuclides, and so on), as well as from the patients who naturally eliminate the radioactivity administered to them.

To the radioactive risk can be added the chemical and infectious risks, in particular in the biomedical field. The infectious risk is due to pathogens (viruses, bacteria, parasites) contained in certain waste and effluent produced by the health care activities. If this risk is to be controlled, then specific handling rules must be followed and appropriate packaging used, failing otherwise it nosocomial diseases (secondary infections contracted in the health care establishments) are possible.

Faced with this problem of health care waste contaminated by radionuclides, which appeared with the growth of nuclear medicine, the public authorities have initiated a process of supervision of the activities and information of both patients and practitioners concerning good practices to be observed in managing this waste. Therefore, a circular from the Ministry for Health (DGS/DHOS of 9 July 2001) drafted recommendations for supervision of management and disposal of radioactive waste and effluent in hospitals. Since then, the Ministry for the Environment (DPPR) in 2003 sent the managers of landfills and incineration plants recommendations stating what to do if the alarms are triggered on the radioactivity detection gates now installed in all such installations. The Minister for Health

issued a new article on 21 January 2004 instructing nuclear medicine practitioners to advise their patients returning home on how to properly dispose of any radioactive waste they may produce. After publication of this ministerial order, a working group was set up to harmonise practices and accompany the dissemination of these new measures.

3 | 2 | 2

Management and disposal of radioactive waste and effluent produced by biomedical research and nuclear medicine

The disposal of radioactive waste produced when handling radioactive sources must comply with the provisions of § 1|2 of this chapter, in particular circular DGS/DHOS 2001/323 of 9 July 2001.

An order concerning waste and effluent produced outside BNIs must be issued to implement article R 1333-12 of the Public Health Code. A working group coordinated by the ASN was set up in September 2004 to make a particularly close examination of how the infectious and radioactive risk is dealt with in waste and effluent management, as well as of the regulatory requirements to be established. This working group comprises representatives from the health authorities (DGSNR, DGS, DDASS), from public health and research institutions (Paris public hospitals, Paris municipal hygiene laboratory, INSERM, etc.) and private pharmaceutical laboratories.

The collection and management of the radioactive waste and effluent produced by biomedical research and nuclear medicine activities is based on 4 principles:

- the waste are sorted out and packaged as soon as possible in the cycle in the producer units, so that separation can take account of the type of waste, the radionuclides it contains as well as their level of activity and half-life. Waste originating from use of radionuclides with a half-life of less than 100 days will be separated from the other waste;
- effluent and waste are stored following this preliminary sorting, for either local disposal (waste marked only by radionuclides with a half-life of less than 100 days), or collection by the ANDRA (presence of radionuclides with a half-life of more than 100 days);
- the radioactivity of the waste and effluent is systematically checked before disposal;
- the waste and effluent are disposed of using appropriate disposal channels. Waste originating from the use of radionuclides with a half-life of less than 100 days may be disposed of - after decay - in the household waste channel, provided that there is no chemical or infectious hazard. If there is such a hazard, the health care waste are routed to one of the specialised channels. Aqueous liquid effluent containing radionuclides with a half-life of less than 100 days may, after decay, be sent to the public sewerage system.

With regard to solid waste, it must be collected from the units that produce it in specially reserved containers, designed to counter any radioactive, infectious and chemical hazard (dedicated packaging). This waste must then be routed to an area specially set aside for its storage, pending local disposal after radioactive decay, or collection by the ANDRA. This area must be specifically laid out to ensure secure access and containment of the radioactive materials.

After an interim storage period taking advantage of natural radioactive decay (as a general rule at least 10 half-lives of the radionuclides concerned), waste originating from medical activities can be disposed of in conventional or hospital waste channels, provided that the level of irradiation is low enough (about 1.5 to 2 times the background level) and there is adequate waste traceability. A gate type radiation detection system can be installed by the operator to ensure compliance with the requirements mentioned above.

Handling of radioactive sources may also lead to the release of liquid effluents. There are 3 main types of releases monitored:

- waste from laboratories handling and preparing unsealed sources from mother solutions. Given the presence of mother solutions with a high activity concentration, accidental release of effluent also with a high activity concentration cannot be ruled out. Only aqueous effluent from handling of radionuclides with a half-life of less than 100 days can be discharged into the sewerage system. Marked non-aqueous effluent (scintillation liquid, etc.) must be collected and follow a dedicated disposal channel involving the ANDRA;
- sanitary facilities of protected rooms reserved for hospitalisation of patients who have received therapeutic doses of iodine 131 of up to 4000 MBq. These patients will eliminate in their urine 60 to 80% of the radioactive iodine administered to them;



Buffer tanks

Activity concentration check points	Activity concentration value adopted	Comments
Diagnosis buffer tanks	7 Bq/l	Tanks for effluent originating primarily in the preparation and administration premises of diagnostic or therapeutic activities (<740 MBq) using radionuclides.
Therapy buffer tanks	100 Bq/l	Tanks connected to the sanitary facilities for patients receiving therapy >740 MBq of iodine 131.
Septic tank	–	Septic tank connected to the nuclear medicine department sanitary facilities reserved for patients who have received diagnostic or therapeutic doses (<740 MBq). As the septic tank functions on a continuous basis, there are no activity concentration values for the effluent output.
Hospital outlet	1000 Bq/l for ^{99m}Tc 100 Bq/l for ^{131}I	These are reference guide values for checks to be regularly performed (at least 4 times per year, over a minimum period of 8h) or continuously with a device on the outlet. If the values are exceeded, a more complete review over a longer period is required in order to determine an average activity concentration which, if higher than the guide values, will require that the establishment look at ways of improving its effluent release methods.

- sanitary facilities of the nuclear medicine department used by patients who have received therapeutic or diagnostic doses. In this latter case, the levels administered do not exceed 740 MBq per application.

To these controlled releases can be added the diffuse radioactivity from the patients, whether hospitalised in the establishment (outside protected rooms), or out-patients.

The procedures for collection of these effluents are as follows:

- effluent from the laboratories is routed to a series of 2 buffer tanks operating alternately with one being filled and the other used for decay storage. This arrangement avoids direct radioactive effluent discharge into the main sewerage system. The capacity of the tanks must be determined to allow storage for a time long enough to obtain decay of the effluent compatible with discharge into the main sewerage system (see table below giving maximum activity concentration levels at the tank outlet).
- liquid effluent from the sanitary facilities in protected rooms is also collected in a series of buffer tanks with the same characteristics as those described above and operating in the same conditions. However, given the high activity concentration of this effluent, these tanks must be separate from those collecting laboratory effluent;
- releases from the sanitary facilities reserved for injected patients must pass through a septic tank type decay pit, before being sent to the main sewerage system. Given the short half-life of the radionuclides contained in this effluent (primarily technetium 99m which has a half-life of 6 hours) passing through this tank contributes to their radioactive decay.

As with solid waste, the disposal of radioactive liquid effluent is only possible after a check on its residual radioactivity. This check is conducted after analysing a sample of effluent taken from the tank to be drained. The different activity concentration values to be used for drainage of the buffer tanks or at the establishment outlet are given above.

3 | 3

Management of waste containing enhanced natural radioactivity

In the environment, there is already a measurable background radiation due to the presence of radioelements which have been or are still being produced by various physical processes. Their concentration does not in general lead to any major hazard, obviating the need to take particular precautions against the radioactivity hazard. In France, exposure to natural radioactivity varies from region to region but is about 1 mSv/year.

Definition of enhanced natural radioactivity: all materials naturally contain radionuclides. Some, such are rare earths, are particularly rich in uranium and thorium. Handling or transforming them can lead to expose the workers or the population. We then talk of enhanced natural exposure, insofar as the radionuclides are naturally present in the raw materials and are not used for their fissile, fusible or fertile properties, but the industrial activities then enhance exposure of the persons. The raw materials liable to lead to significant doses are commonly called NORM (Naturally-Occurring Radioactive Materials) or TENORM (Technologically Enhanced Naturally-Occurring Radioactive Materials) if the industrial process concentrates the radionuclides.

3 | 3 | 1

Uranium mining waste

Uranium mines handle large quantities of raw materials and thus generate large quantities of VLL waste with enhanced natural radioactivity. These are the uranium mine residues, of which 2 categories must be distinguished:

• low-content ore (about 300 to 600 ppm) treated by static leaching and from which the residues take the form of rocky blocks of varying dimensions with a total average specific activity of 44Bq/g (about 4Bq/g of radium 226). These residues are placed either in stockpiles, or in open-cast mines, or used as the first covering layer for disposal of dynamic treatment residues.

• medium content ore (about 1‰ to 1% in French mines) processed by dynamic leaching and from which the residues take the form of clayey sand with a total average specific activity of 312Bq/g (about 29Bq/g of radium 226). These residues are either placed in old open cast mines, sometimes with an additional dyke, or in pools with a surrounding dyke, or behind a dyke damming a thalweg.

In France, the treatment residues represent 49 million tons (31 million tons of dynamic treatment residue and 18 million tons of static treatment residue) spread over 17 disposal sites, run as ICPE. The national inventory of uranium mining sites, produced as part of the MIMAUSA programme (Memory and Impact of Uranium Mines: Summary and Archive) run by the Ministry for Ecology and Sustainable Development, can be accessed on the web site www.irsn.fr.

Thinking about the safety review of former mining sites and the disposal of mining treatment residues, their long-term surveillance and the consequences of inappropriate future use of the land concerned is ongoing.

3 | 3 | 2

Waste resulting from other activities

The Public Health Code requires that industrial activities which are likely to enhance natural ionising radiation must conduct " exposure supervision [of persons] and a dose estimation ". These activities are likely to generate waste which has concentrated the natural radioactivity and may therefore trigger the radiation alarm at the entrance to technical landfills. The main activities concerned are industrial oil drilling and processing facilities, coal burning industries, metal foundries, in particular those using tin, aluminium, copper, titanium, niobium, bismuth and thorium ore, industrial foundries using monazite and zircon sand, the phosphate industries, in particular phosphate extraction, production of fertiliser and manufacture of phosphoric acid, and industrial installations mining, storing, treating or using rare earths including monazite. The main radionuclides identified in this waste are uranium, thorium and radium.

For some of these activities, and in particular those leading to mining treatment residues (mines operated for extraction of rare earths, phosphate ore treatment residues produced by the superphosphated fertiliser industry, etc), the same problem can occur as for uranium mine processing residues (see 3|3|1) concerning the large quantities of waste produced, often managed on-site, and for which there is today no appropriate disposal channel.

Some of these installations are not currently active, however most of them are (or were) regulated by part 1 of book V of the Environment Code. The ASN is cooperating with the relevant classified installations inspection services and in particular is taking part in the working group dealing with the acceptability of enhanced natural radioactivity waste, for which the activity level and concentration could be neglected from the radiation protection standpoint in landfills. The ASN aims to ensure that this waste is sorted and packaged as far upstream as possible, so that it is always routed to the appropriate channel. It should be noted that given the absence of a long-lived low level waste repository, the only channel currently available for the most active waste is interim storage.

In 2004, the ASN asked the Robin des Bois association to conduct a study on the effects of natural radioactivity enhanced by human activities, and the correspondingly polluted sites in France. With regard to the management of waste resulting from wood-burning (ash) a questionnaire was also widely distributed. Actually, the ash concentrates the mineral elements contained in the wood, particularly potassium 40, which does not evaporate during combustion. The use of

modern combustion processes which reduce the volume of ash means that these ashes can trigger the radioactivity detection gates at the entrance to the disposal centres. This questionnaire is part of the precautionary approach designed to identify the potential sources of exposure to ionising radiation of workers and the public and aimed at providing the public with better protection should they be exposed to significant radiation without being aware of it. At present, there is no known radiological health risk associated with wood burning and the handling of wood ash in France. This ash can therefore be disposed of in technical landfills.

4 INTERIM STORAGE OF RADIOACTIVE WASTE AND SPENT FUEL

4 | 1

Basic nuclear installations intended for interim storage of radioactive waste and spent fuel

Solid waste treatment stations olides

The waste treatment stations on the CEA sites at Saclay (BNI 72), Fontenay-Aux-Roses (BNI 74) and Grenoble (BNI 79) (see chapter 13) also provide interim storage for high level waste. The waste is packaged in containers and stored in radioactive decay pits. For BNIs 74 and 79, the CEA is involved in a programme to recover this waste as part of the process to denuclearise the Grenoble and Fontenay-aux-Roses sites.

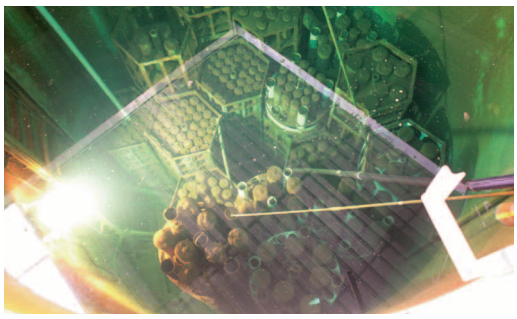
In BNI 72, fuel is also stored in concrete blocks and is currently being recovered for reconditioning in the STAR facility for interim storage in the CASCA facility on site.

The radioactive waste storage yard

The main role of the radioactive waste storage yard (BNI 56) in Cadarache is to provide interim storage of radioactive solid waste from the operation or dismantling of CEA installations and which cannot be stored in the CSA.

The waste is stored there in pits, in warehouses and for the VLL waste, in a dedicated area. The storage yard also contains spent fuel pits stored in a pool. The programme for recovery of these fuels was completed in 2004.

The storage yard is now an obsolete installation which will be replaced by CEDRA. In order to delay saturation of the yard until active start-up of the first CEDRA storage unit, three cells were organised to store medium level waste packages after optimisation of the pits.



Irradied fuel assembly recovery

CEDRA

Decree 2004-1043 of 4 October 2004 authorised the CEA to create the CEDRA basic nuclear installation (packaging and storage of radioactive waste) at the CEA site in Cadarache. The CEDRA installation is scheduled for start-up in 2006 (interim storage unit) and 2009 (treatment unit). This installation will eventually replace some of the existing CEA installations, in particular BNI 37 with regard to waste decontamination and processing, and BNI 56 as regards its interim storage. CEDRA will also

take the waste from past practices on the site. CEDRA will be commissioned in successive stages. Stage 1 will be for interim storage of low level and medium level waste packages. The CEA will transmit the provisional safety report for the first stage in 2005.



CEDRA: building "energy" facility under construction

PÉGASE/CASCAD

PEGASE and CASCAD are two installations at CEA Cadarache site making up BNI 22.

PEGASE mainly stores spent fuel elements and radioactive substances and materials, either under water or dry. Drums of plutonium-containing by-products are stored in the PEGASE premises pending recovery for treatment.

Following the ASN's safety review of the PEGASE installation in 2003, and in the light of the resulting modifications required to guarantee that the superstructure would withstand the design basis earthquake, the CEA has started to remove from storage as rapidly as possible the plutonium-containing waste and certain spent fuel from the installation. The ECUME installation project was intended for storage of fuels with no further purpose and irradiating waste and it was to be a key installation in the Pégase de-storage plan. Budget constraints however forced the CEA to abandon this project. This decision means that the CEA is now taking a fresh look at the management of its waste and spent fuel and at the future of these installations.

The CASCAD installation is dedicated to dry storage of spent fuel. The fuel is placed in containers before being stored in pits, where it is cooled by natural convection.

