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The year 2003 saw no major events affecting nuclear safety, despite a number of alerts, in particular due to exceptional meteorological conditions. It saw the Nuclear Safety Authority devote considerable efforts to developing its radiation protection activities. 2003 was also marked by the effective implementation or the announcement of major decisions affecting the nuclear industry and concerning nuclear safety and radiation protection.

Facilities subject to the control of the Nuclear Safety Authority experienced no significant events in 2003. We could even say that the year saw few incidents classified at significant levels on the INES scale. This overall tendency should not however mask a number of trends which call on us to maintain a high level of vigilance.

First of all, the expanded scope of responsibility of the Nuclear Safety Authority now leads it to look at new types of incidents, occurring in places which hitherto were not within its remit: thus significant exposure of two operators from a control agency was detected during the use of gammagraphs in non-nuclear installations such as refineries. Similarly, a leak of radioactive waste from a hospital pipe and the destruction of a radioactive control source by a maintenance error in a brewery are both incidents which fortunately had no effect on the persons involved, but do reveal the potential dangers that exist for a large number of radioactivity users.

One must also point out that a closer examination of the design and operating conditions of existing installations, the situation of which had been felt to be on the whole satisfactory, can lead to the discovery or re-discovery of risks hitherto underestimated. This is in particular what happened with re-assessment of the seismic risk for the power plants operated by EDF, or with re-examination of the possibility of sump clogging in the reactor buildings in these same plants in the event of a primary leak, which led to the declaration of a level 2 incident on the INES scale and the announced plan for modification of all the reactors. Bringing such risks to light is not in itself a sign of falling safety levels, but rather a means of taking safety forwards by coming back to problems which had incorrectly been considered resolved. This can only encourage the Nuclear Safety Authority to continue with its program of systematic re-assessment of facility safety at intervals which are normally of ten years, in order to highlight and insofar as is possible deal with any of the more shadowy areas in the existing safety files.

Finally, it is striking to note that during the course of 2003 alone, two types of exceptional meteorological conditions affected the nuclear facilities: heat wave and drought in the summer, then flooding in the autumn. In the first case, safety was at no point compromised, in that no safety-related operating parameter in the facilities was reached or exceeded, but the temperature of the discharges, which can affect the environment, temporarily had to be modified to enable the plants to continue to operate and avoid electrical power cuts. In the second case, we were able to see that the work done on the flooding risk following the late 1999 episode at the Le Blayais plant has borne fruit, since no nuclear facility was actually flooded. However, the exceptional flowrates of the rivers and the material carried by them lead to fouling of the water intakes at two plants, causing EDF to effect preventive shutdown of four reactors. The possibility of such climatic episodes becoming more frequent in the coming years, means that we have to place yet more emphasis on prevention.

Overall, nuclear power plant operations by EDF offer a mixed picture for 2003. Progress has been achieved in working methods regarding staff radiation protection, in particular during maintenance work, and results are improving. From the safety viewpoint, however, greater strictness and thoroughness is required in day to day operations.

Special mention must be made of the operating conditions of the CIS bio International establishment. This establishment, which fabricates short-lived radioactive sources designed for medical and pharmaceutical applications, is hosted in the Saclay Centre by the CEA, which remains the de-jure operator, even if the Schering international pharmaceutical group is now really the owner. The CIS bio establishment at Saclay drew attention to itself throughout 2003, with a series of incidents, each of which was not in itself particularly serious, but their repetition indicates a lack of compliance with the requirements of the Nuclear Safety Authority and the general principles of safety and radiation protection. Despite more frequent controls on-site, the situation failed to improve by the end of the year. Considerable efforts will be necessary if this establishment is to continue to operate, given the fact that it is particularly useful for nuclear medicine activities in France and abroad.

2003 was also a year that saw the Nuclear Safety Authority increase its activities in the field of radiation protection. Work on drafting regulations continued in this area, with the aim of completing transposition of the European directives as rapidly as possible. After the 2001 ordinance and the decree on the protection of populations in 2002, the remaining three decrees were signed in March 2003, concerning patient protection, worker protection and radiological emergency response respectively. These decrees themselves entail several dozen implementing orders, which the Nuclear Safety Authority is now in the process of preparing, whenever necessary with the help of the other ministries concerned, in particular the Ministry for Labour. Some of these ministerial orders have already been published.

More specifically with regard to patient protection, this regulatory work was accompanied by preparation of a plan of action which aims to set up and develop an exposure surveillance program. This plan, which is coordinated by the Nuclear Safety Authority, will be the first step towards creating a system designed to collate all information needed to ascertain patient exposure, thus giving a clearer picture of the effectiveness of the optimisation work done in collaboration with the sector professionals, and enabling epidemiological studies to be conducted, targeted on the patient groups subjected to the highest doses.

Much has been done to better define and organise the actions of the Nuclear Safety Authority in the field of radiation protection and several working groups were active during the course of 2003: one advisory committee, chaired by Professor Vrousos, gave consideration to radiation protection priorities; another followed up the lessons learned from the « reconnaissance mission » conducted in two pilot regions, Rhône-Alpes and Basse-Normandie, to identify stakeholders and contacts and prepare for a radiation protection inspection; two committees were devoted to regional services, one looking into the role of the Regional and Departmental Directorates of Health and Social Affairs, the other into the internal organisation of the Regional Directorates for Industry, Research and the Environment, with regard to controlling radiation protection.

Based on the conclusions of this work as a whole, I believe that in 2004, true radiation protection inspections could be launched, region by region, with the aim of setting up an effective system covering the entire country within the next 5 years. On this basis, I also believe that during the course of 2004, it will be possible to propose an interministerial debate on specifics action to strengthen radiation protection around topics such as radon-related risks or the use of radioactive sources, or to improve application of the regulations covering protection of workers and patients. Organisation of the scientific watching brief on the health effects of ionising radiation and training in radiation protection for the coming generations will also be subjects worth examining.

At the beginning of this introduction I mentioned that 2003 had been marked by major decisions affecting the nuclear industry. Thus at the beginning of the year, decisions were taken that had been under preparation for a long time: the new definition of the operating domain of the COGEMA spent fuel reprocessing plant at La Hague, the transition to surveillance phase of the Manche repository operated by the ANDRA near La Hague, the rise capacity in production from the MELOX plant fabricating MOX fuel in Marcoule together with the cessation of industrial production by the ATPu plant in Cadarache and power restart of the Phenix fast neutron reactor in Marcoule, are all examples.

Towards the end of the year, other important decisions were raised. Some of these decisions have already been taken by the industrial managers and the corresponding regulatory procedures are either under way or on the point of being initiated: this is the case with construction of a water test loop for the Cabri reactor in Cadarache, designed for accident studies, installation in Cadarache of the Jules Horowitz experimental reactor, which is to replace several of the CEA’s ageing research reactors and the replacement in Tricastin of the Eurodif gaseous diffusion uranium enrichment facility by a new plant using the more modern ultracentrifugation process. Other projects are currently still pending. For instance, installation in Cadarache, the chosen European site, of the ITER nuclear fusion demonstration reactor, is still waiting for a decision from the international consortium set up for this operation, and the decision to build an EPR type power reactor in France, following that ordered by a Finnish electricity utility, has yet to be taken.

In any case, the Nuclear Safety Authority is doing its utmost to look to the future, by keeping abreast of the intentions of industry and increasing its informal contacts prior to presentation of official authorisation application files, so that it can influence the safety options adopted and avoid the risk of finding itself faced further down the line with safety or radiation protection problems that are hard to solve.

The activities of the Nuclear Safety Authority are increasingly international in nature. This is particularly obvious in the field of radiation protection, where for a long time, standards have been applicable internationally. This is increasingly the case in the field of nuclear safety. International conventions, which France immediately signed, have in recent years provided a supervisory framework firstly for reactor safety and then for the safety of radioactive waste and spent fuel. The desire to harmonise the applicable rules is also appearing at a European level: the European Commission thus drafted two directives, known as the «nuclear package» in these fields. For their part, the Nuclear safety authorities of the European countries, within the WENRA forum, have already undertaken a program of harmonisation of technical rules in these same two areas.

Along the same lines as the above, the subject of radioactive waste was one of those which mobilised the Nuclear Safety Authority during the year. In this area, one must underline France’s participation in the first meeting to examine the national reports drawn up under the above-mentioned Joint Convention on the Safety of Spent Fuel Management and the Safety of Radioactive Waste Management. France’s report, which aimed to be exhaustive and hide nothing of the difficulties encountered, aroused considerable interest and generated much debate. On a more domestic note, and after approval by the ministers with responsibility for nuclear safety and radiation protection, 2003 saw the launch of the national radioactive waste management plan (PNGDR) which had been recommended by the Parliamentary Office for the assessment of scientific and technological options. This plan, which was jointly drafted with all interested partners, including elected representatives and environmental defence associations, should produce a complete overview of all categories of radioactive waste that exist in France, leaving nothing out, and a definition of guidelines for its disposal. With regard to the particular category of high-level, long-lived waste, for which the areas of research were defined in a 1991 law, the Nuclear Safety Authority naturally remained highly attentive to the work done in these areas: separation and transmutation of radionuclides (studies conducted by the CEA), study of deep geological disposal (work conducted by the ANDRA in its Bure underground laboratory, at which excavation resumed in March following a lengthy interruption owing to a fatal accident involving a worker), packaging and long-term surface or sub-surface storage (work conducted by the CEA). Although all of these studies are behind the initial schedule, results should be available for presentation to Parliament within the timeframe stipulated by the law.

With regard to the preparation for emergency situations, it is worth mentioning the reform introduced by doing away with the Interministerial Committee on Nuclear Safety, which was in particular responsible for coordination in the event of a nuclear emergency and which had a permanent general secretariat, and the creation of the Interministerial Committee for nuclear or radiological emergencies, an organisation that would only be activated in the event of a real crisis, and for which the secretariat is entrusted to the Secretariat-General for National Defence. With the backing of the Secretariat-General for National Defence, this new organisation was an opportunity to overhaul the national instructions for nuclear crises and for preparing post-accident plans. The Nuclear Safety Authority is obviously extensively involved in this work. The Nuclear Safety Authority has also initiated revision of the folder of response cards entitled «Medical response to a nuclear or radiological event» to take better account of the new zone-based organisation. In 2003, more than 200 medical emergency professionals were trained in handling the nuclear and radiological risk in the various defence zones.

In 2003, another factor in preparing for emergency situations was the creation of a toll-free telephone number which in particular enables the various Prefectures to contact a Nuclear Safety Authority supervisor round the clock, seven days a week. Until now, the system only existed for the larger nuclear facilities which, in the event of a serious incident or an accident could trigger a national alert activating the Nuclear Safety Authority’s emergency centre; from now on, events of lesser importance, which do not necessarily require activation of an emergency centre but which do require advice, or possibly the dispatch of a response team to the site, will also be handled without delay.

In the field of public information, and despite the lack of truly significant events, the Nuclear Safety Authority observed growing media interest in information about nuclear safety and radiation protection. It has done its best to provide answers, either at periodic meetings with the press, or on more specific occasions. 2003 also enabled the Nuclear Safety Authority to set up a public information centre in its premises at 6 place du Colonel Bourgoin in Paris, where documents concerning nuclear safety and radiation protection can be freely consulted. This centre should open its doors to the public in early 2004.

Information and documentation center of ASN

This round-up of the past year should not make us forget that important changes are just around the corner. I need simply mention the forthcoming transformations to the legislative and regulatory framework within which we work: at a European level, the draft directives already mentioned concerning nuclear safety and radioactive waste respectively, are already under preparation. In France, a bill concerning nuclear transparency and safety, now a part of the energy bill, should increase transparency requirements, renovate the regulatory framework governing basic nuclear installations, and create a true system of radiation protection inspections. The Nuclear Safety Authority, which helped draft these texts, will naturally be involved in finalising and implementing them. The economic context, with the nuclear operators increasingly faced with competition, is also experiencing considerable upheaval; the possible change in the status of EDF and the partial sell-off of AREVA - the parent company of the operator COGEMA and manufacturer Framatome - are being closely looked at by the Nuclear Safety Authority.

Alongside the Nuclear Safety Authority, the Institute for Radiation Protection and Nuclear Safety (IRSN) which is its main technical support body, also experienced significant change. I have always felt that the presence of a robust and competent assessment body alongside the regulatory Authority was a guarantee of our joint efficiency. 2003 saw the IRSN finally given a Chairman, a Board and a Director General, enabling it to define a new organisation, ideally suited to the duties entrusted to it. I am pleased to note that these major changes were implemented with no significant interruption in the provision of the evaluation and appraisal services it provides to the Nuclear Safety Authority. This new organisation was also put in place in parallel with a debate concerning extension of these services to new sectors, in particular that of radiation protection.

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Everything I have just mentioned would of course be impossible without a rise in workforce numbers. The Government had accepted the principle of creating 225 jobs, including 150 radiation protection inspectors, and has taken steps in this direction, leading to the creation of 22 of these high-priority posts in 2003, with a further 22 in 2004. I am pleased to see these positions being effectively created and the Nuclear Safety Authority, which is already a melting-pot of various cultures, from the engineering background of nuclear safety control officers to the medical background of those involved in radiation protection problems, has shown itself capable of integrating persons offering the most original profiles, and hired on a contractual basis. This marriage of cultures, which is essential to our many and varied duties, is in my opinion one of the Nuclear Safety Authority's greatest successes.

André-Claude LACOSTE

MAIN TOPICS IN 2003

1 – Nuclear Safety and Transparency bill

2 – The safety of the EPR reactor project

3 – Radiation protection priorities

4 – Towards radiation protection inspection

5 – Action plan for monitoring patient exposure to ionising radiation

6 – The summer 2003 heat wave and drought and nuclear power plant operations

7 – The national plan for radioactive waste management

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

9 – The European nuclear package

1 Nuclear Safety and Transparency bill

The Nuclear safety and transparency bill, tabled before the Senate on 18 June 2002 by the Minister for Ecology and Sustainable Development was, with a few amendments, incorporated into the guideline energy bill, of which it now constitutes section V.

Following the report submitted by the deputy of Meurthe-et-Moselle, Jean-Yves Le Déaut, to the Prime Minister on 7 July 1998, « on the French system of radiation protection, control and nuclear safety » it will give a 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 control. This obligation is implemented in conditions laid down by decree of the Conseil díEtat, 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 bill gives the key definitions and main principles 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 control 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 bill organises nuclear transparency

The Government’s duties in the field of informing the public are clarified: it is responsible for informing the public concerning the nuclear safety and radiation protection control procedures and results and presents to Parliament the report produced by the Nuclear Safety Authority every year.

The right to access the 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 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 control.

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 bill revises the administrative framwork for nuclear facilities, clarifies and reinforces the system of controls 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 decree n∞†63-1228 of 11 December 1963. 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 legal 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 classified installations. In terms of administrative and penal sanctions, 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.

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

4 - The bill sets up a new framework for specialised radiation protection inspection

These provisions reinforce the current system, in particular in care establishments and research centres using radioactive sources. They supplement the nuclear safety and radiation protection control reforms and the reorganisation of the services in charge of this control, which took place in 2002.

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On 7 November 2003, the Minister for Ecology and Sustainable Development announced that these legislative provisions were available for consultation on the web site of the Directorate General for Nuclear Safety and Radiation Protection and on that of the Ministry for Ecology and Sustainable Development.

The bill should be tabled before Parliament in 2004.

2 The safety of the EPR reactor project

The specified safety goals

Even if the safety of the reactors today operating in France is felt to be satisfactory, the ASN believes that any plan for a new generation of nuclear power plants must attain a higher level of safety.

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

• the number of incidents will have to fall, in particular by improving systems reliability and by taking greater account of human factors related aspects;

• the risk of core meltdown must be reduced still further;

• any radioactive releases which could result from all and any conceivable accidents must be minimised;

- for accidents without core meltdown, measures to protect the populations living in the vicinity of the damaged plant should not be necessary (no evacuation or sheltering);

- for accidents with low-pressure core meltdown, measures to protect the populations 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 for their part be « practically eliminated ».

Finally, owing to operating experience acquired from reactors in service, the ASN also asked that the operating constraints and human factors related aspects be taken into account from the design stage onwards, particularly in order to improve worker radiation protection, limit radioactive discharges and the quantity and activity of the waste produced.

Examples of improvements resulting from the EPR project

These goals led the designers of the reactor to propose a certain number of safety improvements, including the following examples:

- with regard to reducing the risk of accidents, significant strengthening of the civil engineering work on the nuclear island to offer greater protection against external hazards, including earthquakes, industrial explosions and aircraft crashes (on this point, studies are currently under way to improve reactor protection against events

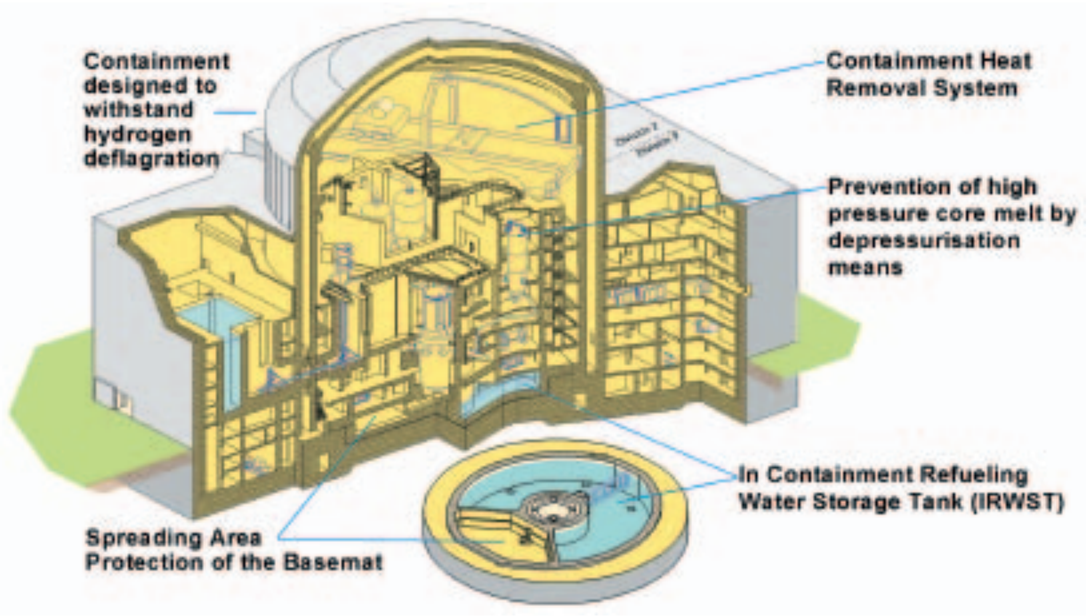


Diagram of an EPR type reactor

such as those that occurred in the United States on 11 September 2001);

- with regard to designing-in serious accident management, positioning under the reactor of a device specially designed to catch, contain and cool the molten core;

- with regard to taking account of human factors in accident management, the design should leave the operators greater time before their intervention becomes necessary.

The EPR 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 organizations 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 certain German experts continue to take part in technical evaluation of the project.

Furthermore, the Finnish electricity production utility TVO, after issuing an international call for bids for the construction of a new reactor, announced its intention to ask the Finnish nuclear safety authority (STUK) for a license for an EPR reactor with the aim of starting work in early 2005. In this context, the Finnish and French nuclear safety authorities naturally decided to work together and harmonise their stances as far as possible.

The position of the French Nuclear Safety Authority

After examining the major safety options for the project presented by the builder, the French Nuclear Safety Authority considers that on the whole they meet the goals defined in 1993.

The ASN also asked that the new design requirements for the EPR project and the results of the R&D programs be used as comparative data for the periodic safety reviews of the 900 MWe reactors, on the occasion of their third ten-yearly inspection.

3 Radiation protection priorities

The role of the advisory committee

Under the authority of the Minister for Health, the Directorate General for Nuclear Safety and Radiation Protection is responsible for drafting and implementing Government policy in the field of radiation protection, defining the main guidelines for the long-term actions of the Government's departments over the coming years, in particular those concerning inspection.