4 | 2

Waste from past practices

Recovery of waste from trenches in the CEA's BNI 56

The Cadarache interim storage area (see § 4/1) is equipped with trenches filled between 1969 and 1974 with low and medium level solid waste, before being covered with earth. At the time, this installation was an experimental storage installation for this type of waste. This waste was packaged in various ways (drums, vinyl bags, etc.). The ASN authorised recovery of this waste in 2003. The CEA

began recovery from the first trench in 2004. The first few months were devoted to remove the earth. Waste recovery and repackaging began in the second half of 2004. The work should last about 5 years. The trenches site will then be handled using the methodology employed for sites polluted by radioactive substances.

The EDF Saint-Laurent (BNI 74)

The Saint-Laurent (BNI 74) silos consist of 2 semi-buried reinforced concrete bunkers. Their tightness is provided by steel plating.

From 1971 to 1994, waste was stored in bulk in the silos. This waste was mainly graphite sleeves containing fuel elements from the nearby GCR reactors, plus technological waste.

There is only one containment barrier between the waste and the environment means. Therefore, this installation does not meet anymore current safety criteria. The ASN asked EDF to empty the silos by 2010. EDF is preparing a technical recovery solution which will be presented in the dismantling dossier to be submitted to the ASN shortly..

4 | 3

The interim storage basic safety rule (RFS)

Experience feedback about radioactive waste operation and radioactive material storage areas has shown that formalised minimum targets concerning the safety of these storage areas are required. With this in mind, a working group consisting of representatives of the main nuclear operators sent the ASN a draft proposal for a storage basic safety rule (RFS).

The application scope of the RFS which could incorporate the proposals from industry, will require further investigation. The ASN in particular wishes this draft will include the results of a study of experience feedback on radioactive products storage abroad, being carried out by a British engineering office.

4 | 4

Management of radioactive waste for which the producer is unknown or insolvent: a public service duty

Every year, radioactive objects for which there is no known owner are found, often when they trigger the radioactivity detection gates in waste disposal facilities and landfills. The objects concerned frequently contain small quantities of radium, a radioactive element commonly used in the early 20th century for its luminescent properties. Localised contamination of the sites following radioactive source handling incidents are also declared to the authorities. The waste management law of 15 July 1975 makes the producer responsible for the disposal of waste liable to harm public health or the environment. However, some of those in possession of radioactive objects or waste are not able to finance the relatively high cost of their disposal in a relevant channel. In such cases the owner of the waste is said to be defaulting.

4 | 4 | 1

Organisation of the public authorities and their various responsibilities

Jointly with the DGS, IPSN and OPRI, the DPPR drafted a circular dated 16 May 1997 on the management of sites contaminated by radioactive substances. The clean-up of these sites can lead to the pro-

duction of radioactive waste. The DRIREs enforce the arrangements of this circular on behalf of the prefect.

Furthermore, the public authorities, more particularly the prefects, can ask the ANDRA, CEA or IRSN to take charge, at least temporarily, of radioactive waste. The conditions in which the prefects refer matters to these organisations must be specified in a draft circular prepared by the ASN, as regards radiological emergencies outside those about basic nuclear installations.

The ANDRA, the national agency for radioactive waste, is the natural recipient of waste for which the owner has defaulted and for which the State assumes responsibility.

4 | 4 | 2

The types of waste concerned and special actions in progress

The waste concerned stems primarily from the widespread use at the beginning of the 20th century of radioactive products, such as radium for its luminescence or its medical applications (needles) and industrial properties (lightning conductors). This use may have led to contamination of land which is no longer used for industrial purposes.

The public authorities created several financing systems to help those in possession of this type of waste (private individuals in particular).

- the radium fund: created in June 2001, it is used to finance up to a maximum of 50% of the cost of clean-up and collection of the waste from sites contaminated by former activities which used or employed radium;

- the agreement between the nuclear power sector producers and the ANDRA: this is implemented in order to secure a site contaminated by radioactive substances in accordance with the provisions of the circular of 16 May 1997 aforesaid.

These two measures cannot guarantee the medium-term financing needed to deal with waste for which the operator is defaulting.

The radium fund was in fact set up for specific cases and can only be used when the contaminating radionuclide is radium. In addition, the agreement between the ANDRA and the nuclear power generating sector producers will end in May 2005 and will probably not be renewed. During the discussions held in 2004 on the draft agreement between the State and the ANDRA, the ASN stated its desire to see the ANDRA given the financial means to discharge a public service duty involving collection and handling of waste for which the owner is defaulting.

4 | 4 | 3

Public service storage facilities

The ANDRA does not operate storage facilities. It concludes agreements with other nuclear operators so that they provide it with interim storage capacity.

The Socatri Company was thus authorised by decree to store low-level long-lived waste on behalf of the ANDRA in 2003. Radium lightning conductors are stored on behalf of the ANDRA in BNI 56 on the CEA's Cadarache installation. The CEA also stores used sources for which there are currently no disposal channels, in BNI 72 in Saclay.

A process was initiated in 2003 by the ASN and the DGEMP, designed to clarify the conditions to deal with this waste. This led the ANDRA and the CEA to draft an agreement applicable to all waste stored by the CEA on behalf of the ANDRA.

5 POLLUTED SITES

Handling and treatment of polluted sites are priority activities for the ASN. This is why, as soon as the DGSNR was created, a sub-directorate was explicitly designated to look after this activity and coordinate the necessary actions, both within the Nuclear Safety Authority and with the local administrations concerned. It proposes in particular the sanitary stipulations that appear necessary following the expert appraisals conducted to estimate the health status of a site polluted by radioactive substances.

5 | 1

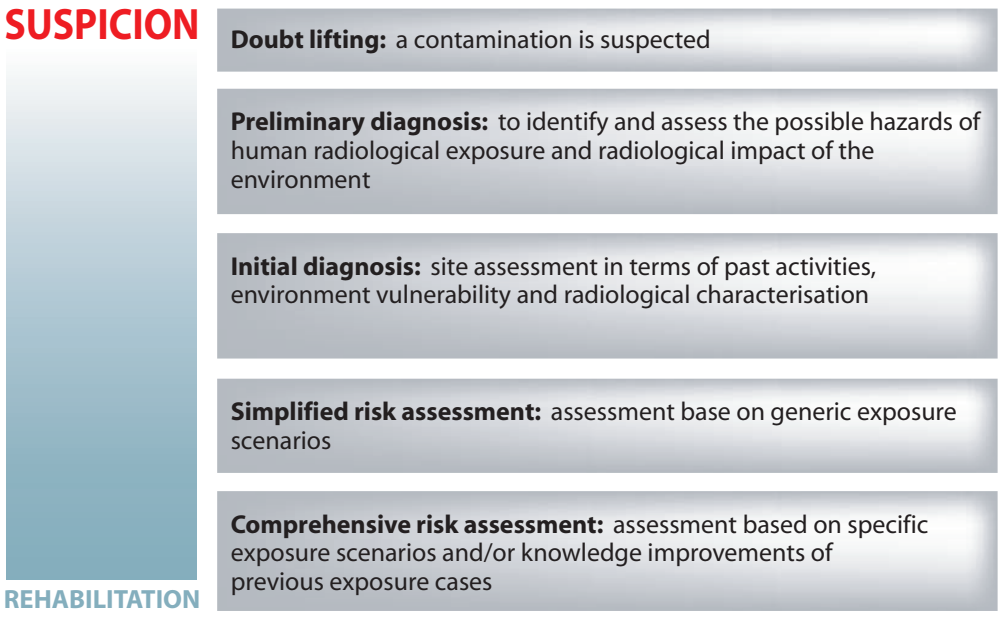
The regulatory framework of action by the public authorities

5 | 1 | 1

Interministerial circular of 16 May 1997

According to this circular, a site polluted by radioactive substances is any site, either abandoned or in operation, on which natural or artificial radioactive substances have been or are employed or stored in conditions such that the site constitutes a hazard for health and the environment.

This circular, for the prefects, describes the administrative procedure applicable to sites polluted by radioactive substances and specifies that the treatment and rehabilitation operations are performed



Polluted site management approach according to the methodological guide

and financed directly by those responsible, as defined by the law of 19 July 1976 concerning installations classified for environmental protection purposes. In the absence of an identified or solvent person responsible, the ANDRA at the request of the ministries concerned, may oversee operations within the framework of procedures to finance rehabilitation of polluted sites defined in this circular.

The methodology guide for management of industrial sites potentially contaminated by radioactive substances, which was published in October 2000 (version 0), describes the applicable approach for dealing with the various situations likely to be encountered in the rehabilitation of sites (potentially) contaminated by radioactive substances and explains the circular of 16 May 1997.

5 | 1 | 2

The law of 30 July 2003

Law n°2003-699 of 30 July 2003 concerning industrial hazards updates the legislative framework for operation of an installation classified on environmental protection grounds and also applies to basic nuclear installations. It provides new tools for dealing with and preventing soil pollution and financing de-pollution. It therefore reinforces the regulations about site rehabilitation, including the obligation of information when selling land polluted by an industrial activity.

5 | 2

The inventories of polluted sites in France

Several complementary inventories are available to the public.

5 | 2 | 1

The ANDRA national inventory

Since 1993, the ANDRA has published a national inventory of radioactive waste giving information on the condition and location of radioactive waste around the country, including on sites identified as being polluted by radioactive substances. The 2004 edition is available on the ANDRA web site, www.andra.fr.

5 | 2 | 2

Databases of the Ministry for Ecology and Sustainable Development

The Ministry for Ecology and Sustainable Development has produced two databases, whatever the polluted site nature (chemical or radioactive) . They are:

• "BASOL" which is an inventory of the sites polluted or likely to be polluted and requiring preventive or remedial action on the part of the public authorities. In 2004, it contains about 3660 sites and is updated on a quarterly basis. A summary of the inventory is accessible on the Ministry for Ecology and Sustainable Development web site, www.ecologie.gouv.fr.

• "BASIAS" which is a record based on regional historical inventories of former industrial sites, a trace of which must be retained. Its purpose is to maintain inventoried site records in order to provide information of use for town planning, land transactions and environmental protection. This inventory should be completed for most departments by 2005/2006 and should contain between 200,000 and 300,000 sites. The information collected is input into a data base managed by the BRGM and available on the web site, www.basias.brgm.fr.

5 | 3

Actions performed and dossiers in progress

5 | 3 | 1

General

The action diversity carried out by the ASN since 2002 as regards sites polluted by radioactive substances illustrates the great variety of situations encountered. The pollution can be due to former activities for which the industrial operator has disappeared (radium industry), "declining" economic activities (uranium mines, rare earths extraction sites) or new industrial activities. The health and environmental impacts also vary widely and the de-pollution targets to be defined depend on the future use (industrial, housing estate, school, park, etc.) chosen for the site concerned. After checking the de-pollution of the site and in order to preserve a history of the location, constraints must be put in place to confirm the possible uses and set utilisation restrictions as necessary.

5 | 3 | 2

Actions performed

The "Radioactive contamination: how to deal with polluted sites?" symposium on 4 May 2004 in Paris

On 4 May 2004, the ASN and the DPPR organised a symposium on the subject "Radioactive contamination: how to deal with polluted sites?", which brought together some 200 people and led to an exchange of views by the public authorities, industry, environmental protection associations and departmental and regional local government; it concerned general policy and the legal framework, hazard assessment, cleanup objectives and methodologies, real estate consequences, media coverage of both polluted site discovery and clean-up. It was an opportunity for presentation of a first inventory of radioactive polluted sites in France and how they are managed, with experience feedback on



National symposium on 4 May 2004 in Paris. From left to right: Jérémie Averous (ASN), Marc Ammerich (ASN), Jacky Bonnemains (Robin des Bois), Delphine Cramano (DDASS), Philippe Crochon (COGEMA), Philippe Guétat (CEA), Franck Karg (HPC Envirotech France), André Heucliz (IRSN), Alexandre Paquot (Direction de la prévention des pollutions et des risques), Émmanuel Kessler (animateur)

the management of radioactive polluted sites abroad, in order to compare the treatment of chemically polluted sites with those affected by radioactive pollution.

The collection of the papers submitted on this occasion constitutes an initial "white paper" on the management of polluted sites in France and abroad. The papers and proceedings of the symposium are available on the ASN's web site. The ASN also devoted the its magazine "*Contrôle*" issued on December 2004 to the follow-up on this 4 May symposium.

This symposium underlined the key problems and set out a number of recommendations. Apart from difficulties of a technical or historical nature, the following must be taken into account:
• the importance of time and cost, which can become a major problem with rehabilitation;
• the need for information and involvement of the local populations concerned right from the outset, and for greater coordination between the various government departments;
• the need for greater public education about the notion of hazards and hazard assessment;
• the need for national solidarity concerning historical sites.

The discussions also underlined that:
• the role of local government is vital as soon as the site is made safe, because it will then have to manage redevelopment of the site and its environment;
• the legal tools presently exist to guarantee a permanent record for future generations and for reuse of the sites;
• the situations and legal practices concerning sites polluted by chemical substances are comparable to those polluted by radioactive substances, and experience feedback acquired with one site may be used for the other.




From left to right: former mining site of Bellezane (Haute-Vienne) before and after its redevelopment

The 4 May 2004 symposium (see § 5|3|2|1) led to the drafting of a 7-point action plan for sites polluted by radioactive substances:
1. To consolidate and complete the inventory of potentially contaminated sites;
2. To continue current actions to deal with former uranium mining sites, by re-examining the safety of the disposal situation if necessary;
3. To strengthen prevention by mandatory removal of radioactive objects (radioactive lightning conductors, radioactive smoke detectors);
4. To build channels for disposal of radioactive waste appropriate to clean-up of polluted sites: role of the National radioactive waste management plan;
5. To reinforce transparency by setting up a dedicated website;
6. To produce a method for determining action priorities for the authorities;
7. To review the applicable texts, in particular the 1997 circular, taking account of institutional changes, greater involvement by locally elected representatives, the financing mechanisms to be set up, and participation by the public as soon as possible in the process. The "methodological guide for management of industrial



Radioactive lightning conductor

sites potentially contaminated by radioactive substances of October 2000 (version 0)" will have to be updated.

International examplesnale

In 2004, an ASN delegation visited the United States and Canada, in particular to examine government management of radioactive polluted sites. It would seem that involvement by the population and local government is very strong and the costs involved in clean-up projects are always high (ranging from several tens of millions of euros for a relatively small site, up to several hundred million euros).

The United States in particular created a public list of site priorities. The American federal administration thus determines the priority sites for rehabilitation on the basis firstly of the available federal resources and the health impact and secondly according to the environmental hazards. This list is updated every year.



Shattuck site (USA)

5 | 3 | 3

Some of the dossiers in progress



Former laboratory for test of the Société Nouvelle du Radium in Gif-sur-Yvette (Essonne)

Coudraies area in Gif-sur-Yvette (Essonne):
Examination of the files on the properties in the Coudraies area in Gif-sur-Yvette (91), which began in 2002, enabled the Essonne prefect to propose allocation of technical and financial aid for the simpler cases. Two clean-up projects were carried out in 2004. For the more complex cases, the committee in 2003 produced summary technical data sheets covering all the solutions examined, along with their technical and economic advantages and drawbacks, leaving it up to the ministries concerned to choose the most appropriate solution for each property, given the economic context. In 2004, purchase of one of the properties by the public authorities was still being examined.

Kindergarden in rue Chomel (Paris):
Since 2003, this site has been completely cleaned up. It was the reason for which the radium fund was created. Nonetheless, insofar as the rehabilitation work was carried out before the radium fund was even set up, the possibility of granting financial aid was examined in 2004, along with the accounting documents necessary for this financial support.

Making safe the Isotopchim site in Ganagobie (Alpes-de Haute-Provence):
From 1987 to the end of 2000, the Isotopchim Company was involved in carbon 14 and tritium labeling of molecules intended for medical applications in Ganagobie (04). In 2000, the company went into liquidation, leaving a contaminated environment (incidental release of carbon 14 into the atmosphere and aqueous releases into the sewers) along with a large amount of chemical and radioactive waste on site.

Since the end of 2000, several inventories have been produced and an initial rehabilitation project examined. In December 2002, the ANDRA/producers programming committee for "orphan" sites, rejected funding of this project owing to the anticipated cost and the lack of any commitment from the local authority.

Since June 2003, the ASN has been associated with the search for solutions and various meetings have been held with all the stakeholders in order to make the site safe, look for appropriate disposal channels for removal of the priority waste present on the site and present this new rehabilitation project to the ANDRA/producers programming committee.

5 | 3 | 4

Management of incidental contamination

The obligation of systematic installation of detection gantries in the industrial waste disposal or recycling centres has on several occasions in recent years revealed traces of radioactivity in the waste to be treated, leading to management of incidental radioactive contamination. Initial experience feedback from the incidents that have occurred since 2003 and which led to radioactive contamination in establishments which normally use no radioactivity (metal foundry) or in which radionuclides are not normally used in unsealed form, showed the need to be able to notify the establishment manager rapidly of his responsibilities and of the radioactive contamination hazards. The ASN drafted a memo in 2003 intended for rapid distribution to all managers of establishments in which unexpected radioactive contamination is detected.

To improve the corrective action taken further to such incidents, an experience feedback meeting should be organised by the ASN in 2005, bringing together experts and industries working in the radioactive decontamination market, to examine polluted site decontamination practices and specify the best practices such as to guarantee:

- effective decontamination, consistent with clean-up doctrines used in installations using radionuclides in unsealed form;
- radioactive waste quality management, consistent with the existing waste disposal channels.

Situation in the Budin foundry in Aubervilliers (93) and the Métal Blanc lead treatment company in Bourg-Fidèle (08).

On 19 May 2003, the radioactivity detection equipment installed at the entrance to the Société Métal Blanc site (08) was triggered by a lorry. The trailer was isolated on the site and abnormal radioactivity was found in the process waste from the Budin foundry (93). The origin of this radioactivity is due to melting of depleted uranium parts included in the heads of radiotherapy appliances (teratron) received from the Debus company in Villejuif (94), which had obtained them from the Cis-Bio company (91). The ASN set decontamination targets for Budin in a letter dated 28 November 2003. On 4 November 2003, the detection portal at Métal Blanc was triggered again. The first phase in decontamination of the premises of the Budin foundry was carried out at the end of 2003, with the second phase awaiting financing.

Scenarios are still under review with all stakeholders to ensure that this incident is sorted out and financed.

6 Long-term management of radioactive waste by disposal

6 | 1

Long-term management by surface or subsurface disposal of radioactive waste

Most short-lived (less than 30 years) medium and low level waste is sent for final disposal to the surface waste repositories owned by the ANDRA (National Agency for Radioactive Waste Management).

These repositories operate on a principle whereby waste is confined and sheltered from hazards, notably water circulation, during what is known as a surveillance period, fixed by convention to last 300 years, until such time as their activity level has become negligible. There are two such repositories in France.

Surface or subsurface storage projects are being defined for other types of low-level waste.

6 | 1 | 1

Manche waste repository

The Manche waste repository, with its 530,000 m³ capacity, was set up in 1969 at Digueville and operated until July 1994. The final covering (leaktight and grass-covered), to protect the structures containing the waste against all water infiltration, was completed in June 1997. The localised settling of this covering layer detected in September 1999 would not appear to have worsened significantly since. However, this aspect remains under close surveillance.



ANDRA – Manche waste repository centre

In September 1998 the ANDRA submitted a request, completed in 1999, for authorisation to enter the surveillance period, which takes account of the recommendations of the Turpin Commission tasked by the government in 1996 with issuing an opinion on the environmental impact of the repository. The safety documents submitted to the ASN to back up this request were formally approved by the ASN in January 1999.

At the request of the ASN, the ANDRA also submitted, in December 1997, a release licence application, revised in 1999.

The ASN, jointly with the various ministerial departments concerned and taking into account the recommendations of the public inquiry committee, then prepared a draft authorisation to enter the surveillance period, amending the initial authorisation decree issued in 1969, together with a draft release licence. The decree and the order were signed and published in the *Official Gazette* on January 2003.

As soon as the surveillance period decree was published, the ASN asked the ANDRA to begin to look at the future of the covering layer and the separation network designed to collect water that had penetrated the repository. The future of the covering layer should be the subject of a report into the benefits to be gained from installing a new and more durable cover, no later than 2009. In 2003, the ASN also authorised the ANDRA to modify the separation network so that it could be resized to take account of the throughput of effluent during the surveillance period. In 2004, the ANDRA sent the ASN the surveillance phase safety case.



ANDRA – Aube waste repository

6 | 1 | 2

Aube waste repository

The Aube waste repository, set up in 1989, covers an area of about one square kilometre in the communes of Soulaines-Dhuys and La Ville-aux-Bois in the Aube department.

Since 1992, this repository has been taking over the activities of the Manche repository. Its design has benefited extensively from feedback relating to the construction and operation of the former plant.

Reduced waste production and the ramp-up of the CENTRACO plant imply that the initially planned 30-year lifetime of this repository could be extended to 50 years.

The waste packages are stored in concrete structures connected to a drainage network for possible water infiltration (separate free-falling subsurface system), which is permanently monitored. The site capacity is 1,000,000 cubic metres of waste packages, entailing about 400 structures.

In addition to the disposal structures, the repository also has a waste packaging facility in which 2 types of operations are carried out: compacting of 200 litre drums in a 1000 ton press and grouting of the 5 or 10 m^3 metal drums containing waste.



ANDRA – Vessel head storage

In 2001, the ANDRA was authorised by the ASN to accept for storage 55 EDF reactor vessel heads which had been replaced. The specific requirements concerning the conditions under which they would be accepted, their activity level and their packaging are stipulated in the letter confirming authorisation. In 2003, construction began on the structures to house the vessel heads. In 2004, the Aube waste repository received the first vessel heads for storage.

In December 1999, the ASN authorised the ANDRA to use the Aube waste repository to store sealed radioactive sources from the CEA, with a half-life of less than that of cobalt 60. In January 2002, the ANDRA submitted an application for generic acceptance of radioactive sources meeting certain criteria, justified by a safety analysis based on the principles of RFS III.2.e. In 2004, the ASN gave the ANDRA authorisation in principle, although this did require that additional information be forwarded, in particular with respect to the packaging of used sealed sources.

In June 2002, the ANDRA sent the ministers in charge of nuclear safety an application to modify the authorisation decree of the Aube waste repository and a release licence application for this repository, to bring it into conformity with the provisions of the Environment code and its implementing decrees. To take account of the ASN's requests for changes to the public inquiry dossiers, the ANDRA completed its dossier in March 2004. The dossiers concerning these requests were submitted for public inquiry at the end of 2004.

6 | 1 | 3

Package acceptance rules

In May 1995, in Basic Safety Rule III.2.e, the ASN defined requirements for radioactive waste package acceptance in a surface repository.

Prior to package acceptance in a waste repository, the ANDRA, which is responsible for the long term safety of the repository, must implement an approval procedure. The file presented by the waste producer must comprise a description of the packaging process used, the technical characterisation documents, an assessment of the activity contained and the quality assurance programme. The characteristics of each package must be in compliance with the technical specifications drawn up by the ANDRA.

Within this process, the ASN carries out surveillance inspections to check that the ANDRA acceptance procedure complies with Basic Safety Rule III.2.e requirements and to ensure that the procedure is correctly implemented. Inspections also take place on the premises of the nuclear operators to supervise the ANDRA's surveillance of waste producers considered to be ANDRA contractors, as provided for in the order of 10 August 1984.

In 1999, the ASN initiated a project to update the RFS III.2.e. This draft RFS will be submitted to the Advisory Committee for waste in 2006.

6 | 1 | 4

Surface or subsurface disposal projects

– Solutions for tritiated waste

Meetings, called jointly by the ASN and the DSND and attended by representatives of the nuclear operators and the ANDRA, were held to examine to what extent certain tritiated waste could be accepted at the Aube repository, in packages offering particularly high containment performance. Studies are in progress for the other waste.

Disposal of waste containing radium

Originating primarily from the radium and derivatives industries, active in the first half of the 20th century, or from certain chemical industries, waste containing radium is usually low level but very long-lived. The radioactive elements it contains, when they decay, also produce radon, a naturally radioactive gas which must not be allowed to build up.

The ANDRA is examining how to eliminate this waste. It is mainly working on a subsurface disposal concept (about fifteen metres below ground level).

For safety reasons, it is important to be able to dispose of this type of waste as soon as possible, as it is currently stored in unsatisfactory conditions. At the end of 2002, the ASN took a stand concerning the concepts proposed by the ANDRA. These concepts are felt to be acceptable but rely on theoretical geological models. The ASN considers that these studies can now only be taken a stage further within the framework of a study of a real site.



Graphite assembly in graphite gas reactor

– Disposal of irradiated graphite waste

The past operation of GCR plants (EDF Chinon, Bugey and Saint-Laurent-des-Eaux reactors and CEA G1, G2, and G3 reactors at Marcoule) and their current dismantling, produce waste containing graphite and significant quantities of long-lived radioelements. This waste consists mainly of graphite stacks and sleeves, activated by neutron irradiation.

Owing to their radiological content, notably regarding long-lived radionuclides, the ANDRA preferred to consider a sub-surface repository design for this waste.

The ANDRA is studying the feasibility of locating on the same site two facilities of different design for graphite waste and waste containing radium respectively, with a view to reducing overall operating costs. The ANDRA believes that a repository of this type could be operational by around 2010.

A working group, led jointly by the ASN and the DSND, periodically reviews these repository projects.

During the 4 June 2004 meeting of the working group for the national radioactive waste management plan, the General Directorate for Energy and Raw Materials (DGEMP) noted the need expressed by the producers for the disposal of radium-containing waste and graphite. It proposed that a search for sites be initiated under the supervision of itself and the ANDRA.

6 | 2

High level long-lived waste disposal: application of article L.542 of the Environment Code (law of 30 December 1991)

Article L. 542 of the Environment Code (resulting from the law of 30 December 1991) set the broad outlines of research into radioactive waste management:
– long-lived high level waste must be managed with due regard for the protection of nature, the environment and health and for the rights of future generations;
– research is proceeding on:

• separation and transmutation of the long-lived radioactive elements in this waste,
• reversible or irreversible disposal in deep geological formations, the feasibility of which would notably be assessed by the construction of underground laboratories,
• processes permitting the packaging and long-term surface storage of this waste;

– Before 30 December 2006, the government will submit a report to Parliament overviewing this research along with a draft law authorising as necessary creation of a long-lived high level radioactive waste repository, and setting the conditions for the constraints and restrictions relating to this repository.

In addition to the report to be produced in 2006 by the National Assessment Committee concerning the quality of the work done, the results obtained and a few recommendations for future guidelines, a document will be needed to present the government's position, stipulating the future stakes and issues in terms of industrial strategy, safety, economics and acceptability by the public. The ASN is involved in the work to draft this document within an interministerial structure.

It should also be pointed out that the three research paths, the progress of which is described below, are not competing but complementary.

6 | 2 | 1

Separation/transmutation

Separation/transmutation processes are aimed at isolating and transforming long-lived radionuclides in nuclear waste into short-lived radionuclides and stable elements.

Separation covers a number of processes, the purpose of which is to recover separately certain long-lived transuranians or fission products. These radionuclides, after repackaging, will be incinerated (by fission) to give short-lived nuclides, or transmuted (by capture) into stable atoms. Ongoing studies in this area are complementary to those performed by the ANDRA on a deep repository design insofar as they could lead to a reduction in the potential harmfulness of the waste placed in the repository.

Laboratory results have been obtained with separation of actinides (americium, neptunium, curium) and long-lived fission products (iodine 129, technetium 99, caesium 135). With regard to transmutation, simulations of various reactor populations were conducted, for transmutation of minor actinides: PWR, fast neutron reactors, 4th generation reactors which will be capable of producing energy by incinerating their own waste and that of the previous generation of reactors. The transmutation strategy requires access to a large nuclear installed base for long periods. The industrial feasibility of these projects still however has to be explored, in particular in the field of transmutation, in which considerable research will still be needed.

The ASN ensures that the experimentations involved in this research programme, performed notably in the Phénix and Atalante installations, are carried out under satisfactory safety conditions. With regard to Phénix, after major reactor renovation work and a final examination by the Advisory Committee for reactors at the end of 2002, the ASN informed the CEA in January 2003 that it had no objections to resumption of operation, which took place in July 2003. At a later stage in this research, the implications of possible industrialisation of the separation and transmutation processes will have to be examined.

6 | 2 | 2

Underground laboratories

Article L. 542-3 of the Environment Code requires that the possibility of reversible and irreversible disposal of radioactive waste in deep geological formations must be examined, in particular by building underground laboratories.

To date, only a single site (Bure, Meuse) has been designated for location of an underground laboratory and authorised by a decree in 1999.

On the basis of this examination, the ANDRA received approval of the shaft sinking conditions on 7 August 2000 from the Ministers for Industry and the Environment. The ANDRA began the shaft sinking work in August 2000. In November 2004, the bottom of the access shaft was at a depth of 445 m at the first experimental niche station and the bottom of the auxiliary shaft was at a depth of 500 m at the laboratory main drifts station.

On 24 August 2004, ministerial approval was given for construction of the experimental niche after examination of the dossiers concerning the summary of mechanical and hydraulic disturbances caused by construction of the shafts and the construction and experimentation programmes concerning this niche. The experimental niche has been under construction since September 2004 and the first experiments should start in January 2005. Ministerial approval for construction of the laboratory drifts followed by their actual construction should take place in early 2005 after examination of the corresponding application forwarded by the ANDRA.

Through inspections at the ANDRA head office and on the Bure site, the ASN ensures that all steps have been taken in terms of quality assurance to guarantee that the experiments conducted during excavation of the shafts provide the anticipated results and that the steps taken to minimise hydraulic and mechanical disturbances in the shaft environment are properly implemented.

In December 2001, the ANDRA sent the ASN the "Dossier 2001" which gives an idea of the future form of the feasibility file for potential disposal on the Bure site and which by the end of 2005 is to be sent to its supervisory ministers. In August 2002, this was supplemented by transmission of a preliminary draft project for a disposal facility and in February 2003 by transmission of the 2002-2005 clay science programme. Based on an identification of the key safety points of the Bure site, a examination programme by the Advisory committee for waste of the various elements of this dossier was defined for the period 2002-2004. Within this framework, the hydrogeological model of the site was examined in November 2002. The overall examination of the 2001 dossier and the approach adopted was carried out in June 2003, the mechanical behaviour of a repository was reviewed by the Advisory Committee on 2 March 2004 and the chemical factors governing its evolution were on 8 June 2004.

In parallel, examination of this dossier through an international peer review was organised for the first half of 2003 by the OECD's Nuclear Energy Agency at the request of the Ministry for Research, and led to the publication in September 2003 of the OECD/NEA report: "The French R&D Programme on Deep Geological Disposal of Radioactive Waste".

The conclusions of the examinations conducted show that the ANDRA's results are founded on high-quality research and development, but that improvements could be made to the presentation of the dossier and the safety analysis methodology.