To establish these guidelines and then define the corresponding action plans, the DGSNR wished to obtain opinions and proposals from a group of personalities of recognised expertise in the field of radiation protection. A letter was therefore sent on 23 December 2002 to Professor Constantin Vrousos, chairman of the committee, asking him to select the priority radiation protection fields for which action is required, taking account both of the health aspects and how they are perceived by the various components of society. The letter stressed the benefit to be gained from polling the widest possible variety of opinion, whether specialised or not in this field, in particular opinions from outside the radiation protection world, for example through interviews with elected, media and association representatives. Taking account of the priorities adopted in other European countries was also mentioned.

CAT scan of the thorax

Composition of the advisory committee

Chairman: M. Constantin Vrousos, Oncology-radiotherapy, University hospital, Grenoble.

Committee members

- Mr Bernard Aubert (medical physics, Institut Gustave Roussy then IRSN)
- Mr Dietrich Averbecq (radiobiology, National Centre for Scientific Research (CNRS))
- Mr Pierre Barbey (biochemistry, Caen University)
- Mr Bernard Basse-Cathalinat (nuclear medicine, University hospital, Bordeaux)
- Mr Yves-Sébastien Cordoliani (medical imaging, Val-de-Grâce Hospital)
- Mr Jean-Michel Giraud (occupational medicine, French Atomic Energy Commission)
- Mr Michel Jouan (epidemiology/risk evaluation, Health Monitoring Institute)
- Mr Eric Lartigau (radiotherapy, Centre Oscar Lambret, Lille)
- Mr Jacques Lochard (Nuclear protection evaluation research centre)
- Mr Serge Prêtre (Swiss expert)

The advisory committee recommendations

This task mobilised the group for 12 months, involving 16 meetings and 38 hearings. The experience of Switzerland, the United Kingdom and Sweden was also analysed, with a delegation sent to the National Radiation Protection Board (NRPB) and the Swedish radiation protection authority (SSI).

The committee's report was submitted to the DGSNR in early February 2004 and can be consulted on the ASN's website (asn.gouv.fr). This report comprises recommended actions, with the priority actions being identified, and includes the reports of all the hearings conducted.

Subsequent action taken by the ASN

Further to these recommendations, the ASN has already decided that fresh actions will be need-

Extract from the summary of the « Radiation protection priorities » report

... guidelines for fundamental subjects...

Adhering to the principle of precaution, the « Radiation Protection Priorities » group recommended that the current radiation protection debate among the experts be focused on reducing the doses received by the people (public, patients and workers). This debate is required in all fields, without exclusion, wherever exposure can be controlled. It should accompany implementation of the principles of justification and optimisation, recently enshrined in law, and which are to be followed by users of ionising radiation sources, whether in industry, medicine or research, but also by the public authorities who are in particular responsible for assigning and allocating public health resources.

In terms of method, and faced with the demands of an increasingly concerned society, in a context of doubt concerning the credibility of the official line, both that of the authorities and of the scientific community, the « Radiation Protection Priorities » group recommended, at least on an experimental basis, new forms of consensus with the « stakeholders » and new forms of decision-making based on transparency, democracy and a wide-ranging base of expertise. Radiological risk management could be an example for all industrial activities which entail a risk.

These new forms of consensus involving the « stakeholders » should also take in communication, in particular by the authorities, information of the citizens about the radiological and nuclear risks and training of the radiation protection players. Strong action must also be taken to ensure that secondary education curricula include the physical and biological basics of the effects of ionising radiation, its various applications and radiation protection, as part of a program of civic studies covering the environment and sustainable development.

Furthermore, faced with the relatively minor influence of French expertise in the international radiation protection bodies, the urgent need to organise exchanges between the various units in France involved in radiation protection related research was stressed. These exchanges should enable a true scientific watching brief to be organised, on a transparent and wide-ranging basis, informing experts and decision-makers of new scientific data, up to and including a periodic critical analysis of these data.

Following the example of Britain, the « Radiation Protection Priorities » group also recommended that alongside a scheduled strengthening of inspection means, user consultancy activities should also be developed, taking the form of services or practical management tools, stressing the role that the public authorities could play in this field. It asked the administrations in charge of radiation protection inspection to take a look at what already works successfully abroad, in particular in the countries of the European Union, and to develop cooperation between approved entities. In the inspection field, the group drew the attention of the Director General for Nuclear Safety and Radiation Protection to the medical radiology sector, where efforts are needed to reduce exposure: prior to the inspection, information and awareness-raising of the medical body concerned is required.

More specifically, the « Radiation Protection Priorities » group familiarised itself with the actions recently initiated by the authorities, in particular those concerning the creation of a centralised system for worker exposure monitoring results (SISERI) and a plan of action for monitoring patient exposure to ionising radiation, the preparation of a national radioactive waste management plan and the creation of the national environmental radiological monitoring network. Its proposals support these various initiatives by clarifying the essential points to be taken into account during their practical implementation.

The question of managing the radon risk, which is still the subject of controversy in France, was also examined. On this point, the « Radiation Protection Priorities » group felt that it is important to continue research into estimating the radon-related risk to the population as a whole, but at the same time to continue to consider defining construction standards for new-build homes and reducing exposure in homes with high concentrations.

France still does not have a true risk management strategy for dealing with the major contamination that would result from a nuclear accident or malicious act leading to long-term exposure of the population. The experts were amazed by the lack of any official programme for defining a strategy for the social and economic management of the areas thus contaminated, be they urban or rural, which would take account of health monitoring of the populations, radiological monitoring of the environment and foodstuffs, and development of a practical radiology culture within the population.

... short-term actions...

Going beyond these recommendations concerning fundamental subjects, the experts identified seven steps to be taken immediately or initiated without delay:

1. Boost the quality and supervision of radiation protection of high level sources, in particular in the field of industrial gammagraphy.

2. As part of the work to set up the centralised system for worker exposure monitoring results (SISERI), schedule the resumption of dosimetry data logging.

3. With a view to subsequent European-wide harmonisation, confer operational status on the existing regulatory provisions concerning individual management of the exposure of roaming workers.

4. Give thought to the non-BNI radiation protection trades (in particular the agent conversant with radiation protection), specifying training, areas of competence and the organisation of intervention conditions, even if this involves changing current regulations.

5. Set up an information and advisory system (toll-free telephone number for instance) for doctors and patients faced with the problem of exposure to ionising radiation during pregnancy.

6. For new and existing installations, make it mandatory to set up a system providing information on the quantity of radiation emitted during paediatric radiology procedures.

7. Check the pertinence of the radiological examinations requested, in particular by sports federations, insurance companies and even the public authorities.

ed to reinforce radiation protection on specific topics such as management of the radon risk or the use of radioactive sources, or to facilitate application of the regulations concerning protection of workers and patients. Organisation of the scientific watching brief on the effects of ionising radiation on health, plus the training of future generations will also need to be closely examined.

On the basis of this work, the ASN will in 2004 draw up a guideline program of work which, under the authority of the Minister for Health, it will submit for interministerial discussion. Although some of the recommendations from the advisory committee are the sole and direct responsibility of the ASN, most of them involve many ministerial departments (Ministries of Labour, Construction, National Education, Research, Agriculture, Ecology and Sustainable Development, Defence, and so on). For a number of the recommendations, the links with programs that either exist or are under preparation and which are run by other organisations or administrations (e.g.: national health and environment plan, cancer plan, etc.) will have to be clarified.

Finally, in 2004, the long and meticulous work to identify the sectors in which inspections by the ASN should be given priority status will have to be put to good use. For example, we will be paying particularly close attention to defining the methods for evaluating and controlling patient radiation protection, jointly with the health professionals

4 Towards radiation protection inspection

Since it was created in 2002, the DGSNR has worked at organising and developing the inspection of radiation protection outside BNIs. Identification of control priorities, definition of action procedures and deployment of the necessary workforce are all being carried out in parallel.

The ASN is devoting attention to setting up an effective and well-proportioned control system, drawing on the experience of the personnel from the permanent secretariat of the CIREA and OPRI who have joined it, and relying on the State's regional services, whose actions in the field are under its responsibility. The ASN also listens closely to the parties concerned by the use of ionising radiation and keeps an open mind with regard to foreign practices.

The nuclear transparency and safety bill comprises provisions which will be such as to back-up the regulatory tools in this inspection system, which will achieve maturity with the gradual addition of the one hundred and fifty inspectors.

ASN actions to prepare radiation protection inspection

With this aim in mind, the Director General for Nuclear Safety and Radiation protection decided that two DRIREs, in the Basse-Normandie and Rhône-Alpes regions, would carry out a « reconnaissance » mission until the end of 2003, in order to initiate radiation protection control practices in non-BNI areas. This mission is carried out in parallel with another mission, entrusted by the Director General for Nuclear Safety and Radiation Protection to an independent advisory committee, responsible for proposing action priorities in the radiation protection field. At the same time, a working group comprising representatives of the DRIRE, DRASS and DDASS was tasked with drawing up procedures for collaboration between the entities in this field. Finally, a working group consisting of representatives of the ASN, the DARPMI and the DRIREs was asked to give thought to the future organisation of the DRIREs with a view to increasing their workforce to take account of radiation protection control.

The lessons of the reconnaissance mission

The primary goal of the «reconnaissance» mission was to identify the scope of radiation protection control by the DSNRs by identifying the ASN's local contacts and the radiation protection issues. It also aimed to begin to define the content of radiation protection inspections. For the duration of this mission, the ASN's actions were carried out with no consideration being given to inspection.

This mission comprised two phases: learning and understanding, then preparing to inspect.

- Learning and understanding

The aim was to identify which local stakeholders were concerned in one way or another by radiation protection control, to understand their duties and how they work and to get in touch with them to explain the ASN's role. The local stakeholders are on the one hand institutional, in other words representatives of the State'sregional and departemental services, and on the other the users of ionising radiation. Contacts were also made with organisations approved by the Ministry for Labour, which exercise a first level of control over the users of ionising radiation.

This phase highlighted the need for close collaboration with the many institutional stakeholders concerned, among which we must mention inspection of classified installations in the DRIREs, the 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 departments, the services of the Ministry for Labour (Departmental Directorates for Labour, Employment and Training, Regional Directorates for Labour, Employment and Training – DRTEFP, DDTEFP).

Furthermore, the reconnaissance model showed the essential role of the organisations approved by the administration in carrying out training, first level controls and analyses linked to radiation protection. In order to ensure effective control of the safety of nuclear activities, two levels of external control would seem to be desirable: systematic and continuous control performed by the approved organisations, themselves monitored by the State, and more detailed control conducted directly by the State, with the intensity proportional to the risks inherent in the installations. Thus, the DSNR in Lyon set up a protocol with certain organisations enabling the ASN to be informed of significant nonconformities. This could pave the way for the future relations between the ASN and the approved organisations.

- Preparing to inspect

The reconnaissance mission, which gave rise to about a hundred reconnaissance visits to the users, was also designed to prepare a methodology and tools for radiation protection inspection.

With regard to the inspection methodology, it would seem that a variety of inspection procedures and types is necessary. Initially, each inspector could carry out about twenty inspections a year, with the frequency of the visits being tailored to the risks (for example every 2 years for hospitals and universities). Inspection guides are also drawn up for certain standard installations (industrial gammagraphy) to facilitate the inspectors' work.

Although many questions are not yet resolved, this mission will in 2004 lead to the creation of a radiation protection inspection program in the Rhône-Alpes and Basse-Normandie regions. As for the other regions which as yet do not have enough personnel assigned to radiation protection control within the DRIREs, they will continue the reconnaissance mission, taking account of the experience acquired by the pilot regions. All these actions are coordinated by the DGSNR.

Radiation protection monitoring surveillance in a nuclear medicine service

Relations with the DDASS and DRASS

The working group responsible for examining the working methods between DDASS/DRASS and DRIRE concluded that given the current move by the Health Ministry's services to focus on health-environment questions, the DDASS and DRASS would have every interest in concentrating on management of the radon-related risk in residential premises and establishments open to the public, and on radiological checks on water intended for human consumption. These services will also take part in managing radiological emergencies and contaminated sites, and will continue to look at the radiological impact of the main nuclear activities. A circular from the DGSNR sent out to the DDASS and DRASS will lay out these duties in official terms.

Organisation of the DRIREs

The working group with responsibility for considering the future organisation of the DRIREs in terms of their radiation protection control activities, has returned its conclusions. They were discussed with the DRIRE directors and ratified by the DGSNR. These conclusions were drawn up on the basis of the creation of one hundred and fifty radiation protection inspector jobs, the principle of which had been adopted by the Government in 2002. The organisation of the DRIREs for non-BNI radiation protection control will eventually be based around eleven inter-regional zones, centred on the nine DSNR that already exist plus two new DSNRs (Regional Directorates) in Paris and Nantes. In 2004, the available workforce will be spread around the inter-regional headquarters, to avoid over-diluting resources; a DSNR or a DSNR will be placed at the disposal and under the authority of each DRIRE. Subsequently, depending on acquired experience and the available workforce, units linked to the DSNRs will be set up in the other regions, closer to the actual facilities.

The work done by the ASN means that in 2004 we can already make the transition from reconnaissance to actual inspection in the two pilot regions, and continue with setting up an overall radiation protection control system for the entire country.

5 Action plan for monitoring patient exposure to ionising radiation.

Radiation protection for persons exposed for medical purposes is based on two principles, justification of the procedures and optimisation of exposure, under the responsibility of the prescribing practitioners and the users of ionising radiation. These principles are stipulated in the new regulations included in the Public Health Code.

The regulation dose limits do not apply to medical exposure, as the optimum dose depends on the medical goal (diagnostic or therapeutic) and should be determined on a case by case basis. However, the notion of « reference dose levels » is introduced to enable physicians carrying out irradiating procedures to evaluate and optimise them.

The ASN is in charge of drawing up the regulations concerning medical exposure and controlling their application, and wished to underpin its work with an «action plan» produced jointly with the professionals and institutional partners concerned. This plan is designed to improve knowledge of the doses administered to patients and to build up a system for dosimetric monitoring and evaluation of the potential effects of these doses.

Better understanding of “medical exposure”

Along with exposure of natural origin, medical exposure is the main source of exposure of the population to ionising radiation in the industrialised nations. Studies conducted so far, both in France and abroad, show a fairly broad spread of doses administered for the same examination. The available data however remain too limited to enable us to identify the most exposed groups or categories of persons.

The new regulations provide for the production of practical guides concerning the indications for medical imaging examinations on the one hand, and the procedures for conducting them on the other, constituting tools for implementing the principles of justification and optimisation. These guides are currently being drafted by the health professionals concerned.

The regulatory work has been accompanied by wide-ranging deliberation, once again with the professionals, regarding optimisation of the doses received by the patient during the examination, with the aim of reducing these doses to the strict minimum, but without compromising the quality of the examinations or the effectiveness of the treatment. Practical implementation of the principle of optimisation will necessarily involve better knowledge of the doses received by the patients, for each type of examination, for their entire lives, given that the forthcoming application of standardised radiology and nuclear medicine procedures should lead to a significant reduction in the spread of doses administered for the same type of examination.

Room and equipment for operating radiology

An action plan coordinated by the DGSNR

Based on the recommendations published in 2002 by the InVS, the DGSNR in 2003 drew up an action plan designed to set up and develop monitoring of patient exposure to ionising radiation of medical origin. Drawn up in close collaboration with the concerned services of the IRSN and InVS, and then submitted to the various institutional partners involved for approval (General Directorate for Health, Directorate for hospitalisation and health care, Social Security Directorate, French Health Product Safety Agency, French environment safety Agency, Health Monitoring Institute, Institute for Radiation Protection and Nuclear Safety, National care accreditation and evaluation Agency), this multi-year plan should be implemented as of 2004. It will be regularly monitored by a committee chaired by the DGSNR and will comprise the directors concerned or their representatives.

The chosen actions are aimed at meeting the following two objectives:

- obtain a better understanding of patient exposure to ionising radiation, to allow greater optimisation of practices and determine the reference dose levels for medical radiology and nuclear medicine;

- pool the knowledge needed for subsequent development of epidemiological monitoring of the effects of ionising radiation.

These actions vary widely in nature and are grouped into 6 categories: regulations, information system, studies, monitoring the effects of ionising radiation, information/training/scientific watching brief and research (see box).

These steps will be carried out jointly with the professionals, involving learned societies in steering these actions and ensuring participation in the field by the professionals concerned (doctors, radiation physicists, electroradiology operators, biomedical engineers, and so on).

1/ Regulations

• Place persons specialising in medical radiophysics at the disposal of the services hosting radiodiagnosis, radiological surgery, nuclear medicine and radiotherapy installations.

• Make it mandatory to equip any new radiology equipment with a device providing information on the quantity of radiation produced during a radiological procedure.

• Enclose the dose readings with each examination report.

2/ Information system

• Identify and monitor the frequency and distribution of examination types in the various categories of the French population.

• Centralise accident and incident information concerning the field of medical applications using ionising radiation.

• Conduct studies prior to setting up a system of individual dose data.

• Incorporate the dosimetric data produced by the digital equipment into the patient's computer file.

3/ Studies

• Conduct surveys to determine exposure and define reference levels for medical practices comprising exposure to ionising radiation.

• Conduct various case studies to characterise the doses received by the patient in computer tomography, paediatric radiology and radiological surgery departments.

4/ Monitor the effects of ionising radiation

• Improve knowledge of the stochastic effects of medical uses of ionising radiation.

• Study the frequency of radiodermatitis and radioepidermatitis in patients.

5/ Information - training - scientific watching brief

• Develop information targeted at health professionals.

• Develop training activities for health professionals.

• Share the scientific watching brief with the various stakeholders in the sector, by regularly issuing critical reviews of scientific publications concerning medical exposure to radiation and its health effects.

6/ Research

• Increase research into the relationship between medical exposure to ionising radiation and the induced carcinogenic and non-carcinogenic effects.

• Evaluate the significance for the patients of the results of the individual susceptibility and genotoxicity tests.

Towards a centralised information system

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.

During this first stage, the radiology and nuclear medicine departments should be given the tools needed for regularly estimating the doses received by the patients. These monitoring tools will be of particular use in evaluating the impact of the action taken in each department, and allow the gradual development of a radiation protection culture which can only benefit the patient, as part of the move to apply optimisation procedures.

This first stage will also be used to examine the feasibility of a centralised information system for evaluating the effectiveness of public policy and changes in terms of exposure, in the light of estimated doses but also the number of procedures carried out.

Finally, more accurate knowledge of patient exposure is an essential precondition to conducting epidemiological surveys among groups of patients who are the most heavily exposed owing to high doses or to particular radiosensitivity (children).

When taken as a whole, the knowledge gleaned from this action plan will enable the ASN to implement the regulations better, 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.

6 The summer 2003 heat wave and drought and nuclear power plant operations

The meteorological conditions observed in France during the summer of 2003, involving a significant rainfall deficit and high atmospheric temperatures, reduced river flowrates and led to a significant rise in water temperature.

The exceptional meteorological conditions caused EDF to conduct closer monitoring of its nuclear facilities and take steps to guarantee the availability of its production resources to meet electricity demand. EDF in particular asked the DGSNR temporarily to modify the thermal discharge conditions for some of its nuclear power plants and the operating conditions of the ventilation in a number of premises and of equipment cooling systems.

The installations thus operated under special waiver conditions for a limited time and the ASN and the various environmental protection stakeholders raised their level of control and monitoring.

Water: a vital element in operation of power plants in general and nuclear power plants in particular

Watercourses constitute the cold source supplying the cooling systems of nuclear reactors.