In December 2002, the ANDRA also sent the ASN the 2002 dossier concerning the possibilities for granite site disposal complying with the government's requirements as expressed in the decision of 9 December 1998 and which was the precursor to the dossier to be transmitted in 2005. This dossier was examined by the Advisory Committee for waste on 30 November 2004.

In preparation of the examination of the "2005 Clay dossier" and the "2005 Granite dossier", the preliminary versions of which should be available in



Laboratory at Bure – Experimental recess

June 2005, with the final version in December 2005, the ASN specified how these examinations were to be carried out. The corresponding meetings of the Advisory Committee should be held in December 2005.

With regard to revision of the regulatory texts, the ASN - in association with the IRSN and the ANDRA - set up a working group responsible for updating RFS III.2.f on deep geological disposal of radioactive waste. The aim is to update the specifications for deep geological disposal by 2006. This updating of Basic Safety Rule III.2.f should allow consideration of design advances obtained notably in the radiation protection field, the importance attached to the notion of reversibility, together with feedback from various modelling exercises carried out in France and abroad. This work benefits from the result of in-depth exchanges from 1995 to 1998 between French and German experts and, since 2000, between French and Belgian experts. Franco-Belgian collaboration in particular led to the production of a joint document on "Elements of the safety approach to deep geological storage of radioactive waste". This document was translated into English, sent out to eight European partners active in this field and debated at a seminar organised at the Paris head offices of the ASN on 5 November 2004 under the chairmanship of the ASN and the AFCN. Future actions to harmonise geological disposal safety rules were discussed and a further meeting is scheduled for 20 May 2005 in Brussels.

The Franco-Belgian document was also presented to the Advisory Committee for waste on 9 November 2004 for discussion of the RFS III.2.f update context.

6 | 2 | 3

Long-term storage

In accordance with Article L.542-3 of the Environment code, the CEA is continuing with preliminary studies into surface and subsurface long-term storage of long-lived medium and high level waste. The purpose of the research into long-term storage is to design a system guaranteeing long-term containment of radioactivity, while also allowing retrieval of the packages and ensuring compatibility with possible subsequent disposal.

Within the framework of technical meetings, the ASN is continuing the interaction process with the CEA, initiated in the second half of 1999 and aimed at ensuring that safety aspects are correctly taken into account from the initial design stages of the long term repository. A technical report presenting a draft project for surface and subsurface storage of waste in accordance with article L. 542-3 of the Environment Code, was sent to the ASN in March 2003. Following this transmission, the ASN informed the CEA of its requirements for preparation of the safety options analysis files. The ASN is considering defining its position in 2006 on the safety of long-term interim storage concepts, by means of a reference guide.

6 | 2 | 4

Specifications and approval certificates for waste packages unsuitable for surface disposal

Since 1996, the ANDRA has initiated a system of specifications and approval certificates which should in 2005 result in package approval certificates indicating conformity with the preliminary design specifications of a deep geological repository.

The ANDRA has chosen a step-by-step procedure whereby initially, and until 2001, the only specifications required are those related to knowledge. It has also defined requirements as to process qualification and management of production for all waste producers, on similar lines to the COGEMA La Hague technical reference systems, thus enabling the organisation of surveillance actions and the identification of non-compliant packages. This work is done in cooperation with the waste producers. In 2003, most of the level 1 approval certificates (reply to initial requirements concerning pac-

kages for inclusion in the design specifications for deep geological disposal) were granted. The level 2 waste package performance specifications state the package properties which would currently appear to determine the sizing or impact assessment of any repository. An initial version of these specifications is currently being completed.

Since 1998, the setting up of this procedure has been closely followed by the ASN, in particular through inspections at the ANDRA and on the premises of the waste producers.

Progress made on long-term interim storage work also involves the preparation of specifications indicating package conformity with the requirements of such installations. Interactions between the concepts of long-term storage and sub-surface storage, with regard to waste packaging, must be taken into account.

Work on this topic seemed to be sufficiently advanced for drafting in 2001 of a reference note concerning packages unsuitable for surface disposal. The ASN's main concern in this matter is to ensure that the design and production of waste packages, which are obviously the key elements in the different waste management channels, adequately integrate the interdependence between the various stages involved. A draft reference note was produced by a working group consisting of the ASN, IRSN, CEA and ANDRA. This draft was presented to the waste producers on 19 November 2004.

7 Outlook

The ASN is focusing on ensuring that the radioactive waste issue is dealt with safely, visibly and exhaustively, regardless of the waste origin and how it is disposed of.

The work conducted in 2004 to produce the national radioactive waste management plan (PNGDR) will lead to clarify of radioactive waste management. Several topics discussed during this work are as so many trails for optimisation of existing channels and development of new ones, such as those for graphite and radium-containing waste for example. In this respect, it would seem essential to have a repository for this waste by 2010. Furthermore, the disposal of certain used sources, such as sealed sources, lightning conductor or fire detector sources, must be quickly examined by the public authorities. It is also important for the ANDRA's public service duty to be recognised as soon as possible and financed by a specific State budget, in order to ensure that radioactive waste is dealt with when its producer is unknown or insolvent, in appropriate conditions of safety and radiation protection. Finally, the ASN considers it necessary to maintain strong efforts to look for definitive management solutions for waste that currently has no disposal channel. The ASN will be continuing its work to ensure that the waste producers make their waste management policies as consistent and responsible as possible, in particular by avoiding production of waste for which there is no disposal channel and by combining their efforts to develop new channels.

The 4 May 2004 symposium on sites and soils polluted by radioactive materials led to the preparation of a action plan. This plan in particular provides for consolidation of the inventory of sites polluted by radioactive materials, for proactive continuation of the work in progress on former uranium mining sites, for reinforced prevention and construction of appropriate management channels for waste resulting from the clean-up of polluted sites. The ASN will be continuing to invest in these topics, and together with the other stakeholders, to revise doctrine concerning polluted sites and soils.

Finally, the ASN hopes that the Parliamentary work scheduled for 2006 about the high-level long-lived radioactive waste management will lead to decisions. The ASN will ensure that the projects developed in the three areas of research provide credible technical solutions that are acceptable with respect to long-term safety and radiation protection. In this respect, it will produce reference docu-

ments, which could subsequently be transformed into technical regulations and in particular which will be about the safety options for the various systems identified by research. Finally, the ASN will take part in the interministerial bodies responsible for drafting the report to be presented to Parliament by the Government in 2006.

A BASIC NUCLEAR INSTALLATION INSPECTORS

B LIST OF BASIC NUCLEAR INSTALLATION* (AS OF 31.12.04)

C ACRONYMS AND ABBREVIATIONS

APPENDIX

BASIC NUCLEAR INSTALLATION INSPECTORS

(as at 31 December 2004)

MANAGEMENT
Jean-Luc LACHAUME
Philippe BORDARIER

GENERAL SECRETARIAT
Luc CHANIAL

SD1
Jacques AGUILAR
Claude BARBALAT
Martine BAUDOIN
Guillaume BELOT
Marianne BERNE
Fabien FERON
Emmanuel JACOB
Jean JARAUDIAS
Olivier LEFORT
Sylvie RODDE
Séverine SOWINSKI
Sophie STRAWA

SD2
Karine AVERSENG
Yves BOULAIGUE
Fabrice CANDIA
Olivier DESCHILDRE
Philippe DUPUY
Céline FASULO
Christian GERMAIN
Sébastien GRENINGER
Olivier GUPTA
Anne-Laure JOYE
Etienne KALALO
Lionel LABEILLE
Manuel VERMUSE
Céline VERNIER

SD3
Jérémie AVEROUS
Patrick BAUDOIN
Céline BLARY
Philippe BODENEZ
Estelle CHAPALAIN
Dorothée CONTE
Aurélie DROGOU
David KREMBEL
Cédric MESSIER
Odile PALUT-LAURENT
Philippe RAIMBAULT
Laurence TABARD

SD4
Marc AMMERICH
Claude ASSALIT
Yvan AUJOLLET
Jean-Marie CHABANE
Joseph CHAMBRAGNE
Jean-Jacques DIANA
Patrick FAVE
Marie-Noëlle LEVELUT
Yves PIED
Marc STOLTZ

SD5
Olivier ALLAIN
Dominique ARNAUD
Benjamin BENOIT
Xavier BUSCOT
François COLONNA
David EMOND
Yves LAPOSTOLLE
Franck MARZORATI
Sophie MOURLON
Pascal MUTIN
Laurent STREIBIG
Cédric TESTANIERE
Jean-Charles VAN HOECKE
Rachel VAUCHER
Gilles VERNIER
Jean VOISIN

SD6
André JOUVE

SD7
Vincent DELPORTE
Anne PILLON

DSNR BORDEAUX
Pierre-Antoine ALAZARD
Erick BEDNARSKI
Serge DESCORNE
Jérôme GOLETTO
Thierry LECOMTE
Alain RIVIERE
Jean-Luc ROUSSEAU

DSNR CAEN
Valentin BLONDEL
Thierry CANLER
Philippe CHARTIER
Christine DARROUY
Jean DELMOND
Jean-Claude ESTIENNE
Cécile EYBERT-PRUDHOMME
Dominique LEROY
Jean-Christophe LUC
Hélène MACH
Vincent MONNIER
Naïma SEFSOUF

DSNR CHALONS-EN-CHAMPAGNE
Caroline BONDOIS AUGE
Pierre-Yves GESLOT
Nicolas INCARNATO
Olivier MESUREUR
Alain THIZON

DSNR DOUAI
Jessie FOURCHE
François GODIN
Thierry GUERVILLE
Michel MARBAIX
Mathieu RIQUART
Philippe TALLENDIER

DSNR LYON
Régis BABEL
Jérôme BAI
Stéphane CALPENA
Jean-François DENIS
Sophie FORNER
Patrick HEMAR
Christian MOULIN
Christian PIGNOL
Christophe QUINTIN
Robert RIVOIRE
Christian ROBERT
Jean-Pierre SCALIA
Luc VENEAU
Rénald VOILLOT
Benoît ZERGER

DSNR MARSEILLE
Alain BOUFFIER
Guy CORNILLAUX
Pierre JUAN
David LANDIER
Pierre VULLIEZ

DSNR NANTES
Pierre SIEFRIDT

DSNR ORLÉANS
Serge ARTICO
Hubert BARATIN
Virginie BREBION
Yann DEFFIN
Yann DERRIEN
Patrice EDEY GAMASSOU
Michel FAUGERON
Pascal GALLON
Céline MAGNIER
David MAGNIER
Christelle MARNET
Vincent PERCHE
Olivier VEYRET
Rémy ZMYSLONY

DSNR PARIS
Adeline CLOS

DSNR STRASBOURG
Sébastien MATHIEUX
Olivier BONNER
Philippe BOUGIT
Anne LARREY
Xavier LESAGE
Xavier MANTIN

POSTED ABROAD
Jean-René JUBIN

LIST OF BASIC NUCLEAR INSTALLATION* (as of 31.12.04)

No in list	NAME AND LOCATION OF THE INSTALLATION	Operator	Type of installation	Declared on:	Authorised on:	Official Gazette (O.G.) of:	OBSERVATIONS
18	ULYSSE (Saclay) 91191 Gif-sur-Yvette Cedex	CEA	Reactor	27.05.64			
19	MÉLUSINE 38041 Grenoble Cedex	CEA	Reactor	27.05.64			Shutdown on 30.06.88. Modification prior to dismantling and decommissioning: decree of 08.01.04 O.G. of 09.01.04
20	SILOÉ 38041 Grenoble Cedex	CEA	Reactor	27.05.64			Shutdown on 23.12.97
21	SILOETTE 38041 Grenoble Cedex	CEA	Reactor	27.05.64			
22	TEMPORARY DISPOSAL FACILITY (PÉGASE) (Cadarache) 13115 Saint-Paul-lez-Durance	CEA	Disposal of radioactive substances	27.05.64	17.04.80	27.04.80	Former reactor shutdown on 19.12.75 Modification: decree of 04.09.89 O.G. of 08.09.89.
24	CABRI and SCARABÉE (Cadarache) 13115 Saint-Paul-lez-Durance	CEA	Reactor	27.05.64			
25	RAPSODIE/LDAC (Cadarache) 13115 Saint-Paul-lez-Durance	CEA	Reactor	27.05.64			Shutdown on 15.04.83
29	ARTIFICIAL RADIONUCLIDES PRODUCTION FACILITY (Saclay) 91191 Gif-sur-Yvette Cedex	CEA (Oris-Industrie)	Fabrication or transformation of radioactive substances	27.05.64			
32	PLUTONIUM TECHNOLOGY FACILITY (ATPu) (Cadarache) 13115 Saint-Paul-lez-Durance	CEA	Fabrication or transformation of radioactive substances	27.05.64			
33	SPENT FUEL REPROCESSING PLANT (UP2 and AT1) (La Hague) 50107 Cherbourg	COGEMA	Transformation of radioactive substances	27.05.64			Modification: decree of 17.01.74 O.G. of 05.02.74 Change in operator: decree of 09.08.78 O.G. of 19.08.78 Boundary change: decree of 10.01.03 O.G. of 11.01.03
34	EFFLUENT AND SOLID WASTE TREATMENT STATION 92265 Fontenay-aux-Roses Cedex	CEA	Transformation of radioactive substances	27.05.64			
35	LIQUID EFFLUENT MANAGEMENT ZONE (Saclay) 91191 Gif-sur-Yvette Cedex	CEA	Transformation of radioactive substances	27.05.64			Modification: decree of 08.01.04 O.G. of 09.01.04

LIST OF BASIC NUCLEAR INSTALLATION* (continuation)

No in list	NAME AND LOCATION OF THE INSTALLATION	Operator	Type of installation	Declared on:	Authorised on:	Official Gazette (O.G.) of:	OBSERVATIONS
36	EFFLUENT AND SOLID WASTE TREATMENT STATION 38041 Grenoble Cedex	CEA	Transformation of radioactive substances	27.05.64			
37	EFFLUENT AND SOLID WASTE TREATMENT STATION (Cadarache) 13115 Saint-Paul-lez-Durance	CEA	Transformation of radioactive substances	27.05.64			
38	EFFLUENT AND SOLID WASTE TREATMENT STATION "STE2" (La Hague) 50107 Cherbourg	COGEMA	Transformation of radioactive substances	27.05.64			Change in operator: decree of 09.08.78 O.G. of 19.08.78 Boundary change: decree of 10.01.03 O.G. of 11.01.03
39	MASURCA (Cadarache) 13115 Saint-Paul-lez-Durance	CEA	Reactor		14.12.66	15.12.66	
40	OSIRIS - ISIS (Saclay) 91191 Gif-sur-Yvette Cedex	CEA	Reactors		08.06.65	12.06.65	
41	HARMONIE (Cadarache) 13115 Saint-Paul-lez-Durance	CEA	Reactor		08.06.65	12.06.65	Final shutdown and dismantling decree of 08.01.04 O.G. of 09.01.04
42	ÉOLE (Cadarache) 13115 Saint-Paul-lez-Durance	CEA	Reactor		23.06.65	28 and 29.06.65	
43	LINEAR ACCELERATOR (Saclay) 91191 Gif-sur-Yvette Cedex	CEA	Particle accelerator		08.10.65	13.10.65	Final shutdown and dismantling decree of 12.01.04 O.G. of 13.01.04
44	STRASBOURG UNIVERSITY REACTOR 67037 Strasbourg Cedex	University Louis Pasteur	Reactor		25.06.65	01.07.65	
45	BUGEY NUCLEAR POWER PLANT (reactor 1) 01980 Loyettes	EDF	Reactor		22.11.68	24.11.68	Boundary change: decree of 10.12.85 O.G. of 18.12.85 Reactor shutdown on 27.05.94 Final shutdown decree of 30.08.96 O.G. of 07.09.96
46	ST-LAURENT-DES-EAUX NUCLEAR POWER PLANT (reactors A1 and A2) 41220 La Ferté-Saint-Cyr	EDF	Reactors		22.11.68	24.11.68	Boundary change: decree of 10.12.85 O.G. of 18.12.85. Final shutdown decree of 11.04.94 O.G. of 16.04.94

LIST OF BASIC NUCLEAR INSTALLATION* (continuation)

No in list	NAME AND LOCATION OF THE INSTALLATION	Operator	Type of installation	Declared on:	Authorised on:	Official Gazette (O.G.) of:	OBSERVATIONS
47	ELAN IIB FACILITY (La Hague) 50107 Cherbourg	COGEMA	Transformation of radioactive substances		03.11.67	09.11.67	Change in operator: decree of 09.08.78 O.G. of 19.08.78
48	SATURNE SYNCHROTRON (Saclay) 91191 Gif-sur-Yvette Cedex	CEA	Particle accelerator	17.02.67			Final shutdown and dismantling decree of 08.10.02 O.G. of 15.10.02
49	HIGH ACTIVITY LABORATORY (Saclay) 91191 Gif-sur-Yvette Cedex	CEA	Use of radioactive substances	08.01.68			Extension: decree of 22.02.88 O.G. of 24.02.88
50	SPENT FUEL TEST LABORATORY (LECI) (Saclay) 91191 Gif-sur-Yvette Cedex	CEA	Use of radioactive substances	08.01.68			Modification: decree of 30.05.00 O.G. of 03.06.00
52	ENRICHED URANIUM PROCESSING FACILITY (ATUE) (Cadarache) 13115 Saint-Paul-lez-Durance	CEA	Fabrication of radioactive substances	08.01.68			
53	ENRICHED URANIUM AND PLUTONIUM WAREHOUSE (Cadarache) 13115 Saint-Paul-lez-Durance	CEA	Radioactive substance repository	08.01.68			
54	CHEMICAL PURIFICATION LABORATORY (Cadarache) 13115 Saint-Paul-lez-Durance	CEA	Transformation of radioactive substances	08.01.68			
55	ACTIVE FUEL EXAMINATION LABORATORY (LECA) (Cadarache) 13115 Saint-Paul-lez-Durance	CEA	Use of radioactive substances	08.01.68			Extension: decree of 04.09.89 O.G. of 08.09.89
56	RADIOACTIVE WASTE INTERIM STORAGE AREA (Cadarache) 13115 Saint-Paul-lez-Durance	CEA	Disposal of radioactive substances	08.01.68			
57	PLUTONIUM CHEMISTRY LABORATORY (LCPu) 92265 Fontenay-aux-Roses Cedex	CEA	Use of radioactive substances	08.01.68			Final production shutdown: 01.07.95
59	LABORATORY FOR PLUTONIUM-BASED FUEL STUDIES (RM2) 92265 Fontenay-aux-Roses Cedex	CEA	Use of radioactive substances	08.01.68			Shutdown on 31.07.82
61	HIGH ACTIVITY ANALYSIS LABORATORY (LAMA) 38041 Grenoble Cedex	CEA	Use of radioactive substances	08.01.68			
63	FUEL ELEMENT FABRICATION PLANT 26104 Romans-sur-Isère	FBFC	Fabrication of radioactive substances	09.05.67			Modification: decree of 09.08.78 O.G. of 08.09.78
65	NUCLEAR FUEL FABRICATION PLANT 38113 Veurey-Voroize	SICN	Fabrication of radioactive substances	27.10.67			

LIST OF BASIC NUCLEAR INSTALLATION* (continuation)

No in list	NAME AND LOCATION OF THE INSTALLATION	Operator	Type of installation	Declared on:	Authorised on:	Official Gazette (O.G.) of:	OBSERVATIONS
66	LA MANCHE WASTE STORAGE FACILITY (CSM) 50448 Beaumont-Hague	ANDRA	Disposal of radioactive substances		19.06.69	22.06.69	Change in operator: decree of 24.03.95 O.G. of 26.03.95 Modification: decree of 10.01.03 O.G. of 11.01.03
67	HIGH FLUX REACTOR (RHF) 38041 Grenoble Cedex	Max von Laue Paul Langevin Institue	Reactor		19.06.69 05.12.94	22.06.69 06.12.94	Boundary change: decree of 12.12.88 O.G. of 16.12.88
68	DAGNEUX IONISATION PLANT Z.I. Les Chartinières 01120 Dagneux	IONISOS	Use of radioactive substances		20.07.71	25.07.71	Increase in maximum activity of ionisation source: decree of 15.06.78 O.G. of 27.06.78 Change in operator: decree of 23.10.95 O.G. of 28.10.95
71	PHÉNIX NUCLEAR POWER PLANT (Marcoule) 30205 Bagnols-sur-Cèze	CEA	Reactor		31.12.69	09.01.70	
72	SOLID RADIOACTIVE WASTE MANAGEMENT ZONE (Saclay) 91191 Gif-sur-Yvette Cedex	CEA	Radioactive substance storage		14.06.71	22.06.71	
73	SOLID RADIOACTIVE WASTE INTERIM STORAGE FACILITY 92265 Fontenay-aux-Roses Cedex	CEA	Radioactive substance storage		14.06.71	22.06.71	
74	INTERIM STORAGE OF IRRADIATED GRAPHITE SLEEVES (Saint-Laurent-des-Eaux) 41220 La Ferté-Saint-Cyr	EDF	Radioactive substance storage		14.06.71	22.06.71	Change in operator: decree of 28.06.84 O.G. of 06.07.84
75	FESSENHEIM NUCLEAR POWER PLANT (reactors 1 and 2) 68740 Fessenheim	EDF	Reactors		03.02.72	10.02.72	Boundary change: decree of 10.12.85 O.G. of 18.12.85
77	POSÉIDON - CAPRI IRRADIATION FACILITIES (Saclay) 91191 Gif-sur-Yvette Cedex	CEA	Use of radioactive substances		07.08.72	15.08.72	
78	BUGEY NUCLEAR POWER PLANT (reactors 2 and 3) 01980 Loyettes	EDF	Reactors		20.11.72	26.11.72	Boundary change: decree of 10.12.85 O.G. of 18.12.85
79	DECAY STORAGE FACILITY 38041 Grenoble Cedex	CEA	Radioactive substance storage		20.12.72	01.02.73	

LIST OF BASIC NUCLEAR INSTALLATION* (continuation)

No in list	NAME AND LOCATION OF THE INSTALLATION	Operator	Type of installation	Declared on:	Authorised on:	Official Gazette (O.G.) of:	OBSERVATIONS
80	HAO (HIGH LEVEL OXIDE) FACILITY (La Hague) 50107 Cherbourg	COGEMA	Transformation of radioactive substances		17.01.74	05.02.74	Change in operator: decree of 09.08.78 O.G. of 19.08.78 Boundary change: decree of 10.01.03 O.G. of 11.01.03
84	DAMPIERRE NUCLEAR POWER PLANT (reactors 1 and 2) 45570 Ouzouer-sur-Loire	EDF	Reactors		14.06.76	19.06.76	
85	DAMPIERRE NUCLEAR POWER PLANT (reactors 3 and 4) 45570 Ouzouer-sur-Loire	EDF	Reactors		14.06.76	19.06.76	
86	BLAYAIS NUCLEAR POWER PLANT (reactors 1 and 2) 33820 Saint-Ciers-sur-Gironde	EDF	Reactors		14.06.76	19.06.76	
87	TRICASTIN NUCLEAR POWER PLANT (reactors 1 and 2) 26130 Saint-Paul-Trois-Châteaux	EDF	Reactors		02.07.76	04.07.76	Boundary change: decree of 10.12.85 O.G. of 18.12.85
88	TRICASTIN NUCLEAR POWER PLANT (reactors 3 and 4) 26130 Saint-Paul-Trois-Châteaux	EDF	Reactors		02.07.76	04.07.76	Boundary change: decree of 10.12.85 O.G. of 18.12.85 Boundary change: decree of 29.11.04 O.G. of 02.12.04
89	BUGEY NUCLEAR POWER PLANT (reactors 4 and 5) 01980 Loyettes	EDF	Reactors		27.07.76	17.08.76	Boundary change: decree of 10.12.85 O.G. of 18.12.85
90	PELLET FABRICATION FACILITY 38113 Veurey-Voroize	SICN	Fabrication of radioactive substances		27.01.77	29.01.77	Modifications : decree of 15.06.77 O.G. of 19.06.77 Modifications : decree of 14.10.86 O.G. of 17.10.86
91	SUPERPHÉNIX REACTOR 38510 Morestel	EDF	Fast neutron reactor		12.05.77 10.01.89	28.05.77 12.01.89	Boundary change: decree of 24.07.85 O.G. of 31.07.85 Commissioning postponement: decree of 25.07.86 O.G. of 26.07.86 Final shutdown and change in operator decree of 30.12.98 O.G. of 31.12.98

LIST OF BASIC NUCLEAR INSTALLATION* (continuation)

No in list	NAME AND LOCATION OF THE INSTALLATION	Operator	Type of installation	Declared on:	Authorised on:	Official Gazette (O.G.) of:	OBSERVATIONS
92	PHÉBUS (Cadarache) 13115 Saint-Paul-lez-Durance	CEA	Reactor		05.07.77	19.07.77	Modification: decree of 07.11.91 O.G. of 10.11.91
93	GEORGES BESSE PLANT FOR URANIUM ISOTOPE SEPARATION BY GASEOUS DIFFUSION (Eurodif) 26702 Pierrelatte Cedex	EURODIF PRODUCTION	Transformation of radioactive substances		08.09.77	10.09.77	Boundary change: decree of 22.06.85 O.G. of 30.06.85
94	IRRADIATED MATERIAL FACILITY (Chinon) 37420 Avoine	EDF	Use of radioactive substances	29.01.64			Modification: decree of 15.04.85 O.G. of 19.04.85
95	MINERVE (Cadarache) 13115 Saint-Paul-lez-Durance	CEA	Reactor		21.09.77	27.09.77	
96	GRAVELINES NUCLEAR POWER PLANT (reactors 1 and 2) 59820 Gravelines	EDF	Reactors		24.10.77	26.10.77	Boundary change: decree of 29.11.04 O.G. of 02.12.04
97	GRAVELINES NUCLEAR POWER PLANT (reactors 3 and 4) 59820 Gravelines	EDF	Reactors		24.10.77	26.10.77	Boundary change: decree of 29.11.04 O.G. of 02.12.04
98	NUCLEAR FUEL FABRICATION UNIT 26104 Romans-sur-Isère	FBFC	Fabrication of radioactive substances		02.03.78	10.03.78	
99	CHINON INTERREGIONAL WAREHOUSE 37420 Avoine	EDF	Interim storage of new fuel		02.03.78	11.03.78	Modification: decree of 04.06.98 O.G. of 06.06.98
100	SAINT-LAURENT NUCLEAR POWER PLANT (reactors B1 and B2) 41220 La Ferté-Saint-Cyr	EDF	Reactors		08.03.78	21.03.78	
101	ORPHÉE (Saclay) 91191 Gif-sur-Yvette Cedex	CEA	Reactor		08.03.78	21.03.78	
102	BUGEY INTERREGIONAL WAREHOUSE 01980 Loyettes	EDF	Interim storage of new fuel		15.06.78	27.06.78	Modification decree of 04.06.98 O.G. of 06.06.98
103	PALUEL NUCLEAR POWER PLANT (reactor 1) 76450 Cany-Barville	EDF	Reactor		10.11.78	14.11.78	
104	PALUEL NUCLEAR POWER PLANT (reactor 2) 76450 Cany-Barville	EDF	Reactor		10.11.78	14.11.78	
105	URANIUM HEXAFLUORIDE PREPARATION PLANT (COMURHEX) 26130 Saint-Paul-Trois-Châteaux	COMURHEX	Transformation of radioactive susbstances				Classified secret until 31.12.78
106	ELECTROMAGNETIC RADIATION LABORATORY (LURE) 91405 Orsay Cedex	CNRS	Particle accelerator	22.03.79			Change in operator: decree of 08.07.85 O.G. of 12.07.85 Modification: decree of 02.07.92 O.G. of 08.07.92

LIST OF BASIC NUCLEAR INSTALLATION* (continuation)

No in list	NAME AND LOCATION OF THE INSTALLATION	Operator	Type of installation	Declared on:	Authorised on:	Official Gazette (O.G.) of:	OBSERVATIONS
107	CHINON NUCLEAR POWER PLANT (reactors B1 and B2) 37420 Avoine	EDF	Reactors		04.12.79	08.12.79	Modification: decree of 21.07.98 O.G. of 26.07.98
108	FLAMANVILLE NUCLEAR POWER PLANT (reactor 1) 50830 Flamanville	EDF	Reactor		21.12.79	26.12.79	
109	FLAMANVILLE NUCLEAR POWER PLANT (reactor 2) 50830 Flamanville	EDF	Reactor		21.12.79	26.12.79	
110	BLAYAIS NUCLEAR POWER PLANT (reactors 3 and 4) 33820 Saint-Ciers-sur-Gironde	EDF	Reactors		05.02.80	14.02.80	
111	CRUAS NUCLEAR POWER PLANT (reactors 1 and 2) 07350 Cruas	EDF	Reactors		08.12.80	31.12.80	Boundary change: decree of 10.12.85 O.G. of 18.12.85 Boundary change: decree of 29.11.04 O.G. of 02.12.04
112	CRUAS NUCLEAR POWER PLANT (reactors 3 and 4) 07350 Cruas	EDF	Reactors		08.12.80	31.12.80	Boundary change: decree of 29.11.04 O.G. of 02.12.04
113	LARGE NATIONAL HEAVY ION ACCELERATOR (GANIL) 14021 Caen Cedex	G.I.E. GANIL	Particle accelerator		29.12.80	10.01.81	Modification: decree of 06.06.01 O.G. of 13.06.01
114	PALUEL NUCLEAR POWER PLANT (reactor 3) 76450 Cany-Barville	EDF	Reactor		03.04.81	05.04.81	
115	PALUEL NUCLEAR POWER PLANT (reactor 4) 76450 Cany-Barville	EDF	Reactor		03.04.81	05.04.81	
116	REPROCESSING PLANT FOR SPENT FUEL ELEMENTS FROM LIGHT WATER REACTORS "UP3 A" (La Hague) 50107 Cherbourg	COGEMA	Transformation of radioactive substances		12.05.81	16.05.81	Commissioning postponement: decree of 28.03.89 O.G. of 07.04.89 Modification: decree of 18.01.93 O.G. of 24.01.93 Modification: decree of 10.01.03 O.G. of 11.01.03 Boundary change: decree of 10.01.03 O.G. of 11.01.03

LIST OF BASIC NUCLEAR INSTALLATION* (continuation)