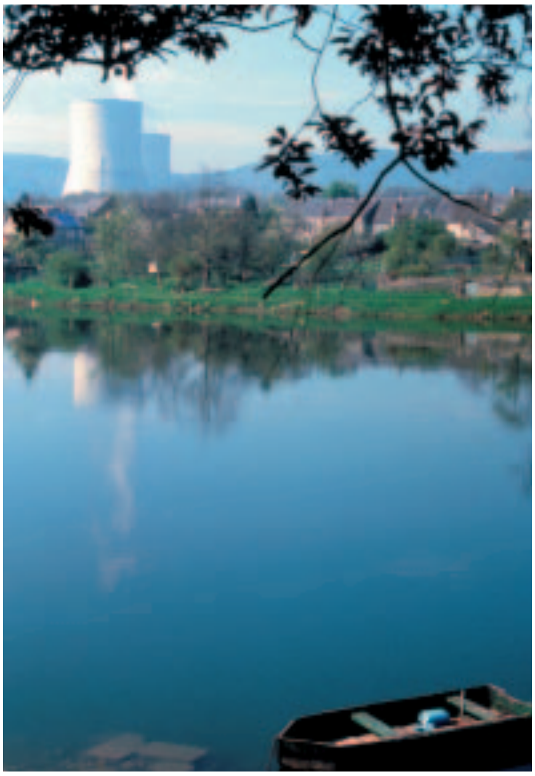
The high temperatures of the cold source in particular reduced the efficiency of the cooling systems in certain premises and reduced the power evacuation capacity during reactor outages.

In order to optimise management of the cooling capacity of the cold source, the operators increased monitoring of the efficiency of those devices exchanging heat with this cold source. For the Belleville and Chooz sites, the operators had to adopt special operating procedures to adapt the power to be evacuated by these systems to the temperature of the river.

They also asked the ASN for a waiver to the general operating rules (RGE) in order to increase the cleaning frequency of these exchangers, to boost the exchange coefficients.

Meeting temperature criteria to guarantee installation safety

The RGE also set the temperature criteria to be met inside the premises or by certain systems.



Chooz nuclear power plant

During the summer of 2003, the nuclear facility operators set up additional air cooling systems (fogging, additional air-conditioning, etc.), as the existing systems did not have sufficient cooling capacity.

In particular, the temperatures recorded in the reactor buildings on the Fessenheim site led the operator to set up a system for cooling the outside of the containment, the effectiveness tests of which were performed at the beginning of the heat wave.

Owing to the gradual temperature rise inside the reactor buildings on the Dampierre and Chooz sites and the ineffectiveness of the sprinkler system used on the Fessenheim site, the three sites asked the ASN for a waiver to the RGE so that they could use a special air mixing system inside the reactor buildings. This authorisation was granted by the ASN.

Controlled relaxation of environmental constraints in order to meet electricity demand

Nuclear power plants generate thermal discharges into watercourses or the sea, either

Dampierre-en-Burly nuclear power plant

directly for those plants operating in an « open circuit », or after passage through cooling towers, enabling some of the calories to be released into the atmosphere. Thermal discharges from the plants raise the temperature between upstream and downstream of the discharge by values ranging from a few tenths of a degree to several degrees.

These discharges are also regulated by the ministerial orders authorising plant discharges.

The meteorological conditions observed during the summer of 2003 raised the temperature of certain watercourses by about 5°C above the mean historical values observed over the past 25 years. For these reasons, the operators reduced power or halted production from several of their reactors, on the Le Blayais, Golfech, Tricastin and Bugey sites.

However, electricity demand was high, precisely because of the heat wave, with increased use of air-conditioning for example, at a time when electricity production facilities other than nuclear reactors were also experiencing operating difficulties. For conventional thermal power plants this was due to the heat wave (thermal releases into water courses and the atmosphere) and for hydroelectric plants it was due to the lack of rainfall (obligation to ensure that leisure activities could continue in reservoirs). This situation highlighted the risk of the electricity production resources being insufficient and significant load-shedding having to be carried out.

This constraint led the operators to request modifications to the provisions of the discharge licensing orders. The Ministers for the Environment, Health and Industry issued an order on 12 August 2003, authorising electricity production facilities located on the Rhone, Moselle, Garonne and Seine rivers to continue operating with thermal discharges higher than the limits authorised in the discharge authorisation orders for these installations, while limiting the temperature rise in these watercourses to between 1 and 3 °C depending on the type of facility and the river.

This authorisation, which ended on 30 September 2003, was in fact used very little.

Publication of this order was accompanied by the creation of an oversight committee for the environment of nuclear production facilities, with the role of monitoring the impact of thermal releases into the watercourses.

Lessons learned

The experience of 2003 showed that the operators had problems with meeting certain temperature criteria specified in the nuclear reactor operating rules. They were forced to provide proof to back up the protective measures that were chosen and, in certain cases, ask for waivers to these same rules in order to allow operation of certain particular ventilation systems. These measures as a whole were such as to guarantee installation safety and maintain the minimum electricity production resources necessary.

This combination of heat wave and drought is a situation that is likely to occur again and should be taken into account, both in sizing and designing nuclear facilities (increased ventilation rates for the premises, installation of air-conditioning systems, etc) and in developing an alert system capable of anticipating such a situation.

The ASN will be vigilant in this respect.

7 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 deputy of the Drôme department, Michèle Rivasi, the Nuclear Safety Authority (ASN) confirms that it is in favour of drawing up a national plan for radioactive waste management.

This proposal is in conformity with a provision already included in article L.541-11 of the Environment Code (resulting from law 75-633 of 15 July 1975 concerning the disposal of waste and recovery of materials). This article gives the Minister for the Environment the option of drawing up national disposal plans for waste considered to be particularly harmful or requiring special treatment and storage. This option was for example used for waste contaminated by polychlorinated biphenyls (PCB).

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

The Nuclear Safety Authority organised two meetings in the first half of 2003 to examine the feasibility of 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. Two initial meetings were organised during the second half of 2003 to present the subjects to be dealt with and discuss the organisation to be put in place to produce such a plan.

The following were invited to take part in the work on the national plan for radioactive waste management: representatives of the waste producers, the 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

The goals of the plan were examined by all parties concerned. Following the debate, these goals were clarified and are presented below:
clear definition of the waste to be considered as radioactive, taking account of the existence of natural radioactivity of variable levels and of certain radioactive materials for which reuse has not been envisaged;

- reliable and exhaustive inventory of radioactive waste, no matter what the origin (including that from defence activities);
- search for management solutions for each category of radioactive waste produced;
- taking charge of older radioactive waste which has been more or less « forgotten »;
- consideration of the concerns of the public, who rightly or wrongly are worried about the fate of radioactive waste;
- the 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;
- 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;

leading to clear, meticulous and safe management.

Interface with ANDRA's inventory work

At the same time, the National Agency for Radioactive Waste Management (ANDRA) set up an organisation for inventorying all radioactive waste in France (radioactive waste observatory, with launch of a forward-looking inventory in accordance with the proposals of the Le Bars report). This inventory will enable the quantities of waste produced to be estimated for various time-frames, including 2010-2020.

The national plan for radioactive waste management (PNGDR) 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 into the disposal of high-level long-lived waste be presented to Parliament before the end of 2006, so that a debate can 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 solely 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 in a more general context.

Initial conclusions

The first meetings of the plenary group tasked with producing the national plan for radioactive waste management, comprising the leading stakeholders, dealt primarily with technical subjects in order to get the ball rolling. Several topics were then discussed, concerning waste with enhanced natural radioactivity, as defined in the Public Health Code, graphite waste and waste containing radium, waste resulting from the treatment of uranium ore and the future of sealed sources at the end of their useful life. Draft recommendations were produced concerning the recovery of certain types of waste from private individuals or establishments without the resources to dispose of it. It would also seem important to monitor the consistency of the regulatory provisions concerning radioactive waste and the benefits of requiring a declaration from all radioactive waste producers need to be examined.

Prospects

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. It should be noted that internationally, this approach was seen as a good practice, 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.

However, to prevent this remaining a purely technical exercise, all the participants concerned by the future of radioactive waste must mobilise: participation by elected representatives and by environmental protection associations is an essential precondition for the success of such a plan.

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.

Graphite stack in a gas-graphite Uranium reactor

8 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. This article therefore includes the provisions voted by Parliament concerning the future of this waste.

Article L.542 of the Environment Code 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 control 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, which receive contributions from other stakeholders both in France and abroad.

Package of high-level long-lived waste stored at COGEMA La Hague

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 the separation of minor actinides 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 certain 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. Post-burnup examinations will be conducted as of 2004.

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 the National Agency for Radioactive Waste Management (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 galleries 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 Nuclear Safety Authority, 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.

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 has submited the storage safety option dossiers for generic sites at the end of 2003.

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 L542 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.

It is up to the authorities to ensure that the steps made necessary by the law of 30 December 1991 are carried out in satisfactory conditions: all those involved in the research work will have to submit their results within a time-frame enabling the Government, but also all parties concerned, to give their opinion on the possible options after 2006. This implies greater coordination between the stakeholders involved in the process.

9 The european nuclear package

On 30 January 2003, the European Commission officially adopted two proposed directives, one defining general principles of the safety of nuclear facilities, the other the management of spent fuel and radioactive waste. This initiative is commonly called the « nuclear package ».

The aims of the « nuclear package »

The aims of the « package » are as follows:

- draft « safety » directive:

to guarantee protection of the population and workers against the hazards of ionising radiation emanating from a nuclear facility, by laying down general principles which will ensure that the basic standards specified in the Euratom treaty are applied;

- draft « waste » directive:

to guarantee that all spent nuclear fuel and radioactive waste is managed safely, so that the workers, population and environment are adequately protected against the effects of ionising radiation.

The debate around the « nuclear package »

The initial content of the texts indicated that the Commission wanted to exert its influence over areas that had hitherto been considered as strictly national. Even if facility safety and the management of radioactive waste had in the past been the subject of community documents, they had not as yet been binding. The initial « package » would have had the effect of transferring competence from the member states of the Union to the Commission.

As soon as it was presented, reaction to the « package » was anything but enthusiastic, with certain States even demonstrating outright hostility.

A number of States also consider that directives are not the best way of setting up general community principles to deal with nuclear safety in the current and future member countries. They believe that texts such as resolutions or recommendations, which are not legally binding, would be preferable. Two proposed texts were therefore presented in September 2003 by Sweden, Finland and the United Kingdom, with the support of Germany.

The current content of the « nuclear package »

Faced with this opposition, the two texts were extensively reworked, in particular under the impetus of the French authorities. The resulting texts were officially presented by the Italian presidency in November, with the hope of bringing the hostile states back on board.

With respect to the initial text, the following profound changes in particular were made to the draft « safety » directive:

- confirmation of the principle of national responsibility for control and technical regulation of nuclear safety;

- deletion from the text of all legal provisions enabling subsequent introduction of « daughter directives »;

- alleviation of the legal provisions concerning financing of dismantling;

- replacement of inspections carried out under the aegis of the Commission by a process of « peer » examinations.

The current content of the «Nuclear package» is fairly similar to that of the two international conventions (ratified by all member states of the European Union):

- convention on nuclear safety;

- joint convention on the safety of spent fuel management and the safety of radioactive waste management.

Its operative field is however more extended than the nuclear safety convention (restricted to only reactors), the safety directive project concerning all power plants. However, some details remains to precise on the “package” for example: the examination process by “peer” reviews.

The ASN position

The DGSNR feels that a move towards harmonising nuclear safety principles and standards is needed.

Thus, when WENRA (association of nuclear regulatory authorities from the European Union and Switzerland) was created at the ASN’s initiative in 1999, its members set themselves the goal of developing a common approach to nuclear safety and regulations, in particular within the Union. To develop these activities, WENRA set up two working groups, in which the ASN plays an active role, one (under the control of the British safety authority) for nuclear power reactors, the other (under the control of the DGSNR) for management of spent fuel and radioactive waste and dismantling operations.

The current version of the « nuclear package » is a move towards harmonisation, while ensuring that the European Commission respects national competences.

The ASN, which believes that the points still outstanding can be improved through discussion, supports the « package » which overall corresponds to what it wants. Legally binding directives will give more stability to the European legislative and regulatory framework for nuclear safety.

Prospects

Although the content of the new, amended, proposals is close to the non-binding drafts presented by the United Kingdom, Sweden and Finland, these texts still divide the fifteen members states, who are unable to agree on their legal status.

The « nuclear package » was submitted to the COREPER (Committee of Permanent Representatives - national ambassadors to the European Union) at the end of November 2003. After noting the disagreement, the COREPER decided to forward to the Irish presidency (starting on 1 January 2004) the task of seeing this matter through to completion.

Finally, the arrival of new member states in the European Union in May 2004, and given their current stance, should strengthen the position of those in favour of directives.

NUCLEAR ACTIVITIES, IONISING RADIATION AND HEALTH RISKS

CHAPTER 1

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4 PROSPECTS

CHAPTER 1
NUCLEAR ACTIVITIES, IONISING RADIATION AND HEALTH RISKS

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 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 gave this directorate responsibility – under the authority of the above-mentioned ministers – 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 cellular DNA; they are not fundamentally different from those caused by toxic chemical substances produced by cellular metabolism.

When not repaired by the cells themselves, these lesions can lead to cell death and the appearance of health effects once the tissue is no longer able to carry out its 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 exceeded 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 the 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.

Unlike deterministic effects, the appearance of carcinogenic effects is not linked to a dose threshold, and only a probability of occurrence can be given for a particular 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 aim of epidemiological surveys is to highlight a link between a risk factor and the occurrence of an illness, between a possible cause and an effect, or at least to permit the claim that there is a very high probability of such a causal link existing. 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. Epidemiological surveys have therefore only been able to highlight pathologies linked to ionising radiation for relatively high radiation doses and high dose rates (for example: monitoring of the populations exposed to the Hiroshima and Nagasaki bombs).

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 radiation 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.

Dose-effect relationship

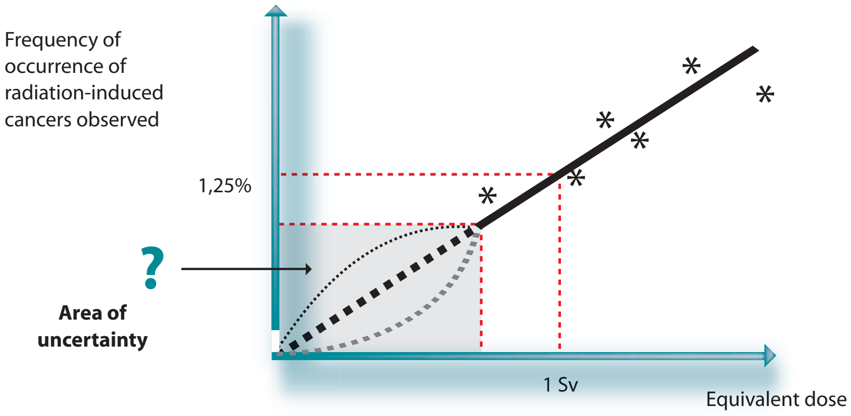


Diagram of the linear relationship without threshold

In this context, 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.

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 uncertainty and vigilance

The action taken in the fields of nuclear safety and radiation protection in order to prevent accidents and limit nuisance 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.

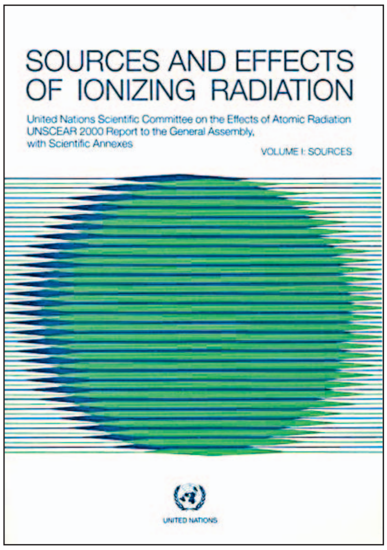
One can in particular mention six areas of uncertainty:

• *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, a risk which seems far from negligible if we apply the prudent assumption of a linear relationship without threshold?

• *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. Although it cannot be ruled out, the probability of this type of event nonetheless remains low.


SOURCES AND EFFECTS
OF IONIZING RADIATION
United Nations Scientific Committee on the Effects of Atomic Radiation
UNSCEAR 2000 Report to the General Assembly,
with Scientific Annexes
VOLUME I: SOURCES
UNITED NATIONS

UNSCEAR 2000 report

• *Dose, dose rate and chronic contamination* – The epidemiological surveys performed on persons exposed to the Hiroshima and Nagasaki bombings, have given a better understanding 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

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[1] Sources and effects of ionising radiations UNSCEAR 2000.

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 installations, 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 situation on 31 December 2003 is shown 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 that of the prime responsibility of the operator. The public authorities see to it that this responsibility is fully assumed, in compliance with the regulatory requirements.

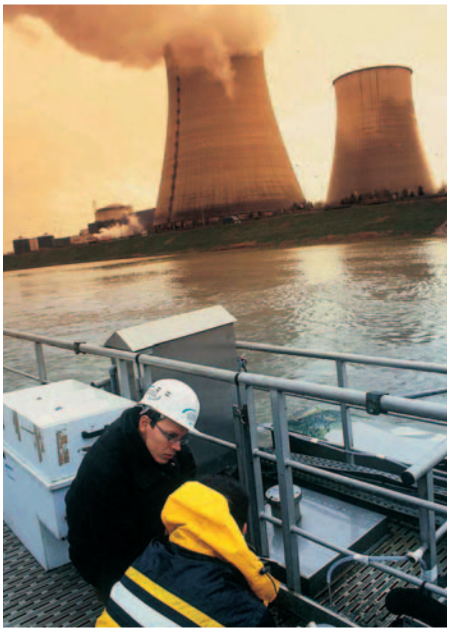
The respective roles of the public authorities and the operator can be summarised as follows:
- the public authorities define the general safety objectives;
- the operator proposes technical procedures for attaining them, and justifies them;
- the public authorities ensure that these procedures are consistent 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 outside contractors, etc.). The operator must also take the steps necessary to 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.



Radiological monitoring of the environmental around a BNI

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.

To this end, the facilities must be so designed, operated and maintained as to limit the production of such effluents, which must be treated so that the corresponding discharges are kept 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 materil 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.

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

Transport of radioactive materials

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 authorisations (case of BNIs, ICPEs and installations subject to the Mining Code) in which, on the basis of information forwarded by the “operator”, 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.

Radiation protection of patients

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 establishment 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 and contamined sites

Dismantling of a nuclear installation

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.

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).

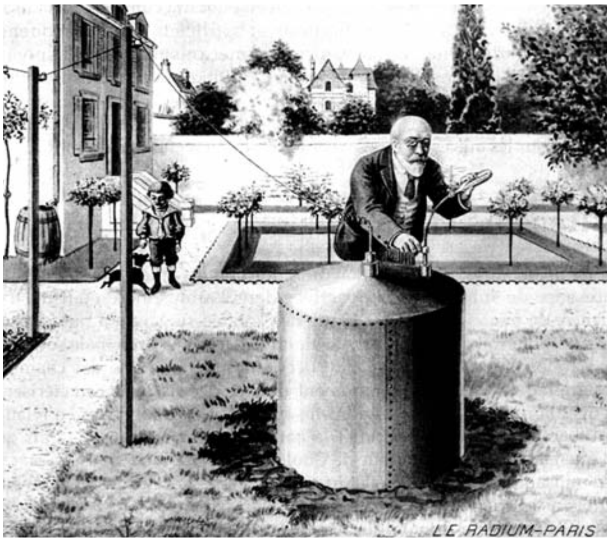
Management of sites contaminated by residual radioactivity resulting either from a past nuclear activity, or an activity which generated deposits of natural radioelements, warrants specific radiation protection actions, in particular if rehabilitation is envisaged. In the light of the current or future 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 | 5

Activities enhancing naturally-occuring ionising radiation

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



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

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.