No in list	NAME AND LOCATION OF THE INSTALLATION	Operator	Type of installation	Declared on:	Authorised on:	Official Gazette (O.G.) of:	OBSERVATIONS
117	REPROCESSING PLANT FOR SPENT FUEL ELEMENTS FROM LIGHT WATER REACTORS "UP2 800" (La Hague) 50107 Cherbourg	COGEMA	Transformation of radioactive substances		12.05.81	16.05.81	Commissioning postponement: decree of 28.03.89 O.G. of 07.04.89 Modification: decree of 18.01.93 O.G. of 24.01.93 Modification: decree of 10.01.03 O.G. of 11.01.03 Boundary change: decree of 10.01.03 O.G. of 11.01.03
118	LIQUID EFFLUENT AND SOLID WASTE TREATMENT STATION "STE3" (La Hague) 50107 Cherbourg	COGEMA	Transformation of radioactive substances		12.05.81	16.05.81	Commissioning postponement: decree of 27.04.88 O.G. of 03.05.88 Modification: decree of 10.01.03 O.G. of 11.01.03 Boundary change: decree of 10.01.03 O.G. of 11.01.03
119	SAINT-ALBAN-SAINT-MAURICE NUCLEAR POWER PLANT (reactor 1) 38550 Le Péage-de-Roussillon	EDF	Reactor		12.11.81	15.11.81	
120	SAINT-ALBAN-SAINT-MAURICE NUCLEAR POWER PLANT (reactor 2) 38550 Le Péage-de-Roussillon	EDF	Reactor		12.11.81	15.11.81	
121	CADARACHE IRRADIATOR (IRCA) 13115 Saint-Paul-lez-Durance	CEA	Use of radioactive substances		16.12.81	18.12.81	Final shutdown and dismantling decree of 12.01.04 O.G. of 13.01.04
122	GRAVELINES NUCLEAR POWER PLANT (reactors 5 and 6) 59820 Gravelines	EDF	Reactors		18.12.81	20.12.81	Boundary change: decree of 10.12.85 O.G. of 18.12.85
123	LABORATORY FOR THE EXPERIMENTAL DESIGN AND FABRICATION OF ADVANCED NUCLEAR FUELS (LEFCA) (Cadarache) 13115 Saint-Paul-lez-Durance	CEA	Fabrication of radioactive substances		23.12.81	26.12.81	
124	CATTENOM NUCLEAR POWER PLANT (reactor 1) 57570 Cattenom	EDF	Reactor		24.06.82	26.06.82	
125	CATTENOM NUCLEAR POWER PLANT (reactor 2) 57570 Cattenom	EDF	Reactor		24.06.82	26.06.82	

LIST OF BASIC NUCLEAR INSTALLATION* (continuation)

No in list	NAME AND LOCATION OF THE INSTALLATION	Operator	Type of installation	Declared on:	Authorised on:	Official Gazette (O.G.) of:	OBSERVATIONS
126	CATTENOM NUCLEAR POWER PLANT (reactor 3) 57570 Cattenom	EDF	Reactor		24.06.82	26.06.82	
127	BELLEVILLE NUCLEAR POWER PLANT (reactor 1) 18240 Léré	EDF	Reactor		15.09.82	16.09.82	
128	BELLEVILLE NUCLEAR POWER PLANT (reactor 2) 18240 Léré	EDF	Reactor		15.09.82	16.09.82	Boundary change: decree of 29.11.04 O.G. of 02.12.04
129	NOGENT NUCLEAR POWER PLANT (reactor 1) 10400 Nogent-sur-Seine	EDF	Reactor		28.09.82	30.09.82	Boundary change: decree of 10.12.85 O.G. of 18.12.85
130	NOGENT NUCLEAR POWER PLANT (reactor 2) 10400 Nogent-sur-Seine	EDF	Reactor		28.09.82	30.09.82	Boundary change: decree of 10.12.85 O.G. of 18.12.85
132	CHINON NUCLEAR POWER PLANT (reactors B3 and B4) 37420 Avoine	EDF	Reactors		07.10.82	10.10.82	Modification: decree of 21.07.98 O.G. of 26.07.98
133	CHINON A1D 37420 Avoine	EDF	Radioactive substance storage		11.10.82	16.10.82	Former reactor shutdown on 16.04.73
134	URANIUM WAREHOUSE 13140 Miramas	COGEMA	Interim storage of products containing urnanium		16.11.83	19.11.83	
135	GOLFECH NUCLEAR POWER PLANT (reactor 1) 82400 Golfech	EDF	Reactor		03.03.83	06.03.83	Boundary change: decree of 29.11.04 O.G. of 02.12.04
136	PENLY NUCLEAR POWER PLANT (reactor 1) 76370 Neuville-les-Dieppe	EDF	Reactor		23.02.83	26.02.83	
137	CATTENOM NUCLEAR POWER PLANT (reactor 4) 57570 Cattenom	EDF	Reactor		29.02.84	03.03.84	
138	URANIUM CLEANUP AND RECOVERY FACILITY (Tricastin) 26130 Saint-Paul-Trois-Châteaux	SOCATRI	Plant		22.06.84	30.06.84	Modification decree of 29.11.93 O.G. of 07.12.93 Modification decree of 10.06.03 O.G. of 17.06.03
139	CHOOZ B NUCLEAR POWER PLANT (reactor 1) 08600 Givet	EDF	Reactor		09.10.84	13.10.84	Commissioning postponement: decrees of 18.10.1993 O.G. of 23.10.93 and 11.06.99 O.G. of 18.06.99

LIST OF BASIC NUCLEAR INSTALLATION* (continuation)

No in list	NAME AND LOCATION OF THE INSTALLATION	Operator	Type of installation	Declared on:	Authorised on:	Official Gazette (O.G.) of:	OBSERVATIONS
140	PENLY NUCLEAR POWER PLANT (reactor 2) 76370 Neuville-les-Dieppe	EDF	Reactor		09.10.84	13.10.84	
141	FUEL EVACUATION FACILITY (Creys-Malville) 38510 Morestel	EDF	Radioactive substances disposal or depot		24.07.85	31.07.85	Commissioning postponement: decree of 28.07.93 O.G. of 29.07.93 Change in operator: decree of 30.12.98 O.G. of 31.12.98
142	GOLFECH NUCLEAR POWER PLANT (reactor 2) 82400 Golfech	EDF	Reactor		31.07.85	07.08.85	
143	NUCLEAR MAINTENANCE FACILITY (SOMANU) 59600 Maubeuge	SOMANU	Nuclear maintenance		18.10.85	22.10.85	
144	CHOOZ B NUCLEAR POWER PLANT (reactor 2) 08600 Givet	EDF	Reactor		18.02.86	25.02.86	Commissioning postponement: decrees of 18.10.93 O.G. of 23.10.93 and 11.06.99 O.G. of 18.06.99
146	POUZAUGES IONISATION PLANT Z.I. de Monlifant 85700 Pouzauges	IONISOS	Ionisation installation		30.01.89	31.01.89	Change in operator: decree of 23.10.95 O.G. of 28.10.95
147	GAMMASTER IONISATION PLANT - M.I.N. 712 13323 Marseille Cedex 14	GAMMA-STER	Ionisation installation		30.01.89	31.01.89	
148	ATALANTE CEN VALRHO Chusclan 30205 Bagnols-sur-Cèze	CEA	R&D laboratory and study of actinides production		19.07.89	25.07.89	Commissioning postponement: decree of 22.07.99 O.G. of 23.07.99
149	AUBE WASTE STORAGE FACILITY (CSA) Soulaines-Dhuys 10200 Bar-sur-Aube	ANDRA	Radioactive substance surface disposal		04.09.89	06.09.89	Change in operator: decree of 24.03.95 O.G. of 26.03.95
151	NUCLEAR FUEL FABRICATION PLANT (MELOX) BP 2 - 30200 Chusclan	COGEMA	Fabrication of radioactive substances		21.05.90	22.05.90	Modification: decree of 30.07.99 O.G. of 31.07.99 Modification: decree of 10.01.03 O.G. of 11.01.03 Modification: decree of 03.09.03 O.G. of 04.09.03 Modification: decree of 04.10.04 O.G. of 05.10.04

LIST OF BASIC NUCLEAR INSTALLATION* (continuation)

No in list	NAME AND LOCATION OF THE INSTALLATION	Operator	Type of installation	Declared on:	Authorised on:	Official Gazette (O.G.) of:	OBSERVATIONS
153	CHINON A2 D 37420 Avoine	EDF	Radioactive substance storage or depot		07.02.91	13.02.91	Former reactor shutdown on 14.06.85
154	SABLÉ-SUR-SARTHE IONISATION PLANT Z.I. de l'Aubrée 72300 Sablé-sur-Sarthe	IONISOS	Ionisation installation		01.04.92	04.04.92	Change in operator: decree of 23.10.95 O.G. of 28.10.95
155	INSTALLATION TU 5 BP 16 26701 Pierrelatte	COGEMA	Transformation of radioactive substances		07.07.92	11.07.92	Modification: decree of 15.09.94 O.G. of 24.09.94
156	CHICADE (Cadarache) BP 1 13108 Saint-Paul-lez-Durance Cedex	CEA	R&D laboratory		29.03.93	30.03.93	
157	TRICASTIN OPERATIONAL HOT UNIT (BCOT) BP 127 84504 Bollène Cedex	EDF	Nuclear maintenance		29.11.93	07.12.93	
158	CIVAUX NUCLEAR POWER PLANT (reactor 1) BP 1 – 86320 Civaux	EDF	Reactor		06.12.93	12.12.93	Commissioning postponement: decree of 11.06.99
159	CIVAUX NUCLEAR POWER PLANT (reactor 2) BP 1 – 86320 Civaux	EDF	Reactor		06.12.93	12.12.93	Commissioning postponement: decree of 11.06.99 O.G. of 18.06.99
160	CENTRACO Codolet 30200 Bagnols-sur-Cèze	SOCODEI	Radioactive waste and effluent processing		27.08.96	31.08.96	
161	CHINON A3 D 37420 Avoine	EDF	Radioactive substance storage		27.08.96	31.08.96	Former reactor shutdown on 17.03.93
162	MONTS D'ARRÉE EL4 D Brennilis 29218 Huelgoat	EDF	Radioactive substance storage		31.10.96	08.11.96	Former reactor shutdown on 31.07.85 Change in operator: decree of 19.09.00 O.G. of 26.09.00 Modification: decree of 12.01.04 O.G. of 13.01.04
163	ARDENNES NUCLEAR POWER PLANT CNA-D 08600 Givet	EDF	Radioactive substance storage		19.03.99	21.03.99	Former reactor shutdown on 17.03.93 Modification: decree of 27.10.04 O.G. of 28.10.04
164	CEDRA (Cadarache) 13115 Saint-Paul-lez-Durance Cedex	CEA	Packaging and interim storage of radioactive substances		04.10.04	05.10.04	

* The missing numbers correspond to facilities which were included in previous editions of the list but which are no longer basic nuclear installations or which have changed categories (new basic nuclear installation).
As of 31.12.04 there are 126 installations with BNI status.

LISTE DES INSTALLATIONS NUCLÉAIRES DE BASE (suite)

N° dans la liste	DÉNOMINATION ET IMPLANTATION DE L'INSTALLATION	Exploitant	Nature de l'installation	Déclarée le :	Autorisée le :	J. O. du :	OBSERVA-TIONS

ACRONYMS AND ABBREVIATIONS

ACC	Hulls and end-pieces compaction facility (COGEMA – La Hague)
ACR	Resins conditioning facility (COGEMA – La Hague)
ACRO	Association pour le Contrôle de la Radioactivité dans l'Ouest (association for the control of radioactivity in the West)
ADNR	European Agreement concerning International Carriage of Dangerous Goods on the Rhine
ADR	European Agreement concerning the International Carriage of Dangerous Goods by Road
AERB	Atomic Energy Regulatory Board (India)
AFCEN	Association Française pour les règles de conception et de construction des matériels des Chaudières ElectroNucléaires (French association for NSSS equipment construction rules)
AFCN	Agence Fédérale de Contrôle Nucléaire (Federal Nuclear inspection Agency – Belgium)
AFSSA	Agence Française de Sécurité Sanitaire des Aliments (French food product safety agency)
AFSSAPS	Agence Française de Sécurité SAnitaire des Produits de Santé (French health product safety agency)
AFSSE	Agence Française de Sécurité Sanitaire Environnementale (French agency for Environmental Health Safety)
ALARA	As Low As Reasonably Achievable
ALS	Accélérateur Linéaire de Saclay (Saclay Linear Accelerator – CEA)
AMI	Atelier des Matériaux Irradiés (Irradiated materials facility – EDF)
ANAES	Agence Nationale d'Accréditation et d'Évaluation des Soins (French agency for health care accreditation and assessment)
ANCLI	Association Nationale des Commissions Locales d'Information (national CLI association)
ANDRA	Agence Nationale pour la gestion des Déchets Radioactifs (French agency for radioactive waste management)
APE	Approche Par Etat (state-based approach)
APEC	Atelier Pour l'Évacuation du Combustible (Fuel evacuation shop)
AP-HP	Assistance Publique – Hôpitaux de Paris (Public Health Service – Paris Hospitals)
AQG	Atomic Questions Group (European Union)
ARE	Alimentation normale des générateurs de vapeur (REP) (Steam generator feedwater system – PWR)

ASG	Alimentation de Secours des Générateurs de vapeur (REP) (Steam generator auxiliary feedwater system – PWR)
ASN	Autorité de Sûreté Nucléaire (French Nuclear Safety Authority)
ASR	Refuelling outage
ASSET	Assessment of Safety Significant Events Team (IAEA expertise)
ATALANTE	Atelier Alpha et Laboratoire pour les Analyses de Transuraniens et Etudes de retraitement (Alpha facility and laboratory for transuranian elements analysis and reprocessing studies – CEA – Marcoule)
ATPu	Atelier de Technologie du Plutonium (Plutonium technology facility – COGEMA – Cadarache)
ATUE	Atelier de Traitement de l'Uranium Enrichi (Enriched uranium processing facility – CEA – Cadarache)
AVN	Association Vinçotte Nucléaire (Belgium)
BAM	Bundesanstalt für Materialforschung und -prüfung (Federal institute for materials research and testing – Germany)
BASIAS	Base de données des Anciens Sites Industriels et Activités de Services (French former industrial sites and department activity database)
BASOL	Base de données sur les sites et sols pollués appelant une action des services publics (French database of polluted sites and soils requiring action by the public authorities)
BCCN	Bureau de Contrôle des Chaudières Nucléaires (French NSSS control office – ASN)
BCI	Bâtiment des Combustibles Irradiés (Spent fuel building)
BCOT	Base Chaude Opérationnelle du Tricastin (Tricastin operational hot unit)
BEIR	Biological Effects of Ionizing Radiation (United States academy of science committees)
BMU	Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit (Ministry for the environment and nuclear safety – Germany)
BNFL	British Nuclear Fuels Limited
BNI	Basic Nuclear Installation
BO	Bulletin Officiel (Official bulletin)
BRGM	Bureau de Recherches Géologiques et Minières (Geological and mining research office)
BWR	Boiling Water Reactor
CADA	Commission d'Accès aux Documents Administratifs (Administrative Documents Access Commission)
CAPE	Centre d'Appui au Parc en Exploitation (Operating Plant Support Centre – EDF/DPN)