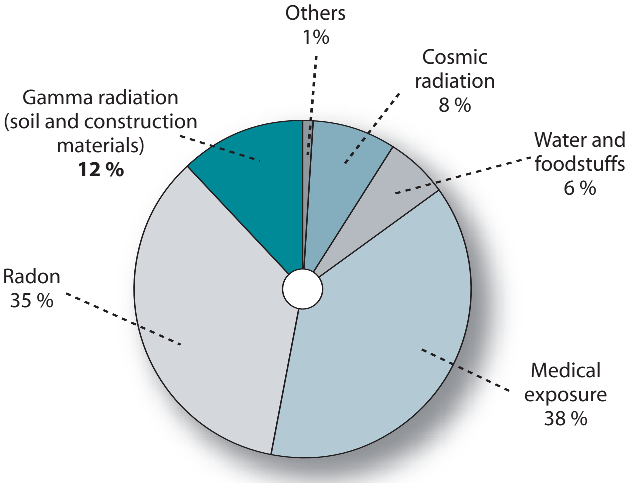
Targeted on the risk to the population as a whole, but also to workers, monitoring of human exposure to radon in premises open to the public is also a radiation protection priority in geographical areas with a high potential of radon exhalation owing to the geological properties of the site. A strategy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

Teaching, health care and social institutions, and health spas, are primarily concerned by 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 patho-



Source: UNSCEAR 1989

Dose distribution

logies 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, at best by measuring the dose rates linked to external exposure to ionising radiation or internal contamination, or failing that, 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 above 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.

For certain exposure source categories, a monitoring system was developed, with monitoring of worker exposure, for which the data are recorded nationally (SISERI), or monitoring of exposure to natural radiation (radon, Téléray). However monitoring of patient exposure is virtually non-existent and warrants action being taken to improve knowledge of the radiation received during examinations and treatment.

3 | 1

Doses received by workers

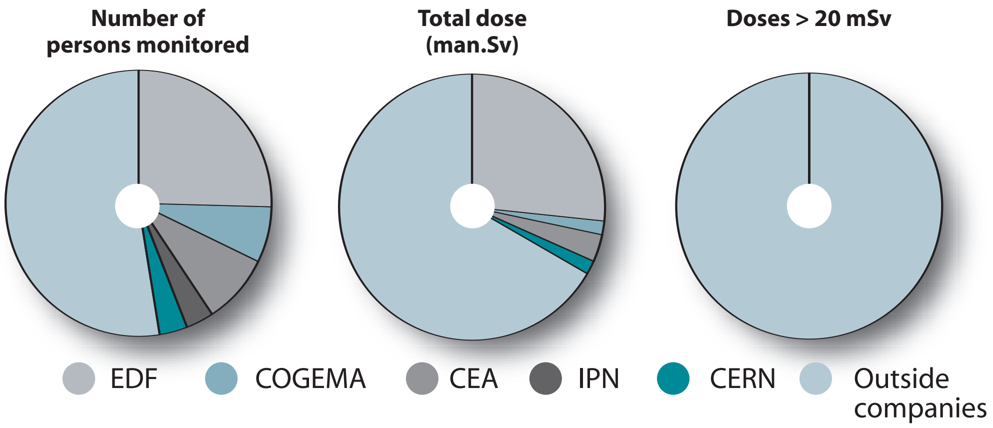
The exposure monitoring system for persons working in installations employing ionising radiation has been in place for a number of decades. It is based on the mandatory wearing of personal dosimeters by workers likely to be exposed and is used to check compliance with the regulatory limits applicable 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.

BNI dose distribution (year 2002)

	Number of persons monitored	Total dose (man.Sv)	Doses > 20 mSv
EDF	20 071	11,25	0
COGEMA + MELOX	5 824	1,24	0
CEA	7 399	1,64	0
IPN	3 614	0,02	0
CERN	2 153	0,15	0
Outside companies	38 348	23,10	5
Total	77 409	37,40	5

Statistical worker dosimetry results (year 2002 – Source IRSN)

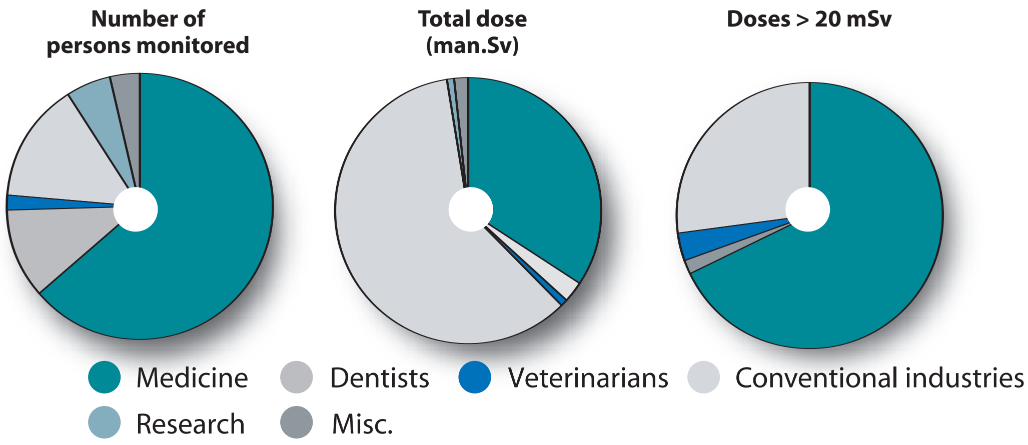
BNI dose distribution (year 2001)



Non-BNI dose distribution (year 2002)

	Number of persons monitored	Total dose (man.Sv)	Doses > 20 mSv
Medicine	110 959	7,61	29
Dentists	24 606	0,56	1
Veterinarians	4 098	0,13	3
Conventional industries	23 991	20,68	36
Research	6 994	0,12	0
Misc.	4 944	0,72	0
Total	175 592	29,82	66

Non- BNI dose distribution (year 2001)



Enhanced natural exposure

In France, understanding of the exposure of persons subjected to enhanced natural radiation remains particularly patchy. However, a few studies have already produced some values for exposure in certain industries. There are three types of worker exposure:

- *ingestion of dust containing large amounts of radioelements (phosphates, metal ore);*

- *inhalation of radon, formed by decay of uranium (poorly ventilated warehouses, health spas);*

- *external exposure due to process deposits (scale forming in pipes for example).*

Thus 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, with a few studies even indicating exposure of about a hundred millisieverts (up to 100 mSv/year for production of zirconium silicates, 120 mSv/year for phosphate extraction, 227 mSv/year for production of niobium and 230 mSv/year for monazite extraction).

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. For these industries, the impact on the population is generally between 1 and 300 µSv/year. However, on three industrial sites in the Netherlands (two phosphoric production installations and one zircon sand treatment plant), the radiological impact on the population was estimated at between 2 and 3 mSv/year. Recycling of phosphogypsum or coal ash in construction would seem to induce doses of no more than 10 and 250 µSv/year respectively.

Health spas are a particular group requiring priority action. Even if few studies have been conducted in France, the high radon content of the water and the poor ventilation of the spas would seem to indicate possibly significant doses, both to the staff and the patients. An IRSN bibliographical study of foreign spas backs up this idea, as annual doses of 10 to 100 mSv (up to 500 mSv) for the staff and 1 to 4 mSv for the patients are not rare.

Cosmic radiation can also be the cause of significant doses. The intensity of this radiation depends among other factors on altitude, so airline crews and frequent travellers are exposed to doses that 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.

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.

3 | 2

Medical exposure

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. The studies conducted so far generally show a wide variability in the doses delivered for a given examination. The implementation of standardised

Medical exposure

In the medical field, patient exposure to ionising radiation is differentiated from the other types of exposure (population, workers) in that it is not subject to any strict limitations, even if the principles of justification and optimisation nonetheless apply. The situation also differs when looking at the field of diagnostic applications (radiology, diagnostic nuclear medicine) or that of radiotherapy, both external and internal: in the first case, optimisation is necessary by looking for the minimum dose such as to obtain pertinent information, while in the second, the dose needed to destroy the tumour must be delivered while maximising protection of the neighbouring healthy tissues.

The patient dose depends on the quality of the equipment used, which fully justifies implementing quality control of the medical devices employed, not only the irradiating equipment, but also that used for these exposures (if a viewer used to visualise a radiology film is faulty, it can lead to a rise in the doses delivered to produce these 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 accurately identify the overall exposure of medical origin, as we do not know the numbers of each type of examination practice and the doses delivered for the same examination can vary widely. However, worldwide statistics (UNSCEAR 2000 report, volume 1) established for 1.530 billion inhabitants (1991-1996 data) indicate an effective annual dose 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 effective annual dose per inhabitant in France is 1 mSv while it is 0.33 mSv in the United Kingdom and 1.9 mSv in Germany.

The studies conducted hitherto 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 scintigraph 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.

radiology and nuclear medicine procedures as of 2003 should lead to a significant reduction in the variability of the doses delivered for a given type of examination. Finally, it is hard to determine accurately the total exposure of medical origin because the number of each type of examination carried out is inadequately known.

3 | 3

Exposure of the population and environmental monitoring

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.

3 | 4

Exposure to radon

Exposure to "domestic" radon (radon in the home) is estimated by regularly scheduled series of measurements followed by statistical interpretations (see IRSN atlas). These lead to the departments being ranked according to the potential for radon exhalation by the land (see chapter 3). For methodological reasons, the results of this surveillance remain too imprecise for an exact evaluation of the exposure to which individuals are subjected.

In premises open to the public (teaching establishments, health and social establishments, thermal spas), radon exposure data are collected by the Departmental Directorates for Health and Social Affairs (DDASS). Centralisation of these data in a new information system run by the Directorate General for Health is currently under preparation (SISE-Habitat).

3 | 5

The radiological quality of water intended for human consumption

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. These programs have already begun in a number of *départements*, at the initiative of the DDASS. They will accelerate in 2004 and 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.

4 PROSPECTS

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 monitoring “domestic” radon are two priority areas for the ASN in the coming years, in cooperation with the IRSN and the InVS. To this should be added development of the national environmental radiology monitoring network, which eventually should improve information of the public.

Progress in knowledge of the biological effects of ionising radiation could reduce the level of uncertainty regarding the associated health risk, particularly for low doses. In accordance with the conclusions of the group chaired by Professor Constantin Vrousos, it would appear essential to set up the necessary processes enabling a review of current research to be produced, this being an essential prerequisite to any consideration of research priorities but also to increasing the French presence in international bodies responsible for assessment of the field of radiation protection.

Finally, close attention should be paid to the work of the ICRP, which is updating its recommendations published in 1990. The ASN will follow this work closely as it could lead to a simplification of the international radiation protection system incorporated in European and national legislation. Inclusion of the environment in the ICRP’s next recommendation is still planned.

THE ORGANISATION OF SUPERVISION OF NUCLEAR SAFETY AND RADIATION PROTECTION

1 ACTION PRINCIPLES

1|1 Responsibility
1|2 Justification
1|3 Optimisation
1|4 Limitation
1|5 Precaution
1|6 Participation

2 ORGANISATION OF SUPERVISION

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

1 ACTION PRINCIPLES

Nuclear activities must be performed according to/respecting a number of principles, some of which are enshrined in legislation and regulations and apply to a specific area of activity.

1 | 1

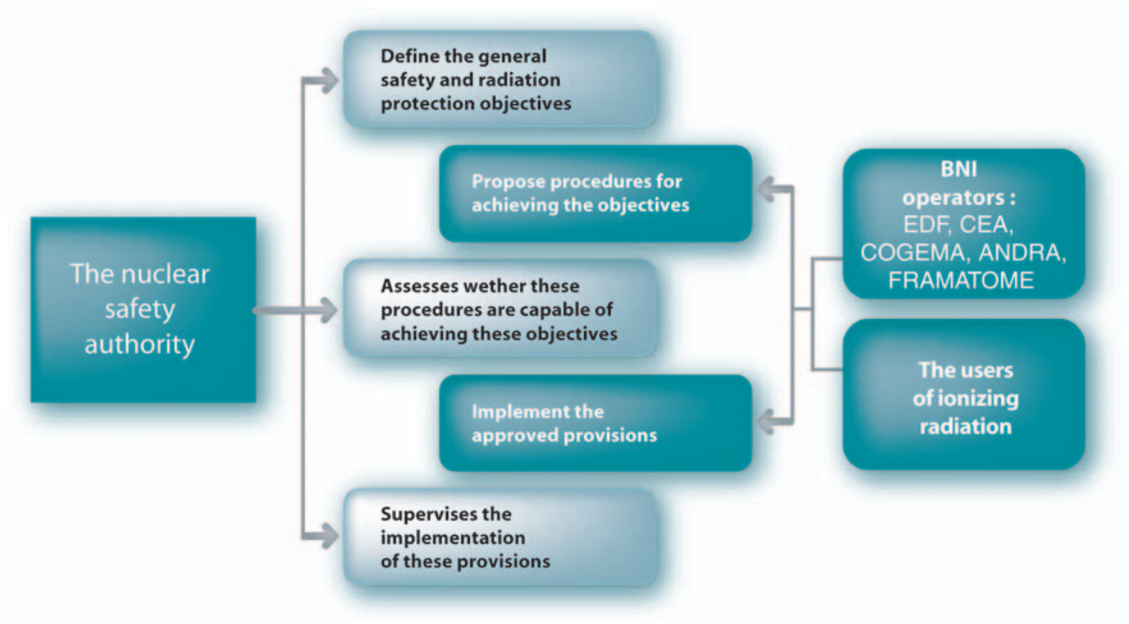
Responsibility

The principle of responsibility states that responsibility for hazardous activities lies primarily with those performing them and not with the public authorities or other parties:
- 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 doctor performing the medical act for radiation protection of patients;
- responsibility of the polluters for harm to the environment;
- responsibility of the producers for disposal of waste.

The polluter pays principle introduced into the environment code is a form of the principle of responsibility, in that the cost of pollution prevention, reduction and remediation measures is borne by the polluter responsible for the harm caused to the environment by its activity.

In practical terms, it involves taxing 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”.



Responsibility of the operators and responsibility of the Nuclear Safety Authority

1 | 2

Justification

The principle of justification is one of the three fundamental principles of radiation protection, enshrined in the Public Health Code (CSP). It states that a nuclear activity can only be undertaken 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.

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 purpose 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 and 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 environment charter bill.

With regard to the biological effects of ionising radiation at low doses and low dose rates, the principle of precaution is implemented through 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 of the ASN's fields of activity:
- public information about events which have occurred in the BNIs;
- public information about normal and accidental discharges from BNIs;
- 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

Nuclear safety and radiation protection in France is organised around the principle of the prime responsibility of the operators (see § 1|1), stating that responsibility for an activity entailing a risk lies primarily with whoever undertakes or conducts it (BNI operator, consignor of a radioactive material transport, source user, etc.) rather than with the public authorities or other party.

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.

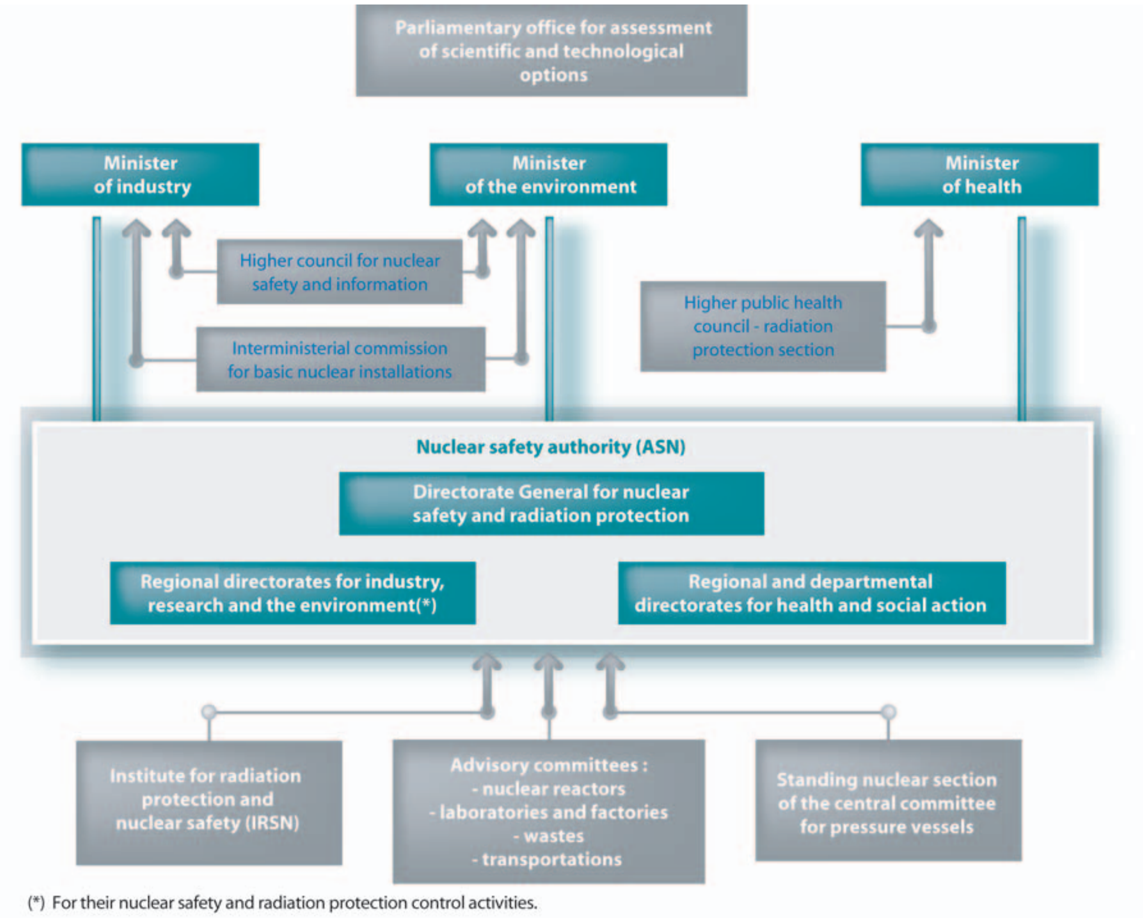
Decree 2002-255 of 22 February 2002 amending decree 93-1272 of 1 December 1993 and creating the Directorate General for Nuclear Safety and Radiation Protection (DGSNR) gave this directorate responsibility – under the authority of the above-mentioned ministers – for defining and implementing public nuclear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

To do this, the DGSNR relies on the State's decentralised departments. The DGSNR together with the State's decentralised departments, for which it organises and supervises the activities in its area of competence, is referred to as the "Nuclear Safety Authority" (ASN).

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.

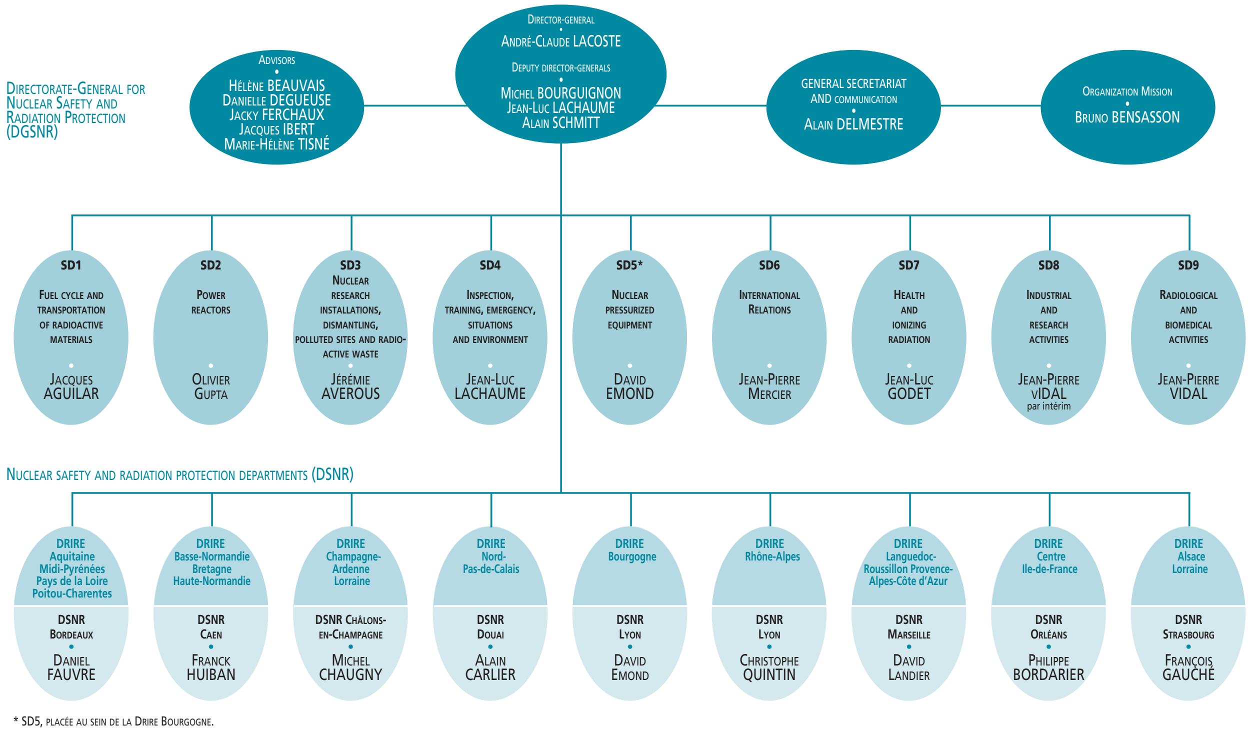


(*) For their nuclear safety and radiation protection control activities.

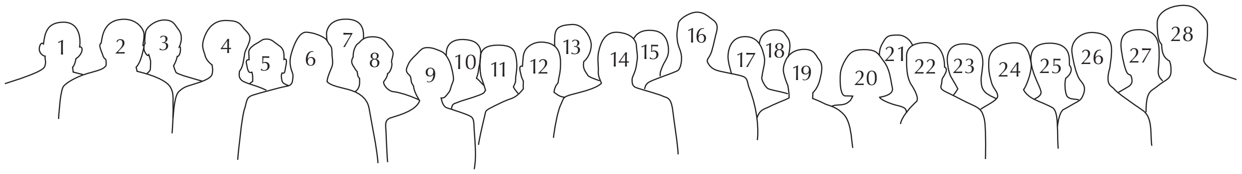
Supervision of nuclear safety and radiation protection in France

CHAPTER 2

THE ORGANISATION OF SUPERVISION OF NUCLEAR SAFETY AND RADIATION PROTECTION



ASN organization chart in 2003



1 Olivier Gupta (SD2)
2 Jean-Luc Godet (SD7)
3 Jean-Luc Lachaume (SD4)
4 Alain Delmestre (Secretary-general)
5 Jean-Pierre Vidal (SD8/SD9)
6 Jean-Pierre Mercier (SD6)
7 Philippe Bordarier (DSNR Orléans)
8 Michel Chaugny (DSNR Châlons-en-Champagne)
9 Danielle Degueuse (Advisor)
10 Jacky Ferchaux (Advisor)
11 Jacques Aguilar (SD1)
12 Philippe Saint Raymond (Deputy director-general)
13 Alain Carlier (DSNR Douai)
14 André-Claude Lacoste (Director-general)
15 Jacques Ibert (Advisor)
16 Alain Schmitt (Deputy director-general)
17 Michel Bourguignon (Deputy director-general)
18 Jérémie Averous (SD3)
19 Cathy Bieth (SD9)
20 Marie-Renée Tisné (Advisor)
21 Bruno Bensasson (Senior executive for organization)
22 David Landier (DSNR Marseille)
23 Christophe Quintin (DSNR Lyon)
24 Hélène Beauvais (Advisor)
25 Xavier Mantin (DSNR Strasbourg)
26 David Emond (BCCN/DSNR Dijon)
27 Daniel Fauvre (DSNR Bordeaux)
28 Frank Huiban (DSNR Caen).

In the performance of its duties, the Nuclear Safety Authority (ASN) calls on the expertise of external technical support organisations, in particular the Institute for Radiation Protection and Nuclear Safety (IRSN), and requests opinions and recommendations from standing groups of experts.

2 | 1 | 1

The Directorate General for Nuclear Safety and Radiation Protection

Its main duties are as follows:
- to draft and monitor application of the general technical regulations concerning the safety of basic nuclear installations;
- to draft and implement, jointly with the other competent administrations, all measures designed to prevent or limit health risks linked to exposure to ionising radiation;
- to carry out BNI licensing procedures (authorisation decree, startup and commissioning licence, effluent discharge licence, etc.);
- to organise the supervision of these installations by the BNI inspectors;
- to organise and co-ordinate radiation protection inspections in the industrial, medical and research fields;
- to supervise and trace ionising radiation sources;
- to supervise the transport of radioactive and fissile materials for civilian use;
- to organise radiological monitoring of the environment, nationwide;
- to prepare and implement regulations concerning the supervision of radioactive waste management;
- to prepare an emergency response organisation to deal with incidents or accidents likely to harm human health, through exposure to ionising radiation;
- to organise public and media information on issues related to nuclear safety and radiation protection;
- to take part in the activities of international organisations and develop bilateral relations with foreign nuclear safety and radiation protection authorities.

The DGSNR also collates all information on research and development work performed in the field of nuclear safety and radiation protection.

2 | 1 | 2

The decentralised departments

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

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

- a reconnaissance mission in the Rhône-Alpes and Basse-Normandie regions, which provided further data for the debate on priorities, modalities and tools for organising the supervision of radiation protection outside the BNIs;

- a working group involving DRASS, DDASS and DRIRE, which clarified the distribution of tasks and the modalities for future coordination between these various departments.

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.

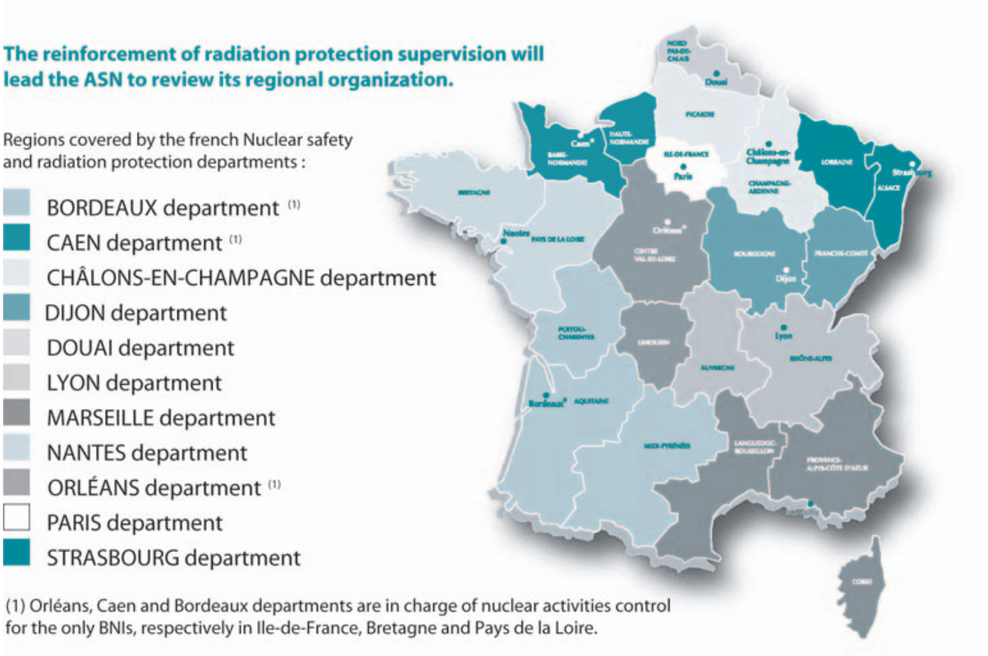
The DSNRs take part in examining the authorisation requests submitted by the operators of the BNIs in their geographical area:
- creation, modification or shutdown of BNIs;
- water intake and effluent discharge by BNIs;
- waivers to the general operating rules.

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



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

(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 in the regions

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 magazine, through their participation in the local information committees and their relations with local associations and media.

As of 2004, based on the experience acquired during the reconnaissance mission mentioned earlier, the role of the DRIREs will gradually be expanded from BNI supervision to supervision of non-BNI radiation protection nationwide.

The main nuclear sites

2 | 1 | 2 | 2

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

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

The DRASS and DDASS take part in monitoring radiation protection both in the environment and in hospitals:
- radiological monitoring of drinking water;
- radon monitoring in buildings open to the public and in housing;
- monitoring of waste and effluent management in health care institutions.

The DRASS and DDASS also take part in preparing for and managing radiological emergency situations, in particular by:
- providing the Prefect with support in the event of an incident or accident;
- contributing to drafting the emergency plans drawn up by the prefects;
- stockpiling and distributing iodine tablets;
- taking part in periodic accident simulation drills.

As of 2004, on the basis of the conclusions of the DDASS-DRASS-DRIRE working group mentioned above, the roles of these departments will be maintained and even expanded to cover subjects relating to health and the environment (drinking water, radon, health impact of installations, environmental monitoring, etc) and reduced with regard to the supervision of radiation protection in medical installations.

2 | 1 | 3

Resources and Humans resources

1°) Resources

Human resources

The total workforce of the ASN amounts to 312 persons, distributed among the DGSNR and the DSNRs in the DRIREs.

On 31 December 2003, this workforce can be broken down as follows:
- 207 civil servants assigned to the ASN;
- 4 staff on assignment from the Minister for Public Works or from the Assistance publique - Hôpitaux de Paris (AP-HP);
- 11 contractual staff;
- 90 staff on assignment from the CEA and the IRSN under the terms of an agreement signed with each of these two entities (see below “Financial Resources”).

78% of the ASN workforce are executives, primarily state engineers (graduates from the *Ecole des Mines* and from the *Ecole des Ponts et Chaussées*, industrial and mining engineers, State public works engineers, public health medical inspectors, health engineering specialists) often with prior experience of inspection activities (in the nuclear or other fields), personnel on assignment from the CEA or the IRSN and with experience of nuclear or radiological activities, as well as contractual engineers specialising in radiation protection.

Within the framework of inspector exchange programmes with foreign nuclear safety authorities, an ASN engineer has been on assignment with the Nuclear Installations Inspectorate (NII) of the Health and Safety Executive (HSE) in Great Britain since September 2002. An engineer from the Consejo de Seguridad Nuclear (CSN) and an engineer from NII have also been assigned to the ASN, since September 2002 and January 2003 respectively.

Workforce On 31 December 2003	Executives		Non-executives		TOTAL
	DGSNR	DSNR	DGSNR	DSNR	
Civil servants	90	78	23	20	211
Non-civil servants	62	13	26	–	101

Location

DGSNR Paris	DGSNR Fontenay-aux-Roses	On assignment*	BCCN/SD5 Dijon	DSNR	TOTAL
89	90	1	21	111	312

* NII : 1

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

Financial resources

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

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

Instituted by article 43 of the 2000 Budget Act, these taxes are paid into the State's general budget. For 2003, the revenue from these taxes amounts to 213.105 M€. The breakdown of contributions is shown in the following table:

OPERATOR	BNI tax for 2003 in k€
EDF	174 191
COGEMA	18 586
CEA	8 866
ANDRA	6 403
EURODIF	1 830
FBFC	1 830
AUTRES	1 399
TOTAL	**213 105**

Data processing resources

Deployment of the "ASN Information System" (ASN IS) continued in 2003. Development of the IT applications was completed and acceptance work is currently nearing completion. Apart from the press review application enabling the ASN to produce its daily press review, the inspections management application was used in 2003 to draw up the ASN's program of inspections for 2004. The work on the ASN IS will continue in 2004, particularly with deployment of IT applications to all ASN sites, training of staff in use of the ASN IS and modernisation of the website.

The information system will enable the ASN to perform its duties more efficiently and effectively, in terms of both supervising nuclear safety and radiation protection and informing the public. It will facilitate the circulation, management and sharing of knowledge and internal communications within the ASN.

2°) Humans resources

Personnel training

Initial and continuing training is a key element in the professionalism of the Nuclear Safety Authority. 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 becomes 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 2003, 2061 days of technical training were given to 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 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 management.

Inspector qualifications

Since 1997, the Nuclear Safety Authority has followed a program of qualification of its inspectors, based on recognition of their technical competence. With it went together the 25 April 1997 creation of a Safety Authority Accreditation Committee. This is a consultative committee primarily composed of people not from the Safety Authority, and its role is to rule on the entire qualifications 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 Pierre Woltner, half of the Accreditation Committee is composed of senior inspectors belonging to the DGSNR and the DSNR, and half of persons with competence for supervision, assessment and teaching in the fields of nuclear safety and supervision of classified installations.

The Accreditation Committee met twice in 2003 and interviewed 4 BNI inspectors.

On 31 December 2003 the number of senior inspectors active within the Nuclear Safety authority stood at 35.

Internal communication

In 2003, Nuclear Safety Authority internal communications were expanded significantly.

On the one hand, the internal actions which have been taken for a number of years now 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 the DGSNR national staff to the DSNRs.

A number of new measures helped reinforce the ASN's proactive stance in this field:
- opening of the Oasis intranet site;
- publication of an internal directory;
- organisation in October of a special event, the ASN 2003 Convention, the aim of which was to stimulate discussion and exchanges of ideas between all ASN personnel.

Quality Management

To guarantee and improve the quality and effectiveness of its actions, the ASN has defined and implemented a quality management system 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 poll, hearings, etc.);

- action plans setting ASN objectives and annual priorities, adjusted in daily life 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 Nuclear Safety Authority calls on the expertise of its technical support organisations. The Institute for Radiation Protection and Nuclear Safety (IRSN) is the main one, but in recent years, the ASN has been following a policy of diversification, both nationally and internationally.

The Institute for Radiation Protection and Nuclear Safety

As a public establishment of an industrial and commercial nature created by law 2001-398 of 9 May 2001 instituting the French environmental safety agency, and by decree 2002-254 of 22 February 2002, the IRSN conducts nuclear safety and radiation protection work and analyses on behalf of the ASN financed under an annual agreement which determines the amount and the nature of the work.

In 2003, the work done by the IRSN on behalf of the Nuclear Safety Authority amounted to 54.08 M€. This appears in Section IV, subsidies, chapter 44-40 article 20, of the budget of the Ministry for Ecology and Sustainable Development.

The other technical support organisations

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

As part of its expert diversification policy, the Nuclear Safety Authority also called on the services of other organisations. Expert assessments were thus requested from the BURGEAP company, the research centre for the evaluation of protection in the nuclear field (CEPN), Armines, the Ligeron SA company, the Geological and Mining Research Office (BRGM) and the National Health Monitoring Institute (InVS).

2 | 1 | 5

The expert groups

The Nuclear 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.

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 Group can call on the services of anyone it deems necessary. 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

The Advisory Committee for nuclear reactors held thirteen meetings during which the following topics were examined:
- generic studies for the periodic safety reviews of the 1300 MWe reactors;
- safety options for the Horowitz future research reactor;
- guidelines to be followed for the periodic safety reviews of the 900 MWe reactors linked to the third ten-yearly inspections;
- final commissioning of the two Chooz B reactors;
- qualification of power reactor equipment for accident conditions;
- design of systems and accident studies for the future EPR reactor;
- safety review of the Phébus reactor for the FPT 3 test;
- ageing and lifespan of power reactors;
- radiation protection in EDF power plants.

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

The Advisory Committee for laboratories and plants held four meetings during which the following topics were examined:
- the safety reassessment of the PEGASE installation in Cadarache;
- the safety reassessment of the fuel fabrication plant (FBFC) in Romans-sur-Isère;
- the increased production capacity of the MOX fabrication plant (MELOX) in Marcoule;
- the safety reassessment of the advanced fuel study and fabrication laboratory (LEFCA) in Cadarache.

The first of these subjects was examined jointly with the Advisory Committee on radioactive waste.

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

The Advisory Committee for radioactive waste

The Advisory Committee for radioactive waste held two meetings devoted to the 2001 file in the geological disposal project presented by ANDRA and which concerned:
- the initial safety check;
- the results of the audit conducted by the OECD's nuclear energy agency (NEA).

Chaired by Mr Robert Guillaumont, the Advisory Committee for radioactive waste comprises representatives of the Administration, experts appointed on proposals from the IRSN, the CEA and

Meeting of the Advisory Committee for Nuclear Reactors on 27 February 2003

ANDRA, experts representing the radioactive waste producers and experts appointed for their particular competence in the nuclear, geological and mining fields.

The Advisory Committee for transport

The Advisory Committee for transport held one meeting in 2003, during which it examined proposals for changes to international regulations for the transport of radioactive materials.

Chaired by Mr François Barthélemy, the Advisory Committee for transport comprises representatives of the Administration and the French committee for certification of licences for the training and monitoring of personnel working with ionising radiation, experts appointed on proposals from the IRSN, the 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.

In accordance with the ministerial order of 4 March 2003, it comprises members of the various administrations concerned, persons appointed for their particular competence and representatives of pressure vessel builders and users and interested technical and professional organisations. It is chaired by Mr Jean Scherrer.

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), also chaired by Mr Jean Scherrer.

The SPN's role is primarily to give its opinion concerning application of pressure vessel regulations to nuclear steam supply systems.

In 2003, the Standing Nuclear Section met on two occasions.

During the 18 April session, it examined the following points:
- thermal fatigue in fluid mixing zones with a high temperature differential in PWR pressurised circuits (see chapter 11, § 3|7|1) ;
- chemical cleaning of the Chinon B1 steam generators (see chapter 11, § 3|6|5);
- criteria for assessing leaks from steam generator tube bundles during hydrotests (see chapter 11, § 3|6|4).

During its 2 July session, it examined the design and manufacturing choices for the vessel nozzle support ring for the EPR reactor project (see chapter 11, § 6).

2 | 2

The other stakeholders

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 request has been renewed on a yearly basis.

From the outset, the Parliamentary Office carefully defined the scope of its rapporteurs, entrusted with investigating how safety and radiation protection were organised at both governmental and nuclear operator levels, comparing their findings with practice prevailing in other countries and checking that the authorities were equipped to carry out the tasks allotted to them. This “supervision of the supervisors” thus concerns the efficacy of administrative structures as well as technical issues, such as the future of nuclear waste or the transportation of radioactive materials, or again, socio-political questions, like the circulation and perception of nuclear news items.

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

In 2003, to supplement the Parliamentary Office’s studies into the safety of nuclear installations and radioactive waste, the report from Mr Christian Bataille, deputy from Nord and Mr Claude Birraux, deputy from Haute-Savoie and Chairman of the Office, concerning the lifespan of nuclear power plants and the new types of reactors, examines the remaining service life of the EDF installed plant base and the progress of the projects which, as and when the time comes, could replace the reactors currently in service.

The report examines the various physical and other factors influencing the ageing of nuclear power plants and examines the question of whether or not the forty year design life could be exceeded in practice. The issue of the French nuclear generating plant population is compared in technical and regulatory terms with the nuclear power plants in Finland, Sweden, Germany and America.

Considering that a replacement solution must be prepared at the same time as optimising the lifespan of the plants currently in service, Mr Christian Bataille and Mr Claude Birraux analyse in detail the various light water reactor projects from around the world and designed to follow on from existing models in 2015, in particular the EPR reactor from Framatome ANP which is particularly competitive. They propose that construction work on an initial example begin in the very near future.

Presenting the other nuclear systems being examined by research organisations in France, but also in the United States and Sweden, Mr Christian Bataille and Mr Claude Birraux analyse their objectives and the conditions in which they are being developed, for a time frame that could be no earlier than 2035, in the light of the technological hurdles to be cleared and the industrial demonstrations to be conducted.

The National Assembly also asked the Office to examine the progress and prospects of research into radioactive waste management. This task was entrusted to deputies Christian Bataille and Claude Birraux.

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.

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 the environment, 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 Nuclear Safety Authority, in particular presents its annual report and deals with relevant secretarial requirements.

Under the chairmanship of Mr Philippe Lazar, the CSSIN met four times in plenary session in 2003, before its mandate expired on 12 September. It met on 19 February, 2 April, 4 June and 4 September.

During the course of this year, the Council mainly devoted its work to the following four subjects:

- distribution of a booklet entitled “Sûreté des centrales et des déchets nucléaires - Eléments de débats” (*Safety of nuclear power plants and nuclear waste - The key questions*) and organisation of local debates about energy;
- meta-analysis of nuclear incidents and accidents in nuclear installations;
- management of exceptional climatic situations by EDF and the consequences for electricity production;
- drafting of the Council’s four-year activity report.

The Council heard the 2002 report from the Inspector General for Nuclear Safety and Radiation Protection at EDF, and the ASN’s report for the year 2002.