CASCAD	CASemate de CADarache (Cadarache bunker – CEA)
CBNI	Classified Basic Nuclear Installations
CCAP	Commission Centrale des Appareils à Pression (French central committee for pressure Vessels)
CDH	Conseil Départemental d'Hygiène (Departmental Health Council)
CEA	Commissariat à l'Énergie Atomique (French atomic energy agency)
CEDRA	Conditionnement et Entreposage de Déchets RAdioactifs (Radioactive Waste Packaging and Interim Storage unit – CEA – Cadarache)
CEIDRE	Centre d'Expertise et d'Inspection dans les Domaines de la Réalisation et de l'Exploitation (Construction and Operation Appraisal and Inspection Centre – EDF)
CENTRACO	CENtre de TRAitement et de COnditionnement de déchets de faible activité (low-level waste processing and packaging centre) (CEA – Marcoule)
CEPN	Centre d'études sur l'Évaluation de la Protection dans le domaine Nucléaire (Study Centre for Nuclear Protection Assessment)
CERCA	Compagnie pour l'Étude et la Réalisation des Combustibles Atomiques (company for the design and fabrication of atomic fuel)
CERN	European Organization for Nuclear Research
CETEN-APAVE	CEntre TEchnique National et international des Associations de Propriétaires d'Appareils à Vapeur et Électriques (national and international technical centre of associations of owners of electric equipment and pressure vessels)
CFCa	Complexe de Fabrication de Cadarache (Cadarache fabrication complex – COGEMA – MOX facility)
CFU	Colony Forming Unit (the CFU per litre is the unit used to measure the legionella concentration)
CHICADE	CHImie Caractérisation des Déchets (chemistry, waste characterization – CEA Cadarache)
CHU	Centre Hospitalier Universitaire (university hospital)
CHUV	Centre Hospitalier Universitaire Vaudois (Vaudois region university hospital – Lausanne)
CICNR	Comité Interministériel aux Crises Nucléaires ou Radiologiques (French Interministerial Committee for Nuclear or Radiological Emergencies)
CIDEN	Centre d'Ingénierie Déconstruction Environnement (Engineering Centre for Dismantling and related Environmental Issues – EDF)
CIINB	Commission Interministérielle des Installations Nucléaires de Base (interministerial commission for basic nuclear installations)
CIPN	Centre d'ingénierie du parc nucléaire (Engineering Centre for Operating Plants)

CIREA	Commission Interministérielle des RadioÉléments Artificiels (activities taken over by the ASN in 2002) (French interministerial commission for artificial radioelements)
CISN	Comité Interministériel de la Sécurité Nucléaire (replaced by the CICNR) (French interministerial committee for nuclear security)
CITMD	Commission Interministérielle du Transport des Matières Dangereuses (French interministerial commission for the carriage of dangerous goods)
CLI	Commission Locale d'Information (local information committee)
CLIS	Comité Local d'Information et de Suivi (local committee for information and follow-up) (underground laboratories)
CMIR	Cellule Mobile d'Intervention Radiologique (mobile radiological intervention unit)
CMS	Cote Majorée de Sécurité (maximum design flood level – flood protection)
CNDP	Commission Nationale du Débat Public (French national Public Debates Commission)
CNEN	Centre National d'Équipement Nucléaire (National Centre for Nuclear Equipment – EDF)
CNEPE	Centre National d'Équipement de Production Électrique (National electricity generating equipment centre – EDF)
CNPE	Centre Nucléaire de Production d'Électricité (nuclear power generation site – EDF)
CNRA	Committee on Nuclear Regulatory Activities (NEA)
CNRS	Centre National de la Recherche Scientifique (French national centre for scientific research)
CNS	Council for Nuclear Safety (South Africa)
COFRAC	COmité FRançais d'Accréditation (French accreditation committee)
COGEMA	COmpagnie GÉnérale des MAtières nucléaires (AREVA group)
COGIC	Centre Opérationnel de Gestion Interministérielle des Crises (French interministerial emergency management operational centre)
COMURHEX	société pour la COnversion de l'URanium en métal et en HEXafluorure (company for the conversion of uranium into metal and hexafluoride)
CONCERT	CONCertation on European Regulatory Tasks (grouping of the safety regulators from eastern and western European countries)
CPA	Conditions Particulières d'Autorisation (special authorisation conditions – radiation sources)
CPE	Conditions Particulières d'Emploi (special utilisation conditions – radiation sources)

CPP	Circuit Primaire Principal (REP) (main primary system – PWR)
CPY	second series of 900 MWe PWRs (EDF)
CP0	first series of 900 MWe PWRs (EDF)
CP1	1st subdivision of the CPY series
CP2	2nd subdivision of the CPY series
CRIIRAD	Commission de Recherche et d'Information Indépendantes sur la RADioactivité (Committee for independent research and information on radioactivity)
CRPPH	Committee on Radiation Protection and Public Health (NEA)
CSA	Centre de Stockage de l'Aube (ANDRA) (Aube waste repository – ANDRA)
CSD-C	Colis Standard de Déchets Compactés (standard compacted waste package)
CSHPF	Conseil Supérieur d'Hygiène Publique de France (French High Public Health Council)
CSN	Consejo de Seguridad Nuclear (Spanish nuclear safety authority)
CSNI	Committee on the Safety of Nuclear Installations (NEA)
CSP	– Circuit Secondaire Principal (REP) (main secondary system – PWR) – Code de la Santé Publique (Public Health Code)
CSS	Commission on Safety Standards (IAEA)
CSSIN	Conseil Supérieur de la Sûreté et de l'Information Nucléaires (French high council for nuclear safety and information)
CSTFA	Centre de Stockage des déchets de Très Faible Activité (ANDRA – Morvilliers VLL waste repository)
CT	Code du Travail (Labour Code)
CTC	Centre Technique de Crise (technical crisis centre)
DAC	Décret d'Autorisation de Création (authorisation decree – BNI procedure)
DAPE	Dossier d'Aptitude à la Poursuite de l'Exploitation (Operation extension approval dossier)
DARPE	Demande d'Autorisation de Rejets et de Prélèvements d'Eau (effluent discharge and water intake licence application)
DARPMI	Direction de l'Action Régionale et de la Petite et Moyenne Industrie (Directorate for Regional Action and Small and Medium-sized Enterprises – French Ministry of the Economy, Finance and Industry)
DDAC	projet de loi portant Diverses Dispositions d'Adaptation au droit Communautaire (Community law adaptations bill)
DDASS	Direction Départementale des Affaires Sanitaires et Sociales (Departmental Health and Social Action Directorate)

DDSC	Direction de la Défense et de la Sécurité Civiles (Directorate for Civil Security and Defence – French Ministry of the Interior)
DDTEFP	Direction Départementale du Travail, de l'Emploi et de la Formation Professionnelle (Departmental Labour, Employment and Professional Training Directorate)
DFD	Franco-German Steering Committee
DFK	Franco-German committee for nuclear plant safety issues
DGAC	Direction Générale de l'Aviation Civile (Directorate General for Civil Aviation – French Ministry for Transport)
DGCCRF	Direction Générale de la Concurrence, de la Consommation et de la Répression des Fraudes (Directorate-General for Competition Policy, Consumer Affairs and Fraud Control – French Ministry of the Economy, Finance and Industry)
DGEMP	Direction Générale de l'Énergie et des Matières Premières (Directorate General for Energy and Raw Materials – French Ministry for Industry)
DGS	Direction Générale de la Santé (Directorate-General for Health – French Ministry for Health)
DGSNR	– Directeur Général de la Sûreté Nucléaire et de la Radioprotection (Director General for Nuclear Safety and Radiation Protection) – Direction Générale de la Sûreté Nucléaire et de la Radioprotection (General Directorate for Nuclear Safety and Radiation Protection – ASN central structure)
DG TREN	Directorate General for Energy and Transport – European Commission
DHOS	Direction de l'Hospitalisation et de l'Organisation des Soins (Directorate for hospitalisation and health care organisation – French Ministry for Health)
DIDEME	DIrection de la DEmande et des Marchés Énergétiques (Directorate for Energy Demand and Energy Markets – French Ministry for Industry)
DIN	– Division Ingénierie Nucléaire (Nuclear Engineering Division – EDF) – Division des Installations Nucléaires (nuclear installation departments – replaced by the DSNR in 2002)
DNA	Deoxyribonucleic acid
DOE	Department of Energy (United States)
DPN	Division Production Nucléaire (Nuclear Generating Division – EDF)
DPPR	– Directeur de la Prévention des Pollutions et des Risques (Director for the Prevention of Pollution and Risks – French Ministry for the Environment) – Direction de la Prévention des Pollutions et des Risques (Directorate for the Prevention of Pollution and Risks – French Ministry for the Environment)
DRASS	Direction Régionale des Affaires Sanitaires et Sociales (Regional Health and Social Action Directorate)

DRIRE – Directeur Régional de l'Industrie, de la Recherche et de l'Environnement (Regional Director for Industry, Research and the Environment)
– Direction Régionale de l'Industrie, de la Recherche et de l'Environnement (Regional Directorate for Industry, Research and the Environment)

DRT Direction des Relations du Travail (Directorate for Labour Relations – French Ministry for Labour)

DRTEFP Direction Régionale du Travail, de l'Emploi et de la Formation Professionnelle (Regional Labour, Employment and Professional Training Directorate – French Ministry for Labour)

DSIN – Directeur de la Sûreté des Installations Nucléaires (Nuclear Installation Safety Director)
– Direction de la Sûreté des Installations Nucléaires (Nuclear Installation Safety Directorate – replaced by the DGSNR in 2002)

DSN Division principale de la Sécurité des installations Nucléaires (Main nuclear installations safety division – Swiss nuclear safety authority)

DSND Délégué à la Sûreté Nucléaire et à la radioprotection pour les activités et installations intéressant la Défense (Delegate for Nuclear Safety and Radiation Protection for National Defence Installations and Activities – French Ministries for Defence and Industry)

DSNR Division de la Sûreté Nucléaire et de la Radioprotection (Regional Department for Nuclear Safety and Radiation Protection) (ASN)

DSS Direction de la Sécurité Sociale (Directorate for Social Security – French Ministry for Health)

DTI Dose Totale Indicative (total indicative dose)

DUP Déclaration d'Utilité Publique (declaration of public interest procedure)

EAN European Alara Network (the aim of which is to promote implementation of the ALARA principle)

EAS circuit d'Aspersion de Secours de l'enceinte (Containment spray system – PWR)

EBRD European Bank for Reconstruction and Development

EC European Community

EDE circuit de mise en dépression de l'Espace entre les Deux Enceintes d'un réacteur (Containment annulus ventilation system – PWR)

EDF Électricité De France

EDS Entreposage de Déchets Solides (solid waste interim storage area)

EEC European Economic Community

EGRA Expert Group on Regulatory Autorisation (sub-group of the NEA's CRPPH)

EIS Élément Important pour la Sûreté (Element Important for Safety)

EPA	Environmental Protection Agency (United States)
EPN	Exploitation du Parc Nucléaire (nuclear capacity operation department – EDF)
EPR	European Pressurized water Reactor (new type of reactor developed by FRAMATOME-ANP)
EPS	Étude Probabiliste de Sûreté (probabilistic safety study)
ERNET	Emergency Response NETwork
ERP	Établissement Recevant du Public (establishment open to the public)
ESP	Équipement Sous Pression (pressure vessel)
ESS	Événement Significatif pour la Sûreté (event significant for safety)
EURATOM	EURopean ATOMic energy community treaty
EURODIF	usine EUROpéenne d'enrichissement par DIFfusion gazeuse (European gaseous diffusion enrichment plant)
FAIOp	Fiche d'Action Incendie Opérateur (operator fire action sheet)
FBFC	Société Franco-Belge de Fabrication de Combustibles (Romans-sur-Isère) (Franco-Belgian fuel fabrication company)
FDG	2.5 Fluorodeoxyglucose
FH	Facteur Humain (human factor)
FMEA	Failure Modes and Effects Analysis
FRAMATOME	French NSSS builder (AREVA group)
FRAMATOME-ANP	Framatome – Advanced Nuclear Power (company set up by AREVA and SIEMENS to develop the new EPR reactor type)
FRAREG	FRAmatome REGulators (Association of nuclear safety authorities in countries operating power plants of French design)
GAN	GosAtomNadzor (Russian nuclear safety authority)
GANIL	Grand Accélérateur National d'Ions Lourds (Large National Heavy Ion Accelerator – Caen)
GB I	Georges Besse Plant I – Eurodif
GB II	Georges Besse Plant II – planned
GIAG	Guide d'Intervention en Accident Grave (Serious accident action guide)
GP	Groupe Permanent d'experts (Advisory Committee)
GQA	Groupe des Questions Atomiques (Atomic questions group – European Union)

GV	Générateur de Vapeur (steam generator)
G7	Group of the 7 leading industrial nations (Canada, France, Germany, Italy, Japan, United Kingdom and United States)
G8	Group of the 8 leading industrial nations (G7 + Russia)
HAO	Haute Activité Oxyde (Oxide high activity shop: COGEMA – La Hague)
HAVL	Haute Activité et Vie Longue (High level long-lived waste)
HFD	Haut Fonctionnaire de Défense (Defence High Official) (at each French ministry)
HSE	Health and Safety Executive (United Kingdom)
HSK	Hauptabteilung für die Sicherheit der Kernanlagen (main nuclear installations safety division – Swiss safety authority)
IAEA	International Atomic Energy Agency (UN)
ICAO	International Civil Aviation Organisation
ICCRB	International Consultative Committee of Regulatory Bodies (group comprising representatives from the Regulatory authorities of Canada, Finland, France, Germany, Italy, Spain, Switzerland, United Kingdom and United States for the purpose of advising the Ukrainian safety authority with respect to the Chernobyl site)
ICPE	Installation Classée pour la Protection de l'Environnement (installation classified on environmental protection grounds)
ICRP	International Commission on Radiological Protection
IDSP	Indice de Dose de Scanographie Pondéré (weighted scanner dose index)
IEC	International Electrotechnical Commission
IFSI	Institut de Formation en Soins Infirmiers (nursing training institute)
ILE	ITER Legal Entity (international body to be created to operate ITER)
ILL	Institut Laue-Langevin (Laue-Langevin Institute – Grenoble)
IMDG	International Maritime Dangerous Goods code
IN	Inspection Nucléaire (Nuclear inspectorate – EDF)
INB	Installation Nucléaire de Base (BNI – basic nuclear installation)
INBS	Installation Nucléaire de Base Secrète (BNIS – classified basic nuclear installation)
INERIS	Institut National de l'Environnement industriel et des RISques (French National institute for the study of industrial environments and risks)
INES	International Nuclear Event Scale

INRA	– International Nuclear Regulators' Association – Institut National de Recherche Agronomique (French national agronomy research institute)
INSAG	International Nuclear Safety Advisory Group (IAEA)
INSERM	Institut National de la Santé Et de la Recherche Médicale (French national health and medical research institute)
INSTN	Institut National des Sciences et Techniques Nucléaires (National institute for nuclear science and techniques – CEA)
InVS	Institut de Veille Sanitaire (French health watch institute)
IPSN	Institut de Protection et de Sûreté Nucléaire (institute for nuclear safety and protection – replaced by the IRSN in 2002)
IRCA	IRradiateur de Cadarache (Cadarache irradiator – CEA)
IRM	Imagerie par Résonance Magnétique (magnetic resonance imaging)
IRPA	International RadioProtection Association
IRRT	International Regulatory Review Team (delegated by the IAEA to audit a safety authority)
IRSN	Institut de Radioprotection et de Sûreté Nucléaire (French Institute for Radiation Protection and Nuclear Safety)
IS Ouest	Institut de Soudure Ouest
ISO	International Standard Organisation
ISOE	Information System on Occupational Exposure (OECD)
ISR	Ingénieur Sûreté Radioprotection (safety and radiation protection engineer – EDF)
ITER	International Thermonuclear Experimental Reactor
JNES	Japan Nuclear Energy Safety organisation
JO	Journal Officiel (French Official Gazette)
ke	kiloeuros (thousand euros)
KEPCO	Kansai Electric Power Company (Japan)
KINS	Korean Institute of Nuclear Safety (South Korea)
LAMA	Laboratoire d'Analyse des Matériaux Actifs (active materials analysis laboratory – CEA Grenoble)
LCC	Laboratoire Central de Contrôle qualité des produits (central product quality control laboratory – COGEMA La Hague)
LCPu	Laboratoire de Chimie du Plutonium (plutonium chemistry laboratory – CEA – Fontenay-aux-Roses)