Number 150 of the Contrôle review dealing with “Safety and Competition” was presented to the members of the CSSIN.

The Council heard Mr Grit, of the DGEMP, who presented the national energy debate.

It also heard Mr Bourguignon, of the DGSNR, who presented the national nuclear and radiological risks training curriculum for emergency medical professionals.

During these sessions, the following points were also raised: earthquake resistance of nuclear installations, the problems of fuel-tightness in the Cattenom plant and fuel with M5 cladding, fall-out from Chernobyl and the dismantling of Superphénix.

The CSSIN finally issued a recommendation sent to the Ministers concerned and to the press, regarding nuclear safety in the context of deregulation of the electricity production market.

Secretarial duties are handled by the DGSNR.

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 about the specific provisions applicable to each of these installations. It is also required to give its opinion on the drafting and application of general BNI regulations. It comprises a standing section, competent to deal with routine issues.

The Commission, which is required by law to meet at least once a year, held four sessions in 2003, under the chairmanship of Mr Yves Galmot, honorary Department Head of the Council of State, which examined the following topics:
- on 25 April:
- three draft decrees authorising the Atomic Energy Commission (CEA) to carry out final shutdown and dismantling of BNI n° 41 named Harmonie (calibrated neutron source reactor) and BNI n° 121 named IRCA (irradiator) located in Saint-Paul-lez-Durance, as well as BNI n° 43 named ALS (Saclay linear accelerator) located in Saint-Aubin,
- a draft decree authorising the CEA to modify the radioactive liquid effluent management zone in the Saclay research centre,
- a draft decree modifying decree 96-978 of 31 October 1996 concerning the creation of BNI EL4-D, a facility for storing equipment from the Monts d'Arrée nuclear power plant,
- a draft decree authorising the CEA to modify BNI n° 19 named Mélusine (pool reactor) located in Grenoble, with a view to its dismantling and declassification,
- on 4 July, a draft decree authorising modification of the annual production capacity of the MELOX plant in Marcoule;
- on 24 October, a draft decree authorising the CEA to create a BNI named CEDRA (radioactive waste packaging and interim storage facility) in Saint-Paul-lez-Durance;
- on 20 November, four draft decrees authorising EDF to modify the perimeters of BNI 128 (Belleville nuclear power plant), BNIs n° 111 and 112 (Cruas nuclear power plant), BNI n° 135 (Golfech nuclear power plant) and BNI n° 88 (Tricastin nuclear power plant) and, for this latter, to take charge of the liquid radioactive effluent and solid waste produced by the Tricastin operational hot unit.

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

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 official bulletin 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 2003, the section's activities dealt mainly with regulatory work concerning examination of draft orders to implement the public health code and the labour code (see chapter 3). At the same time, several working groups were set up (iodine tablet dosage, medical treatment of irradiated or contaminated victims and radiation protection recommendations for nuclear medicine patients).

A standing committee, to assist the Radiation Protection Section, will also be created by ministerial order in early 2004. Its main role will be to propose opinions or recommendations on all subjects concerning radiation protection linked to the use of sources of ionising radiation, except for questions concerning the protection of persons exposed for medical purposes. It will also take part in drafting the regulations and technical instructions on this subject.

Under the chairmanship of Mr André Aurengo, the radiation protection section comprises members appointed on proposals from the National Academy of Medicine, the National Academy of Pharmacy, the Academy of Science, the National Council of the Order of Physicians, the National Council of the Order of Pharmacists, the National Council of the Order of Veterinarians, the CEA and the INSERM, as well as personalities appointed for their particular competence.

Secretarial duties are handled by the DGSNR.

2 | 2 | 3

The public health and safety agencies

a) The National Health Monitoring Institute (InVS)

The National Health Monitoring Institute is a state institution under the authority of the Minister for Health. It is responsible for permanent monitoring and observation of the health of the population, for collating, analysing and updating knowledge of health risks, their causes and their development, and for detecting any event modifying or likely to impair the general state of 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 regard to monitoring of cancers which could be attributable to ionising radiation, the InVS proposes and implements appropriate surveillance systems (for example: thyroid cancer monitoring system) and in particular national registers (leukaemia register, child cancers register, etc.). The InVS is also competent for risk evaluation (for example: InVS/IPSN report on the evaluation of risks linked to fall-out in France from the Chernobyl accident) or epidemiological surveys (for example, current survey on risk factors linked to a rise in the numbers of thyroid cancers).

In 2003, the InVS published its recommendations for setting up a national epidemiological surveillance system for thyroid cancers and took part in preparing the national plan for surveillance of medical exposure (see chapter 1, § 3|2|1) prepared by the DGSNR.

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 the monitoring of medical devices and in particular issues approval of the organisations responsible for this monitoring task and defines the corresponding reference requirements, per equipment category.

In 2003, the AFSSAPS published the monitoring reference requirements for medical devices (mammography and radiotherapy equipment) and set up the procedure for accreditation of the organisations responsible for external inspection of these 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 mission is to issue opinions on the radiological quality of food products 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 assessment work in the field of ionising radiation, and the links to be established with the IRSN and the InVS, have yet to be specified.

In 2003, the AFSSE provided secretarial services for the group of experts tasked by the Minister for Health with examining the future national health and environment plan.

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.

CHAPTER 3

1 RADIATION PROTECTION REGULATORY PROVISIONS

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
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2 BNI REGULATORY PROVISIONS

2|1 Licensing procedures
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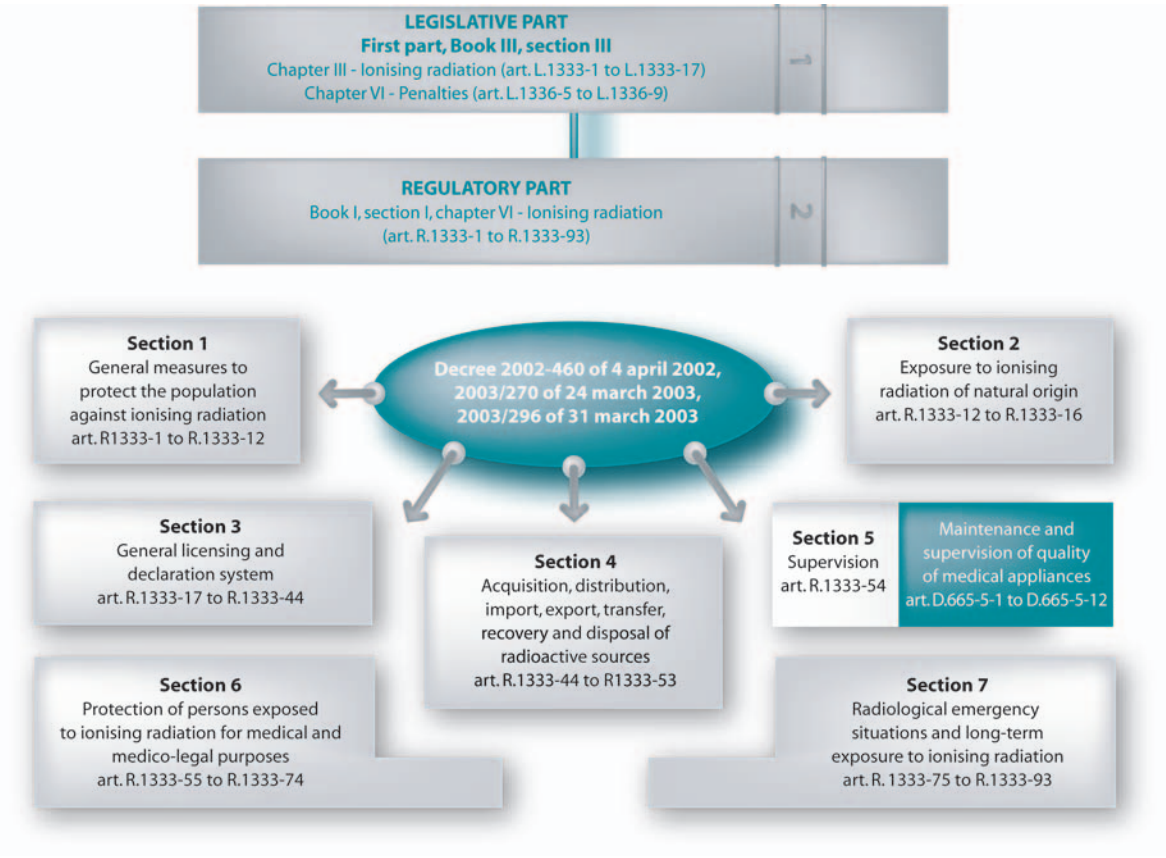
APPENDIX 1 – VALUES AND UNITS USED IN RADIATION PROTECTION

APPENDIX 2 – LIMITS AND DOSE LEVELS

1 RADIATION PROTECTION REGULATORY PROVISIONS

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 updated in 2003 and the implementation decrees were published in 2002 and 2003.
The following overall architecture was adopted for updating of this legislative and regulatory framework:



Legislative and regulatory architecture for radiation protection

The new legislative part of the Public Health Code (chapter V.I "Ionising radiation") is almost complete. The new requirements under preparation concerning radiation protection inspection are still to be published. They are part of the draft guideline energy law concerning nuclear safety and transparency.

For the regulatory part, 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, decree 2003-295 of 31 March 2003 concerning intervention in a radiological emergency and in the event of

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[1] Council Directive 96/29/Euratom of 13 May 1996 laying down basic safety standards for the protection of workers and the general public against the dangers arising from ionising radiation.

[2] Council Directive 97/43/Euratom of 30 June 1997 on health protection of individuals against the dangers of ionising radiation in relation to medical exposure.

[3] Ordinance 2001-270 of 2 March 2001 on the transposition of Community directives in the field of protection against ionising radiation.

[4] Decree 2003-461 of 21 May 2003 concerning certain regulatory requirements of the public health code.

March 2003

Ministerial order of 3 March 2003 (Official Gazette of 19 March 2003) setting the lists of medical appliances subject to the obligation of maintenance and quality control mentioned in articles L.5212-1 and D-665-5-3 of the Public Health Code

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 mentioned in article D.665-5-6 of the Public Health Code

March 2003

Decision by the Director General of the AFSSAPS of 27 March 2003 (Official Gazette of 8 April 2003) setting the provisions for checking the quality of analogue mammography installations

August 2003

Ministerial order of 17 July (Official Gazette of 21 August)
Radioscopy without image intensification (appliance decommissioning procedures)
art. R.1333.58

Ministerial order of 15 July 2003 (Official Gazette of 15 August 2003)
Approval of organisations responsible for measuring radon in premises open to the public
art. R.1333.15

October 2003

Ministerial order of 17 October 2003 (Official Gazette of 28 October 2003)
National network for collection of environmental radioactivity measurements

November 2003

Ministerial order of 1 September 2003 (Official Gazette of 13 November 2003)
Methods for calculating effective doses and dose coefficient values, Public Health Code, art. R.1333-10 and Labour Code, art. R231-80

Ministerial order of 20 October 2003 (Official Gazette of 4 November 2003)
Intervention levels for protection of the population

January 2004

Order DGSNR/DRT of 2 December 2003 (Official Gazette of 6 January 2004) defining exemption thresholds for parameters other than those mentioned in article R.1333-27 of the Public Health Code

Order DGSNR/DRT 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

Order DRT/DERF 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

List of ministerial orders published on 1 February 2004

long-term exposure and decree 2003-296 of 31 March 2003 concerning worker protection against the hazards of ionising radiation have been published.

Decrees 2002-460, 2003-270 and 2003-295 are codified in chapter III "Ionising radiation" of the new regulatory part (articles R.1333-1 to R.1333-92) introduced by decree 2003-461 of 21 May 2003. Decree 2003-296 is codified in section VIII "Prevention of the risk of exposure to ionising radiation" of the Labour Code.

Effective application of the new regulatory requirements remains dependent on the publication of a large number of ministerial orders. Some of them (11) were published in 2003, others will be published in 2004.

1 | 1

The legislative bases of radiation protection

1 | 1 | 1

The Public Health Code

The new chapter V.I "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. 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.

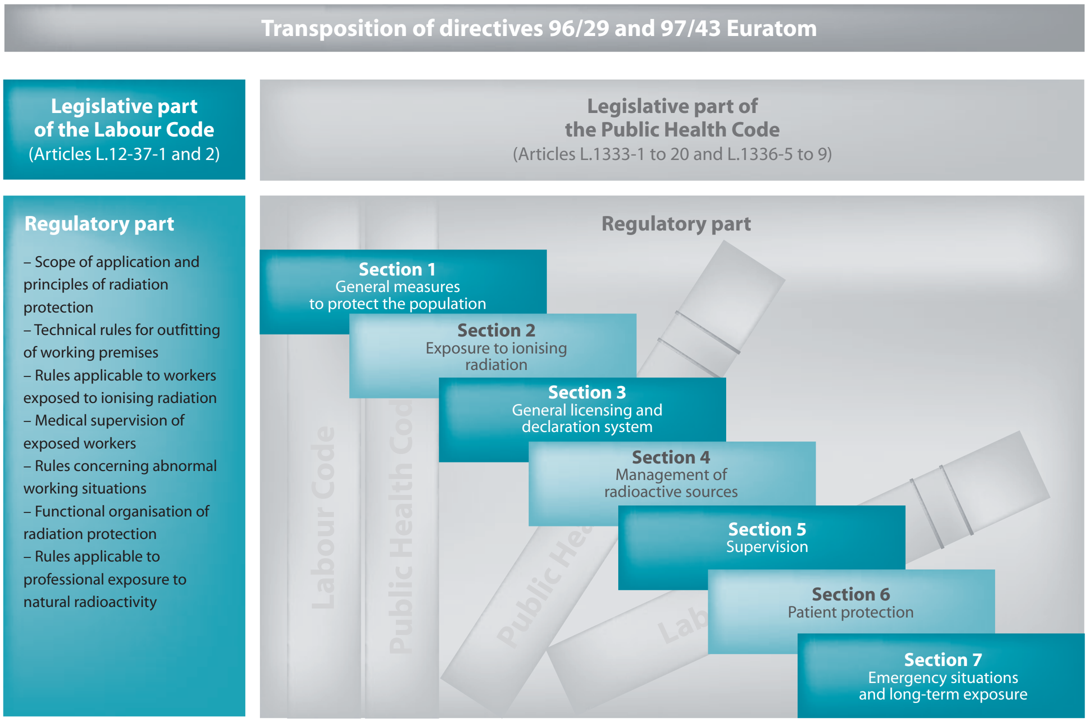
1°) The principle of justification – "A nuclear activity or an intervention can only be undertaken or carried out if its health, social, economic or scientific benefits so justify, given the risks inherent in human exposure to ionising radiation which it is likely to entail."

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 the DGSNR in the case of sources used for medical purposes, industrial and research purposes, it is the competence of the 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



The new regulatory part of the Public Health Code

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.

This new legislative base introduced into the Public Health Code enables to prescribe, by means of decrees taken after advice of the Council of State, general rules concerning the conditions for prohibition, authorisation and declaration of use of ionising radiation (art. L1333-2 and 4), as well as rules for artificial or natural radionuclides management (art. L1333-6 to L1333-9). These authorisations and declarations concern all applications of ionising radiation generated by radionuclides or by electrical X-ray generators, whether for medical, industrial or research purposes. Some may however benefit from exemptions.

Transposition of Directive 96/29 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. L1333-10).

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

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 et 2) introduce a legislative basis specific to the protection of workers, whether or not salaried, pending transposition of 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

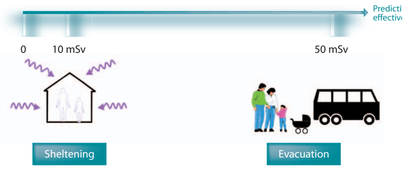
Protection of individuals against the dangers of ionising radiation from nuclear activities

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 establishment, the employer, in particular when he or she is not the head of the establishment, and the person with competence for radiation protection;
- the dose limits (art. R. 231-76), which after a period of 2 years, will be reduced to a maximum of 20 mSv for 12 consecutive months, barring waivers resulting from exceptional exposure levels justified in advance, or emergency occupational exposure levels;
- the 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 limits of the various controlled areas (art. R. 231-81), which will be reviewed in the light of the new dose limits, with the supervised area covering potential worker exposure of more than 1 mSv per year, and the controlled area covering exposure likely to exceed 6 mSv per year;
- the duties of the person with competence for radiation protection, extended to definition of working areas using radiation, study of exposed workstations and measures to reduce exposure (optimisa-



Work in radiopharmacy laboratory

tion); for the performance of these duties, the person will have access to passive dosimetry and operational dosimetry data (art. R. 231-106);
- the modalities of medical supervision of exposed workers and the duties of the occupational physician (art. R. 231-98 to R. 231-102).

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 advice 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 1cm_ 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 will be set up (art. R.1333-11); the data collected will contribute to estimating the doses received by the population. It 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 the IRSN, with its guidelines defined by the DGSNR (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.

Village near the Cruas power plant (Ardèche)

– Management of waste and effluent from BNIs and ICPEs 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 establishments, including hospitals (art R. 1333-12), general rules will be specified by an interministerial order (not yet published). These waste and effluents must be disposed of in duly authorised facilities, unless there are special provisions for on-site organisation and monitoring of their radioactive decay (this concerns radionuclides with a 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 ICPEs). Otherwise, these discharges are the subject of technical specifications.

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

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 for medical radio-diagnostic (except for sophisticated equipment) is subject to declaration in this case, or to licensing in all other cases.

The licensing system applies without distinction to undertakings and institutions which actually possess radionuclides, but also 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 will be specified in a ministerial order, publication of which is expected in 2004.

The new modalities for accreditation of organisations responsible for supervision of installations, as required by the Health Code and the Labour Code, were defined in the order of 9 January 2004. The ASN is now responsible for examining accreditation applications submitted by the organisations.

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 product safety agency (AFSSAPS) ;
- the licences required for the use of radionuclides, products or devices containing them, are issued at a national level by the DGSNR;
- X-ray generators, which hitherto were subject to technical approval by the 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 the 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

The 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 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.

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 the CIREA (Interministerial commission on artificial radioelements) and their supervision is now the responsibility of the ASN. However, the CIREA's radioactive source inventory duties have been transferred to the 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 the IRSN is mandatory for the acquisition, distribution, import and export of radionuclides in the form of sealed or unsealed sources, or products or devices containing them. This prior registration 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 the 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 the 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 licensing date has expired.

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 dangers arising from ionising radiation in an accident or radiological emergency situation by implementing intervention measures (or countermeasures) appropriate to the nature and scale of the exposure. In the particular case of nuclear accidents, these countermeasures were defined in an interministerial circular of 10 March 2000, specifying 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 countermeasures 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.

Intervention trigger levels for protection of the population

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.

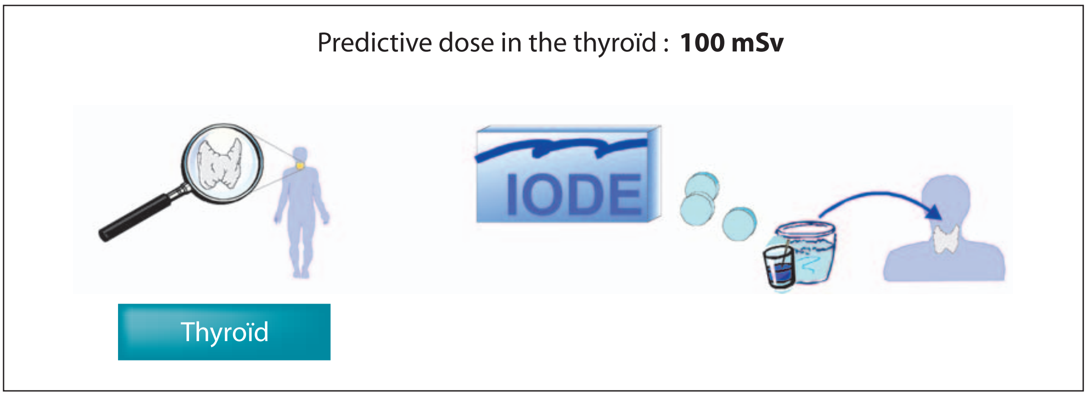
b) The second group comprises personnel who are not members of the special response teams but who are called in on the basis of their competence. They are given appropriate information.