LDAC Laboratoire de Découpage d'Assemblages Combustibles (Fuel assembly shearing laboratory – CEA – Cadarache)

LECA Laboratoire d'Examen des Combustibles Actifs (Active fuel examination laboratory – CEA – Cadarache)

LECI Laboratoire d'Essai sur Combustibles Irradiés (spent fuel testing laboratory – CEA – Saclay)

LEFCA Laboratoire d'Études et de Fabrications expérimentales de Combustibles nucléaires Avancés (Laboratory for the experimental design and fabrication of advanced nuclear fuels – CEA – Cadarache)

LEP Large Electron Positron (CERN)

LHA Laboratoire de Haute Activité (High activity laboratory – CEA – Saclay)

LHC Large Hadron Collider (CERN)

LOLF Loi Organique relative aux Lois de Finances (French constitutional bylaw on budget acts)

LPC Laboratoire de Purification Chimique (chemical purification laboratory – COGEMA – Cadarache)

LUDD Laboratoires, Usines, Déchets et Démantèlement (laboratories, plants, waste and dismantling)

LURE Laboratoire pour l'Utilisation du Rayonnement Électromagnétique (Electromagnetic radiation laboratory – CNRS – Orsay)

MAD Mise à l'Arrêt Définitif (decommissioning)

MAGNUC MAGazine télématique NUCléaire (MAGNUC viewdata magazine)

MAPu Moyenne Activité Plutonium (medium level Plutonium (MAPu shop: COGEMA – La Hague)

MARN Mission d'Appui à la gestion du Risque Nucléaire (Nuclear Risk Management Aid Committee – French Ministry for the Interior/DDSC))

MAU Moyenne Activité Uranium (medium level uranium (MAU shop: COGEMA – La Hague)

MCMF Magasin Central des Matières Fissiles (central fissile material warehouse: CEA – Cadarache)

MDB Mission Déléguée de Bassin (River authority)

MDS atelier de Minéralisation Des Solvants organiques (organic solvent mineralisation facility – COGEMA – La Hague)

Me Mégaeuros (million euros)

ME Ministre chargé de l'Environnement (Minister for the Environment)

MELOX usine de fabrication de combustible MOX (MOX fuel fabrication plant – Marcoule)

MEM	Ministère de l'Énergie et des Mines (Maroc) (Ministry for Energy and Mines – Morocco)
METI	Ministry of Economy, Trade and Industry (Japan)
MI	Ministre chargé de l'Industrie (Minister for Industry)
MIMAUSA	Mémoire et Impact des Mines d'urAniUm : Synthèse et Archive (History and impact of uranium mines: Summary and Archive – programme for an inventory of uranium mining sites)
MIR	Magasins InterRégionaux de combustibles (inter-regional fuel stores – EDF)
MMS	Moyen Mobile de Secours (mobile emergency equipment)
MOX	Mixed uranium and plutonium oxide fuel
NEA	Nuclear Energy Agency (OECD)
NF	– Naeglaria Fowleri (species of amoeba) – Norme Française (French standard)
NII	Nuclear Installations Inspectorate (United Kingdom)
NISA	Nuclear Industrial Safety Agency (METI – Japan)
NNEMA	National Nuclear Emergency Management Administration (China)
NNR	National Nuclear Regulator (South African safety authority)
NNSA	National Nuclear Safety Administration (People's Republic of China)
NORM	Naturally Occurring Radioactive Materials
NRBC	Nuclear, Radiological, Biological, Chemical
NRC	Nuclear Regulatory Commission (USA)
NRPB	National Radiological Protection Board (United Kingdom)
NSC	Nuclear Safety Commission (Japan)
NSD	Nuclear Safety Directorate (United Kingdom safety authority)
NSSG	Nuclear Safety and Security Group (G8)
NSWG	Nuclear Safety Working Group (G7)
NUPEC	Technical expertising organisation of the NISA (METI – Japan)
NUSSC	NUclear Safety Standards Committee (IAEA)
N4	1450 MWe nuclear reactor series (EDF)
OECD	Organization for Economic Cooperation and Development
OMF	Optimisation de la Maintenance par la Fiabilité (reliability centred maintenance)

OPECST	Office Parlementaire d'Évaluation des Choix Scientifiques et Technologiques (French Parliamentary Office for the assessment of scientific and technological options)
OPRI	Office de Protection contre les Rayonnements Ionisants (Office for Protection Against Ionising Radiation – until 2002)
ORL	Oto-Rhino-Laryngologie (Ear Nose and Throat)
OSART	Operational SAfety Review Team (IAEA)
OSPAR	Convention for the Protection of the Marine Environment of the North-East Atlantic, signed in 1992 and combining and updating the Oslo 1972 and Paris 1974 conventions
PAI	Plan d'Actions Incendie (fire-fighting action plan)
PASEPRI	Plan d'Action pour la Surveillance de l'Exposition des Patients aux Rayonnements Ionisants (action plan for monitoring patient exposure to ionising radiation)
PBMR	Pebble Bed Modular Reactor (reactor project – South Africa)
PCC	Poste de Commandement Contrôle (command and control post – evaluation of consequences and measures)
PCD	Poste de Commandement Direction (Strategic Management Command Post)
PCL	Poste de Commandement Local (local command post – installation operation)
PCM	Poste de Commandement Moyens (Logistic Management Command Post)
PCR	Personne Compétente en Radioprotection (person with competence for radiation protection)
PET	Positon Emission Tomography (camera)
PETSCAN	PET camera coupled with a scanner
PF	Produits de Fission (fission product)
PHARE	Poland and Hungary Assistance for Reconstruction of Economy (European Union programme for aid to the countries of central and eastern Europe)
PIC	Programme d'Investigation Complémentaire (additional investigation programme – EDF)
PMSI	Programme Médicalisé des Systèmes d'Information (medicalised programme for information systems)
PNGDR	Plan National de Gestion des Déchets Radioactifs (French national radioactive waste management plan)
PNSE	Plan National Santé Environnement (French national health environment plan – to reduce the effects of environmental damage on the health of the population)
PPI	Plan Particulier d'Intervention (offsite emergency plan)
PRER	Pôle de Radioprotection Environnement et Risques (radiation protection, environment and risks centre)

PRI	Protection Radiologique Intégrée (integrated radiological protection)
PROSPER	Peer Review of the effectiveness of experience feedback system (IAEA assessment)
PSI	Programme de Suivi de l'Irradiation (irradiation monitoring programme – PWR)
PSRPM	Personne Spécialisée en RadioPhysique Médicale (medical radiophysics specialist)
PSS	Plan de Secours Spécialisé (specialised emergency plan)
PSS-TMR	Plan de Secours Spécialisé Transport de Matières Radioactives (specialised emergency plan for the transport of radioactive materials)
PTB	Plage de Travail Basse (low operating range – PWR)
PTR	Reactor cavity and spent fuel pit cooling and treatment system – PRW
PUI	Plan d'Urgence Interne (onsite emergency plan)
PWR	Pressurised Water Reactor
P4	first series of 1300 MWe nuclear reactors (EDF)
P'4	second series of 1300 MWe nuclear reactors (EDF)
RADWASS	RADioactive WAste Safety Standards (IAEA)
RAMG	Regulatory Assistance Management Group (EU – project to provide technical assistance to the safety authorities in eastern Europe)
RASSC	RAdiation Safety Standards Committee (IAEA)
RCC	Règles de Conception et de Construction (design and construction rules)
RCC-E	RCC for electrical equipment
RCC-G	RCC for civil engineering
RCC-M	RCC for mechanical equipment
RCD	Reprise et Conditionnement des Déchets (waste recovery and packaging)
RCV	circuit de contrôle Chimique et Volumétrique (chemical and volume control system – PWR)
RBE	Relative Biological Effectiveness
REX	Retour d'Expérience (operating feedback)
RFS	Règle Fondamentale de Sûreté (basic safety rule)
RGE	Règles Générales d'Exploitation (general operating rules)
RHF	Réacteur à Haut Flux (high flux reactor – Institut Laue-Langevin)
RIA	Radio Immunology Assay

RIC	système d'instrumentation du cœur (in-core instrumentation system – PWR)
RID	Regulations concerning the International carriage of dangerous goods by rail
RIS	circuit d'Injection de Sécurité (Safety injection circuit – PWR)
RIVM	Dutch national institute for Public Health and the Environment
RJH	Réacteur Jules Horowitz (Jules Horowitz reactor – irradiation reactor project: CEA)
RNR	Réacteur à Neutrons Rapides (fast neutron reactor)
RPS	Rapport Préliminaire de Sûreté (preliminary safety analysis report)
RRA	circuit de Refroidissement du Réacteur à l'Arrêt (residual heat removal system – PWR)
RRI	circuit de Refroidissement Intermédiaire (component cooling system – PWR)
RSE-M	Règles de Surveillance en Exploitation des matériels Mécaniques (rules for in-service monitoring of mechanical equipment)
RSN	Règlement relatif à la Sécurité des Navires (regulations for the safety of ships)
RTGV	Rupture de Tube de Générateur de Vapeur (steam generator tube break)
RTV	Rupture de Tuyauterie Vapeur (steam line break)
RUS	Réacteur Universitaire de Strasbourg (Strasbourg University reactor)
RWMC	Radioactive Waste Management Committee (NEA)
SCR	Service Compétent en Radioprotection (radiation protection department)
SAMU	Service d'Aide Médicale Urgente (French emergency medical service)
SCHAPI	Service Central d'Hydrométéorologie et d'Appui à la Prévision des Inondations (Central Hydrometeorology and Flood Prediction Support Department – French Ministry for the Environment/water division)
SCSIN	Service Central de Sûreté des Installations Nucléaires (Central Nuclear Installations Safety Department – replaced by the DSIN in 1991)
SEC	circuit d'Eau brute Secourue (essential service water system – PWR)
SENA	Société d'Énergie Nucléaire franco-belge des Ardennes (Ardennes Franco-Belgian nuclear energy company) (operated the Chooz plant until 1996)
SEPTEN	Service Études et Projets Thermiques Et Nucléaires (Design Department for Thermal and Nuclear Projects – EDF/DIN)
SFBMN	Société Française de Biophysique et de Médecine Nucléaire (French association for biophysics and nuclear medicine)
SFEN	Société Française d'Énergie Nucléaire (French nuclear energy society)
SFPM	Société Française de Physique Médicale (French medical physics society)

SFR	Société Française de Radiologie (French radiological society)
SFRO	Société Française de Radiothérapie Oncologique (French oncology radiotherapy society)
SFRP	Société Française de RadioProtection (French radiation protection society)
SGCISN	Secrétariat Général du Comité Interministériel de la Sécurité Nucléaire (General secretariat of the French interministerial commission for nuclear security) (until 2003)
SGDN	Secrétariat Général de la Défense Nationale (French General Secretariat for National Defence)
SI-ASN	Système d'Information de l'Autorité de Sûreté Nucléaire (French Nuclear safety authority's information system)
SICN	Société Industrielle de Combustible Nucléaire (industrial nuclear fuel company)
SIGIS	Système d'Information de la Gestion et de l'Inventaire des Sources (Source inventory management information system)
SIRCOM	Service de la COMmunication (Communication department – French Ministry of the Economy, Finance and Industry)
SISE-Habitat	Système d'Information Santé Environnement sur l'habitat (environment habitat health information system)
SISE-RI	Système d'Information Santé Environnement-Rayonnements Ionisants (environment-ionising radiation health information system)
SISE-Eau	Système d'Information Santé Environnement-Eau (environment-water health information system)
SITOP	SITe Optimisation (SITOP project about organisation change at COGEMA La Hague)
SKI	Swedish Nuclear Safety Authority
SMHV	Séisme Maximal Historiquement Vraisemblable (maximum historically probable earthquake)
SMS	Séisme Majoré de Sécurité (design basis earthquake)
SNCS	Société Normande de Conserve et de Stérilisation (Norman Company for Sterilization)
SNM	Système Nucléaire Militaire (military nuclear system – weapons system designed or adapted to deploy a nuclear weapon, or military ship with nuclear propulsion)
SNRCU	State Nuclear Regulatory Committee of Ukraine
SOCATRI	SOCiété Auxiliaire du TRIcastin (Tricastin auxiliary company – clean-up and uranium recovery)
SOCODEI	SOciété pour le COnditionnement des Déchets et Effluents Industriels (company for industrial effluent and waste treatment)
SOMANU	SOciété de MAintenance Nucléaire (Maubeuge) (nuclear maintenance company)

SPF	Stockage de Produits de Fission (fission products disposal – SPF shops – COGEMA – La Hague)
SPN	Section Permanente Nucléaire de la CCAP (standing section of the CCAP for nuclear matters)
SPRA	Service de Protection Radiologique des Armées (French army radiological protection service)
SSI	Swedish radiation protection authority
STA	Science and Technology Agency (Japan)
STAR	Station de Traitement, d'Assainissement et de Reconditionnement (Treatment, cleanup and reconditioning station – CEA – Cadarache)
STD	Station de Traitement des Déchets (waste treatment station)
STE	– Spécifications Techniques d'Exploitation (technical operating specifications) – Station de Traitement des Effluents (effluent treatment station)
STEDS	Station de Traitement des Effluents et des Déchets Solides (radioactive effluent and solid waste treatment station)
STUK	Finnish Nuclear Safety and Radiation Protection Authority
SÚJB	Czech Nuclear Safety Authority
TACIS	Technical Assistance to the Commonwealth of Independent States (EU aid programme)
TAR	Tour AéroRéfrigérante (cooling tower)
TENORM	Technologically Enhanced Naturally Occuring Radioactive Materials
TEP	Traitement des Effluents Primaires (boron recycle system – PWR)
TFA	Très Faible Activité (Very Low Level waste)
TMR	Transport de Matières Radioactives (radioactive material transport)
TRANSAS	TRANsport Safety Appraisal Service (AIEA delegation to assess the organisation of radioactive materials transport and application of the corresponding international regulations)
TRANSSC	TRANsport Safety Standards Committee (IAEA)
TVO	Teollisuuden Voima Oy (Finnish electricity utility)
EU	European Union
ÚJD	Slovak Nuclear Safety Authority
UKEA	United Kingdom Environmental Agency
UN	United Nations

UNGG	Uranium Naturel Graphite Gaz (former gas-cooled nuclear reactor technology)
UNIPE	Unité Nationale d'Ingénierie du Parc en Exploitation (corporate operational NPP engineering department – EDF)
UNSCEAR	United Nations Scientific Committee on the Effects of Atomic Radiation
UOX	uranium oxide based fuel
UTE	Union Technique de l'Électricité et de la communication (technical union of electricity and communication)
UTO	Unité Technique Opérationnelle (operational technical unit – EDF)
VATESI	Lithuanian Safety Authority
VD	Visite Décennale (ten-yearly outage)
VDS	Visite De Surveillance (supervisory inspection)
VD2	2nd ten-yearly outage
VD3	3rd ten-yearly outage
VP	Visite Partielle (partial inspection)
VVP	Vapeur Vive Principale (Main Steam System – PWR)
WANO	World Association of Nuclear Operators
WASSC	WAste Safety Standards Committee (IAEA)
WATRP	Waste management Assessment and Technical Review Programme (IAEA expertise)
WENRA	Western European Nuclear Regulators' Association (extended in 2003 to all "nuclear" States that are members of the European Union or currently negotiating membership)
WGIP	Working Group on Inspection Practices (NEA)
WHO	World Health Organisation
www.asn.gouv.fr	Address of the Nuclear Safety Authority website

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