The reference individual exposure levels, which are practical reference points expressed in terms of effective dose, should be set as follows:

a) The effective dose likely to be received by personnel in group 1, in the exercise of their regular duties, is 100 millisieverts. It is set at 300 millisieverts when the intervention measure is aimed at protecting other people.

b) The effective dose likely to 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.



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 the 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. An implementing order (not yet published) should set reference levels to allow definition of radiological decontamination (or rehabilitation) of the contaminated land and buildings, on a case by case basis.

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 procedures 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 make them more transparent, 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 plays a part in this same principle of optimisation. This level, which is obtained by a statistical survey of the doses received through examination in various facilities, corresponds to the 75th percentile of the dose distribution thus obtained. 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.

– 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. An order to be published in 2004 should clarify the duties and the training of these experts.

– 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.

– 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 defined apply both to the person requesting the examinations and to the person performing them.

X-ray of the chest

1 | 3 | 2

Maintenance and quality control of medical devices

Decree 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 Product Safety Agency (AFSSAPS) must be issued to determine the acceptability criteria, monitoring parameters and frequency of the inspections conducted on the medical devices concerned. The first decision concerning control of mammography installations, dated 27 March 2003, was published on 8 April 2003.

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 the 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

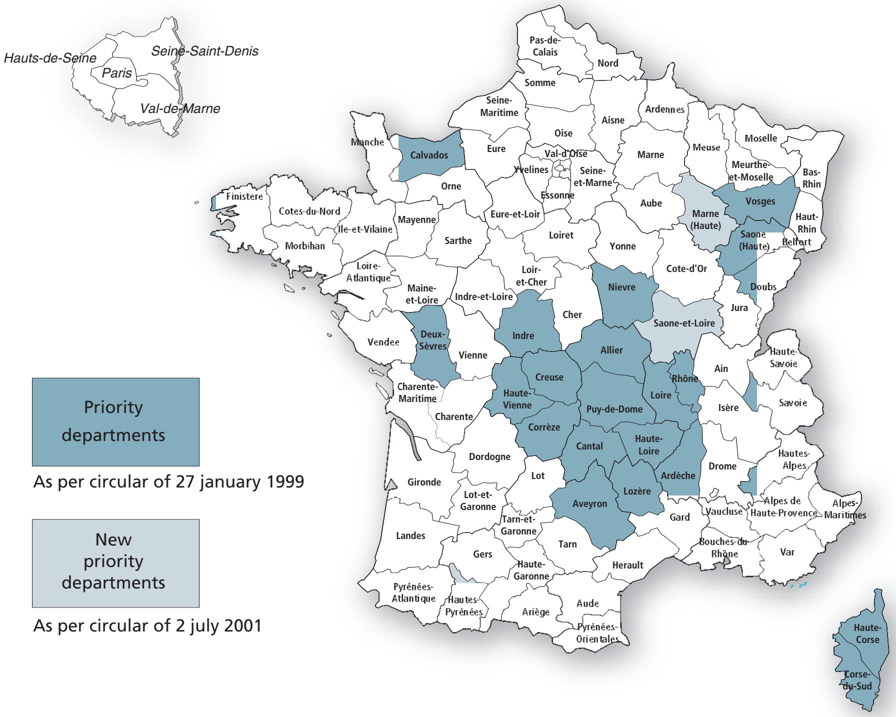
The regulatory framework applicable to management of the radon risk in premises open to the public (art R. 1333-15) introduces the following clarifications:
- the radon monitoring obligation applies in geographical areas in which radon of natural origin is likely to be measured in high concentrations 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, an implementing order will define 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 teaching 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 enclosed 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.

Two accreditation levels are adopted: a first one for screening and checking the effectiveness of the works (see diagram enclosed) and a second for further investigations, which require expertise in all radon measurement techniques (integrated, spot, continuous). The organisations will be approved on the basis of the main criteria, which are the setting up of a quality assurance system and the training or qualification of the personnel for radon measurement.



Map of departments with radon priority

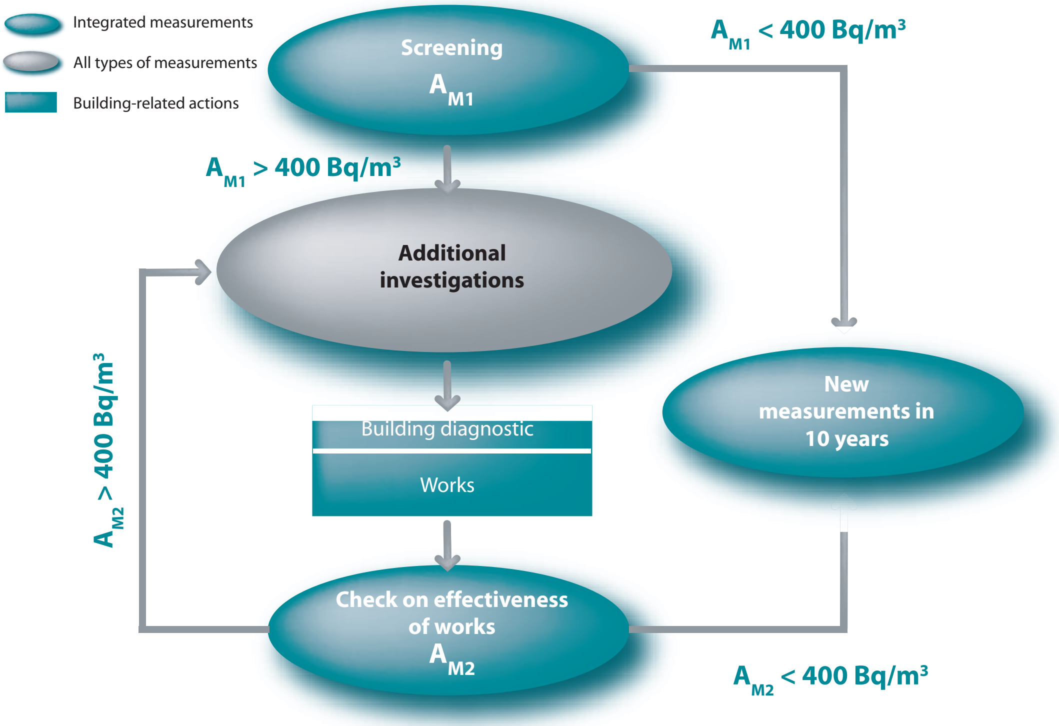


Schéma simplifié de la méthodologie de gestion du risque radon dans un bâtiment

Accreditation is granted or refused after consulting 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.

In the working environment, the new article R. 231-115 of the Labour Code requires the head of the establishment 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/m^3. An implementing order is expected, in order to define the categories of establishments 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 will be issued in a ministerial order (under preparation).

For these activities, there is now an obligation to monitor exposure and estimate the doses to which the population is subjected. Furthermore, the Minister for Health may initiate measures to protect against ionising radiation, should this prove necessary in the light of the estimates made. 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 establishment, was introduced into the Labour Code. Should the dose limit of 1 mSv/year be exceeded, steps to reduce exposure should be taken.

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 establishment 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. An order to be published in early 2004 will set the modalities for implementation of these provisions.

In order to collect data about this natural exposure, an observation system named SIEVERT was set up by the Directorate General for Civil Aviation, the IRSN, the Paris Observatory and Paul-Émile Victor French institute for polar research.

1 | 5

Radiological quality of water intended for human consumption and foodstuffs

European Directive 98/83/EC, transposed into national law 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 calculation. The document recently 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. An order to be published in 2004, implementing the decree of 20 December 2002, will use this basis to define new radiological monitoring programmes for the mains water supply and non-mineral bottled waters.

- Several European regulations (Regulation No 3954/87/Euratom and following, Regulation (EEC) No 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

In addition to the general regulations applied, such as those pertaining to radiation protection, described in paragraph 1|2 above, 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 procedures

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 the operator at any time 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 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

Siting

Well before applying for an authorisation decree, the operator provides information to the authorities concerned on the site or sites selected for construction of a BNI, which means that the main site characteristics can 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 Directorate-General for Energy and Raw Materials at the Ministry for Industry will be directly involved. The 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, in all cases 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.

The 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 it must take into account 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 the 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 documents, visit the site, arrange to meet all people wishing to make statements, organise public meetings and request extension of the inquiry period.

When the inquiry is over, he examines the observations of the public entered into the inquiry register or sent to him directly. Within one month of the end of the inquiry, he sends a report and his recommendations to the Prefect.

The departmental or regional offices of the ministries concerned by the project are also consulted by the Prefect.

Finally, the latter sends the report and conclusions of the Inquiry Commissioner, together with his 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 submitted for review by one of the DGSNR Advisory Committees.

In view of the recommendations of the Advisory Committee, the results of the public inquiry and possibly the remarks of other ministers, the DGSNR prepares a draft authorisation decree, if there are no objections.

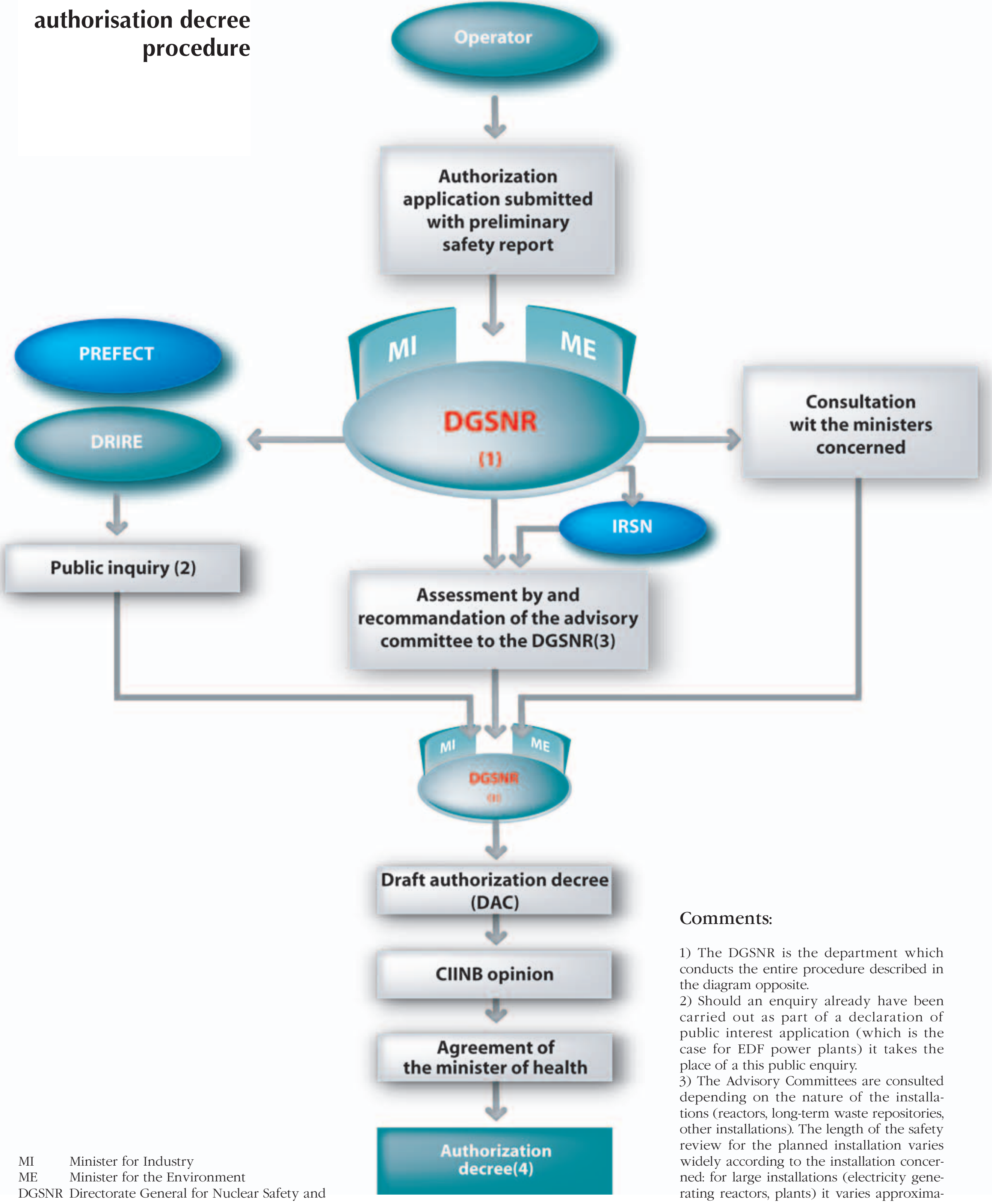
This draft decree is then sent to the Interministerial Commission for Basic Nuclear Installations (CIINB) by the ministers in charge of nuclear safety. The Commission is required to submit its opinion within two months.

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 the Environment and for Industry, defines the perimeter and the characteristics of the installation and the specific require-

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 enquiry 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.

ments which must be met by the operator. It also states the justifications which the operator shall submit both for the commissioning and normal operation of the installation and subsequently for its final shutdown.

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 text applicable with regard to environmental protection or worker health and safety issues.

Authorisation decrees issued or modified in 2003

UP 3-A (La Hague - Manche)	10 January 2003	Decree authorising COGEMA to modify BNI n° 116
UP 2-800 (La Hague - Manche)	10 January 2003	Decree authorising COGEMA to modify BNI n° 117
STE 3 (La Hague - Manche)	10 January 2003	Decree authorising COGEMA to modify BNI n° 118
Perimeters of UP 2-400, STE 2 and AT 1, HAO, UP 3-A, UP 2-800, STE 3 (La Hague - Manche)	10 January 2003	Decree authorising COGEMA to modify the perimeters of BNIs n^{os} 33, 38, 80, 116, 117, 118
Radioactive waste repository (CSM) (Digulleville - Manche)	10 January 2003	Decree authorising the ANDRA to modify BNI n° 66
Uranium clean-up and recovery installation (Bollène - Vaucluse)	10 June 2003	Decree authorising SOCATRI to modify BNI n° 138
MELOX (Chusclan - Gard)	3 September 2003	Decree authorising COGEMA to modify BNI n° 151

2 | 1 | 4

Operating licences

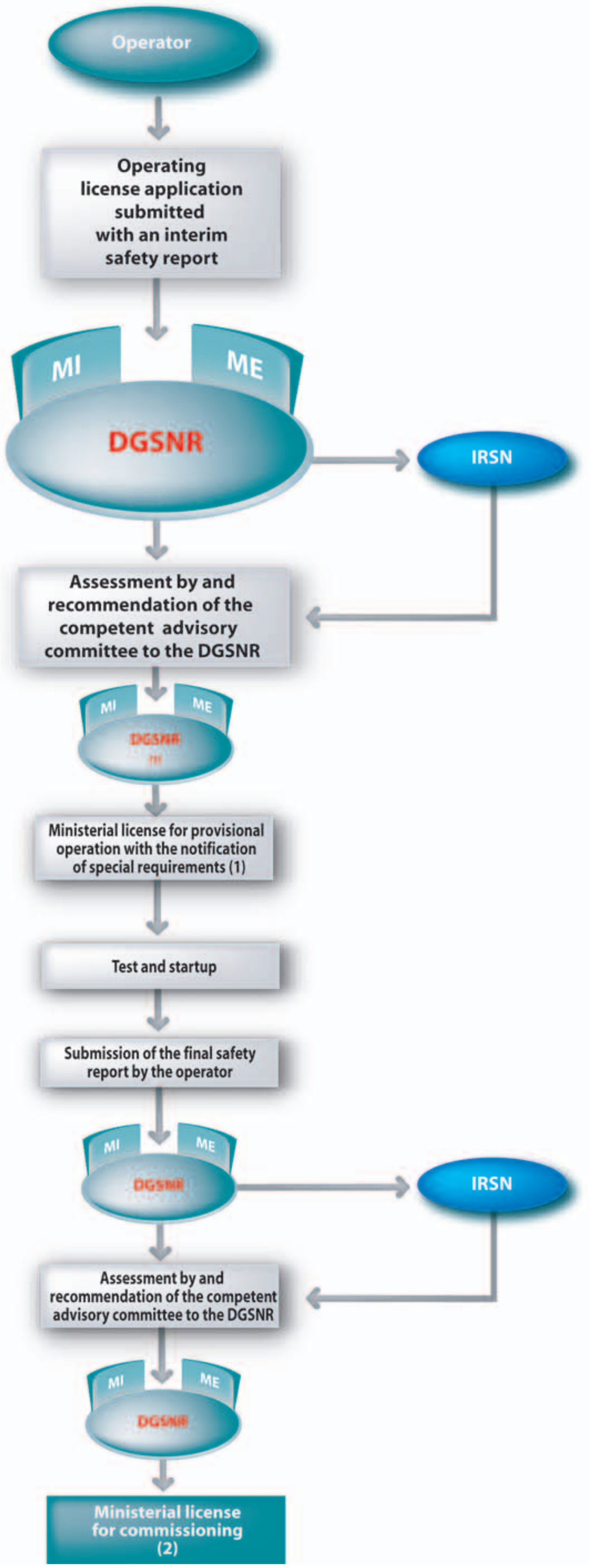
· Procedure applicable to power reactors

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

Moreover, six months before fuel loading, the operator must send the ministers for the Environment and for Industry a provisional safety analysis report together with provisional general operating rules (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. The DGSNR consults the Advisory Committee for nuclear reactors on these documents before drafting its own recommendations. Upon receipt of the latter, the ministers can authorise fuel loading and pre-commissioning tests.

For PWRs, at least four successive licences are required in the startup stages:

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

- 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 nominal 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 the 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;
- a licence for power build-up to 100% of nominal.

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 the 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.

· Procedures applicable to 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 the Environment and for Industry.

This pre-commissioning authorisation is accompanied by notification of technical requirements. It is granted after examination by the 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 definitively 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 the 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 operating licence issued in 2003

CHICADE (Cadarache Saint-Paul-lez-Durance - Bouches-du-Rhône)	28 March 2003	Operating licence for BNI nº 156 given to the CEA

2 | 1 | 5

Final shutdown and dismantling licences

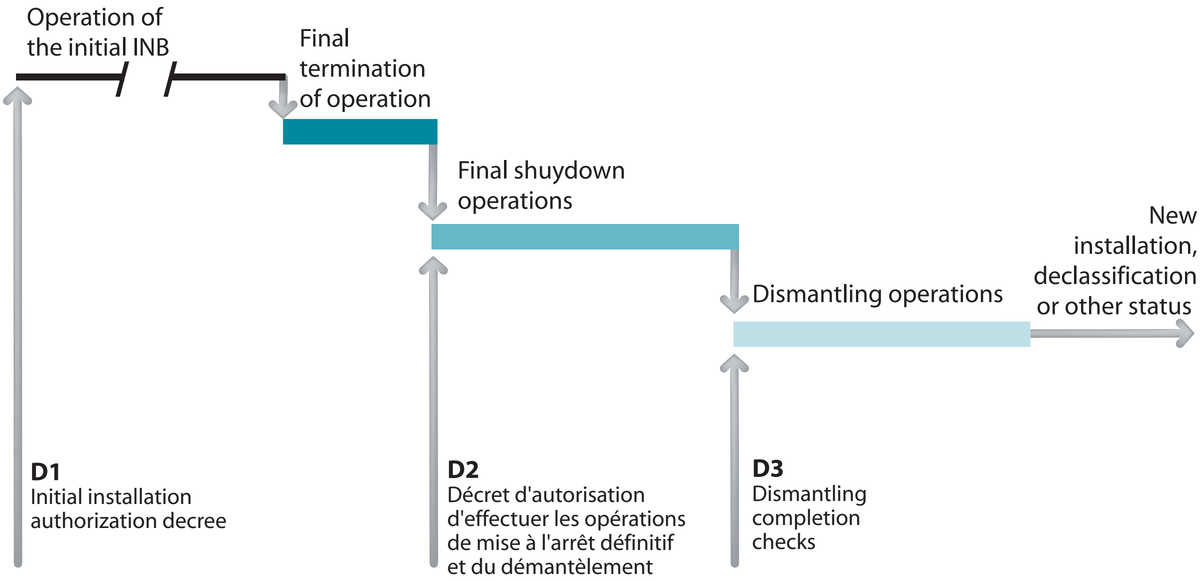
As specified in article 6b of the above-mentioned decree of 11 December 1963, when an operator decides, for any reason, to close down its installation, it must inform the Director General for Nuclear Safety and Radiation Protection, by sending him:
- a document justifying the selected configuration in 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 operations 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 operations.

The implementation of these various provisions is subject to their approval by decree, countersigned by the ministers for the Environment and for Industry, after assent of the Minister for Health and prior consultation of the Interministerial Commission for Basic Nuclear Installations (CIINB).

In some cases, operations such as the unloading and removal of nuclear material, the disposal of fluids, or decontamination and clean-up operations can be performed under the provisions of the authorisation decree for the plant considered, providing they involve no non-compliance with previously imposed requirements nor with the safety analysis report and general operating rules currently in force, subject to certain modifications if necessary. In all other cases, such operations come under the provisions of the 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.



Dismantling of basic nuclear installations

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 on 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 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 operations which are either initiated immediately or deferred only slightly;
- 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 declassification of a BNI and the corresponding criteria.

Licences issued in 2003

NONE

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.

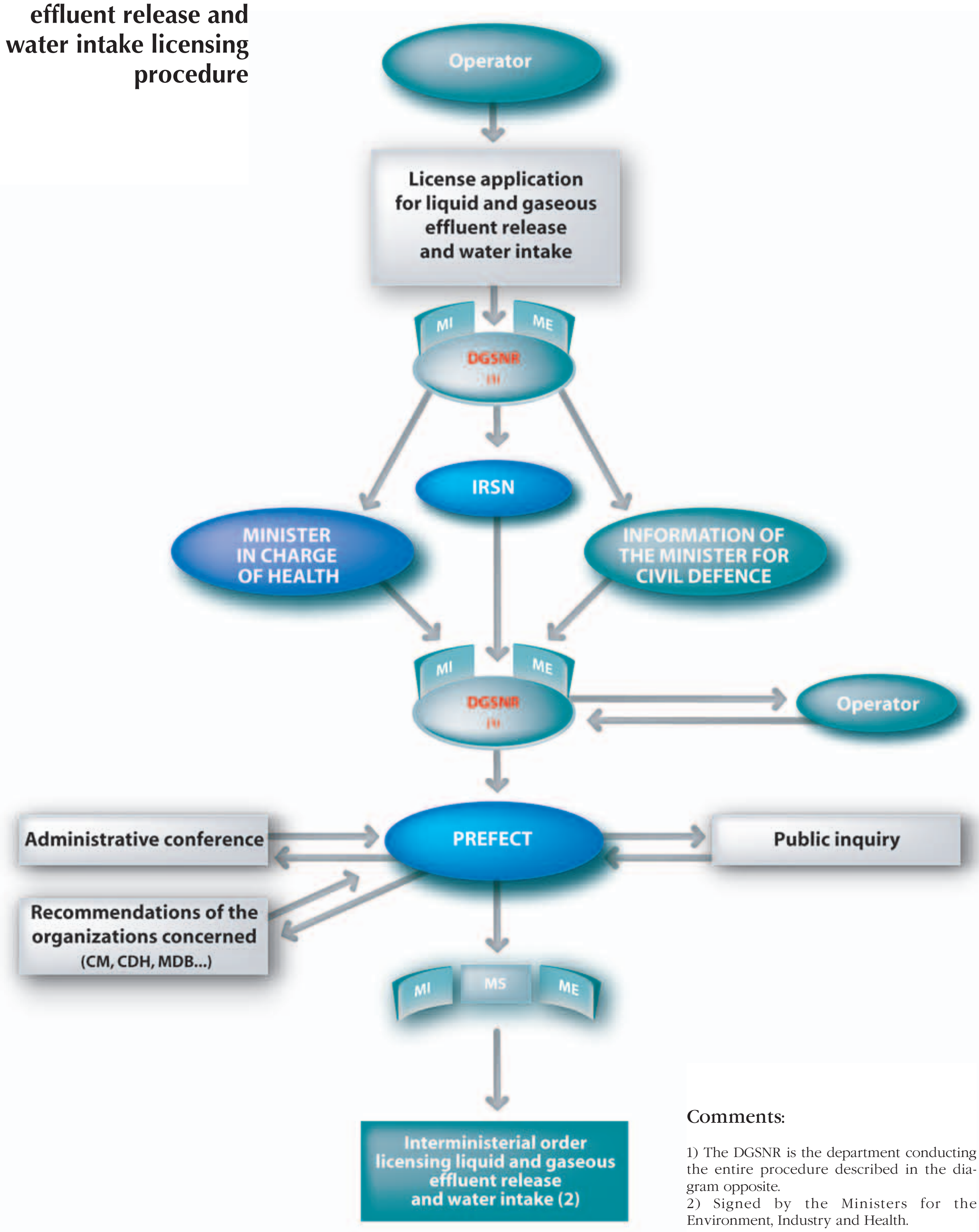
In application of decree 95-540 of 4 May 1995, as modified, on BNI liquid and gaseous effluent release and water intake, the same licence, issued at ministerial level, can where necessary cover both radioactive and non-radioactive liquid and gaseous release and water intake for a given BNI. The procedure 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 the DGSNR.

The procedures stipulated in the above-mentioned decree also apply to the installations classified on 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 licensing application

The effluent release and water intake licence application covers all such operations for which authorisation is required. It is sent to the ministers for Industry and for the Environment. In addition to various drawings, maps and information, it comprises a description of the operations or activities envisaged and an assessment of their impact on human health and on the environment, comprising a list of proposed compensatory measures and the intended surveillance provisions.

Liquid and gaseous effluent release and water intake licensing procedure



Comments:

1) The 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

· 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 the Environment.

· Consultation of the public and local authorities and organisations

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

The Prefect organises an administrative conference between various decentralised State departments which he considers 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.

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 the Environment.

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

Within the framework of general technical rules defined by an order of the ministers for Industry, the Environment and Health of 26 November 1999, which was 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 or activity and of surveillance of environmental effects;

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

d) the way in which the public shall be informed.

At the request of the licensee or on their own initiative, the ministers for Health, for Industry and for the Environment may, after consultation with the Departmental Health Council 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 the 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 licences issued in 2003

Radioactive waste repository (CSM) (Digulleville - Manche)	10 January 2003	Order authorising ANDRA to continue discharging gaseous and liquid effluent for operation of BNI n° 66
Nuclear plant (La Hague - Manche)	10 January 2003	Order authorising COGEMA to continue water intake and liquid and gaseous effluent release for operation of the La Hague site
Nuclear power plant (Chinon - Indre-et-Loire)	20 May 2003	Order authorising EDF to continue water intake and liquid and gaseous effluent release for operation of the Chinon nuclear power plant
Nuclear power plant (Le Blayais - Gironde)	18 September 2003	Order authorising EDF to continue water intake and liquid and gaseous effluent release for operation of the Blayais nuclear power plant
Nuclear power plant (Cruas - Ardèche)	7 November 2003	Order authorising EDF to continue water intake and liquid and gaseous effluent release for operation of the Cruas nuclear power plant
Nuclear power plant (Gravelines - Nord)	7 November 2003	Order authorising EDF to continue water intake and liquid and gaseous effluent release for operation of the Gravelines nuclear power plant

2 | 2

Technical rules

Technical nuclear safety rules and practices are set out in a structured series of texts. They are summarised below in increasing order of detail. The first texts are regulatory, very general, broader in scope but without attention to 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 ministerial order of 26 February 1974 applies to the particular case of the construction of the main primary system of EDF PWRs. Operational supervision of the main primary system and the main secondary systems of PWRs are covered by the interministerial order of 10 November 1999. The DRIRE Bourgogne (BCCN) has particular responsibility for supervising application of these orders.

Decree 99-1046 of 31 December 1999 and the ministerial order of 15 March 2000 on pressure vessels apply to the other pressure vessels.

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

BNI water intake and effluent release which in application of the procedure decree of 4 May 1995, discussed in § 2|1|6 above, are subject to the joint authorisation of the ministers for Health, Industry and the 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 state departments and the general public. Its implementation is detailed in the interministerial circular of 17 January 2002 mentioned above, particularly with regard to the goals and application of the new regulations, depending on whether an initial application or a modification is being dealt with.

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

The current body of general technical regulations will soon be changing, as the DGSNR is working on broadening its 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

The 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 the 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, provided 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 the 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".

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

Work is now proceeding on revision of the 1995 RFS concerning waste packages for surface disposal. A draft, based notably on the safety assessment results obtained for the Aube repository in 1999, on ANDRA operating feedback and on a series of ASN inspections, was transmitted to the operators. The draft should be examined by the Advisory Committee for Waste in late 2004 or in early 2005.

Re-examination of RFS I.4.a on fire protection in BNIs other than reactors, began in 1999 and showed that 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. A second step will consist in revising RFS I.4.a to bring it into conformity with the order and the circular.

2 | 2 | 3

French nuclear industry codes and standards

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

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

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

These documents are drawn up by the manufacturers and not by the Nuclear Safety Authority, which nevertheless examines them in detail, both in their initial and revised versions. In most cases, their contents are then integrated into a Basic Safety Rule, thereby confirming their relevance at the time of publication.

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

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

With a view to ensuring cohesion with the RCC-M code, the AFCEN, as from 1990, undertook the drafting of a set of “rules for in-service surveillance of mechanical equipment” (RSEM), the first edition of which was available in 1997. Under the impetus of the ASN, EDF undertook to ensure compliance of this code with the ministerial order of 10 November 1999 (referred to in § 2|2|1), which gave rise to publication of a new edition of the RSEM. This new version was accepted by the DGSNR in June 2002 and has been applied to all nuclear power plants since January 2003. Codification work is continuing in order to complete code conformity with the order of 10 November 1999, a process which entails discussions with the DGSNR.

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 the 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 opinion of the Council of State:

– Basic Nuclear Installation “equipments” are these constituting elements 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 in charge of BNIs 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 must comply are notified by the ministers in charge of BNIs.

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.

The DGSNR conducts the examination procedure of the 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.

APPENDIX 1

VALUES AND UNITS 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 humans. Transposition of directive 96/29 Euratom led to updating of the definitions of the main parameters used in radiation protection (Appendix 1 of Decree of 4 April 2002).

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 taken, 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 dose 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 radiaiton 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:

$$H_T = \Sigma_R \, w_R \, D_{T,R}$$

The equivalent dose unit is the sievert (Sv).

The ICRP's values for w_R which were published in an interministerial order on 1 September 2003 (J.O. of 13 November 2003) are shown 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 (τ) 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 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 [HT(τ)] 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(τ), 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 late 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.

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[1] For the calculations, the "other" organs are represented by a list of 12 organs for which there can be selective irradiation through 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 is given to the mean dose received by the other 11 organs. the sum of the various w_T is equal to 1, which corresponds to uniform irradiation of the whole body. The w_T values are appropriate to expressing 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 wR 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 to be 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 Pi members of the ith subgroup of the population or group.

The collective dose unit i 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	Comments
Annual limits for the general public Art. R.1333-8 of 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 exosed)	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.
Worker limits for 12 consecutive months Art. R.231-77 of CT	Adults: • Effective doses for the body • Equivalent doses for the hands, forearms, feet and ankles • Average dose over any area of 1cm^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. These are limits that must not be exceeded. ☞ As an interim measure, for a period of 2 years, the whole-body limit is dose 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 ceiling 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	Comments
Diagnostic examinations Reference level diagnostic Art. R.1333-68	Dose levels for standard diagnostic examinations	e.g., entry level 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 accordance to 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 2004	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 (target-organ or target-tissue) during radiotherapy (experimentation)		

Intervention trigger levels in case of radiological emergencies (Public Health Code)

	Definition	Values	Comments
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 with the relevant response decision to protect the population: • sheltering • evacuation • administration of stable iodine (thyroid dose)	 10 mSv 50 mSv 100 mSv	☞ The Prefect can make adjustments to take account of local factors.
Protection of rescuers Reference levels Art. R.1333-86	These levels are expressed as effective dose: • for the special teams for technical or medical intervention • for the other rescuers	 100 mSv 10 mSv	☞ This level is raised to 300 mSv when the intervention is designed to prevent or reduce exposure of a large number of people.

Action trigger levels (Public Health Code and Labour Code)
(Activity or dose levels above which action must be taken to reduce exposure)

	Definition	Values	Comments
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 general public Art. R.1333-15 and 16 of the CSP	Premises open to the public	400 Bq/m^3 1000 Bq/m^3	☞ Above 1000 Bq/m^3, temporary closure of the premises may be effective pending performance of the work.
Worker protection Art. R.231-115 of the CT	Working environments	400 Bq/m^3	
Enhanced natural exposure (other than radon)			
Protection of the general public Art. R1333-13 and 14 of the CSP		None	☞ Any population protection action to be taken will be defined on a case by case basis.
Worker protection Art. R.231-114 of the CT	Effective dose	1 mSv/year	
Water intended for human consumption Decree n° 2001-1220 of 20 December 2001	Annual total indicative dose (TID), calculated based on the radioelements present in th water, except for tritium, potassium 40, radon and daughter products	0,1 mSv	☞ 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	100 Bq/L	☞ Tritium is a contamination indicator.
Foodstuffs (emergency situation) European regulations *Codex alimentarius…*	Commercialization limits		See folowing table

Consumtion 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 foods, 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 produce**	**Other foodstuffs** excerpt minor foodstuffs	**Liquid** foodstuffs
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	1 000	1 250	1 000

Maximum allowable radioactive contamination levels of feedingstuffs (caesium 134 and caesium 137):

Pork:	1250 Bq/kg
Poultry, lamp, 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
Iode 131, caesium 134, caesium 137	1 000
BABY FOODS AND MILK	
Americium 241, plutonium 239	1
Iodine 131, strontium 90	100
Caesium 134, caesium 137	1 000

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[1] *Council regulation (Euratom) n° 3954/87 of 22/12/1987 and following.
Regulation n° 2219/89/EEC.

CHAPTER 4

1 BNI SUPERVISION

1|1 Scope of supervision
1|1|1 Nuclear safety
1|1|2 Radiation protection
1|1|3 BNI design, construction and operation quality
1|1|4 Pressure vessels
1|1|5 Environmental protection
1|1|6 BNI working conditions

1|2 Supervision procedures
1|2|1 Inspection
1|2|2 PWR outage supervision
1|2|3 Pressure vessel supervision
1|2|4 Technical examination of operator files

1|3 ASN decisions and formal notices
1|3|1 General framework
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2 SUPERVISIONS OF NON-BNI RADIATION PROTECTION

2|1 Scope of supervision

2|2 Supervision procedures
2|2|1 Radiation protection inspection
2|2|2 ASN examination of the procedures laid down by the Public Health Code

3 OUTLOOK

4

CHAPTER

SUPERVISION OF NUCLEAR ACTIVITIES

The purpose of Nuclear Safety Authority (ASN) supervision is to ensure that all users of ionising radiation fully comply with their responsibilities and obligations with regard to radiation protection.

In the case of BNIs, this verification encompasses nuclear safety. This external supervision by no means exempts the user of ionising radiation from organising his own supervision of his activities. In the particular case of BNIs, ASN supervision involves both inspection of all or part of an installation as well as examination of files, documents and information provided by the operator to justify its actions. This supervision applies to all stages in the life of the installations: design, creation, commissioning, operation, final shutdown, dismantling.

In other areas, 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

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 circuit (CPP) and main secondary circuit (CSP) equipment.

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 § 2|1|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.

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

Nuclear safety supervision assignments are carried out, within the ASN, by the Directorate General for Nuclear Safety and Radiation Protection (DGSNR) and its Regional Divisions (DSNR) within the Regional Directorates for Industry, Research and the Environment (DRIRE). The 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 co-ordinating 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

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 examining specific files and on the occasion of 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 deviations and incidents be stringently dealt with and that preventive measures be taken;
- that suitable documents testify to results obtained;
- that the operator supervise the service companies used and check compliance with procedures adopted to guarantee quality.

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

1 | 1 | 4

Pressure vessels

1 | 1 | 4 | 1

Present situation

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

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

Among the BNI pressure vessels within the scope of the ASN, the main primary and secondary systems of the 58 EDF PWRs are 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:
- for the design and construction stage, on the ministerial order of 26 February 1974, concerning the main primary system, and on Basic Safety Rule II.3.8 (1990), concerning the main secondary system;
- for the operating stage, on the ministerial order of 10 November 1999, covering requirements for both these systems.

Pressure vessel operation is covered by supervision particularly focused on non-destructive tests, maintenance operations, the handling of nonconformities affecting these systems and periodic requalification of them. The principal PWR main and secondary system files currently being dealt with are discussed in Chapter 11.

1 | 1 | 4 | 2

Current developments

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

The 13 December 1999 decree, thus replaces the decree of 2 April 1926 for steam pressure vessels and the decree of 18 January 1943 for gas pressure vessels.

A process of updating nuclear regulations was however initiated in order to take account of changes in the conventional sector and of experience feedback.

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

The second step, today in progress, consists in:
- regulating all the other BNI pressure vessels which are not covered by the European directive. This concerns pressure vessels which are "specially designed for nuclear uses, the failure of which could lead to radioactive emissions". The year 2003 was devoted to defining requirements graduated according to the gravity of the radioactive emissions, in order to lead to a draft ministerial order, which is now the subject of consultation with industry and the organisations concerned;
- updating the regulatory provisions concerning the construction of PWR main primary and secondary systems. The technical rules approved by the Standing Nuclear Section of the Central Committee for Pressure Vessels in October 1999 were forwarded to the manufacturers concerned as the reference system both for any future construction work as well as for the replacement of large components necessary to the upkeep of the nuclear power installed fleet. These requirements constitute the basis of the construction regulatory provisions. They are now incorporated into the draft order mentioned above, which will eventually supersede the applicable chapters of the order of 26 February 1974 and RFS II.3.8.

1 | 1 | 5

Environmental protection

The prevention and limitation of environmental hazards and detrimental effects due to BNI operation are ensured by application of the following legislation:
- the decree of 11 December 1963 concerning BNIs, further defined by its implementing order of 31 December 1999 which sets out general requirements concerning the prevention of environmental risks (notably accidental contamination) and noise pollution, together with BNI waste management;
- the legislation concerning installations classified on environmental protection grounds and included within the perimeter of BNIs;
- the decree of 4 May 1995 concerning BNI liquid and gaseous effluents release and water intake, further defined by its implementing order of 26 November 1999 and the circular of 20 January 2002.

Generally speaking, ASN policy regarding environmental protection tends towards that applied to conventional industrial activities. For example, the order of 26 November 1999, prescribing general technical provisions regarding the limits and 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.

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

In line with this policy, the ASN has for several years been developing inspections focused on effluent and waste management and on the implementation of rules applicable to installations classified on environmental protection grounds. This action is intensifying, owing to the inspection procedures involving sampling which have been in force since 1 January 2000 (see § 2|1).

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 nuclear power plants, these functions are entrusted to DRIRE personnel, under the supervisory authority of the DIDEME (Directorate for Energy Demand and Supply Contracts) at the Ministry for the Economy, Finance and

Industry, acting on behalf of the Ministry for Labour. The DRIRE 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. For this reason, the ASN, the DIDEME and the labour inspectors endeavour to co-ordinate their respective actions to the extent possible.

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

1 | 2

Supervisions 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 plant safety.

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 DRIRE, 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 a ministerial order signed jointly by the ministers for the Environment and for Industry. Their supervisory functions are carried out under the authority of the Director General for Nuclear Safety and Radiation Protection. The inspectors take an oath and are bound to professional secrecy.

1 | 2 | 1 | 2

2003 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.

It is to be noted that the more complex inspections are directed by senior inspectors (see Chapter 3).

· Inspections in 2003

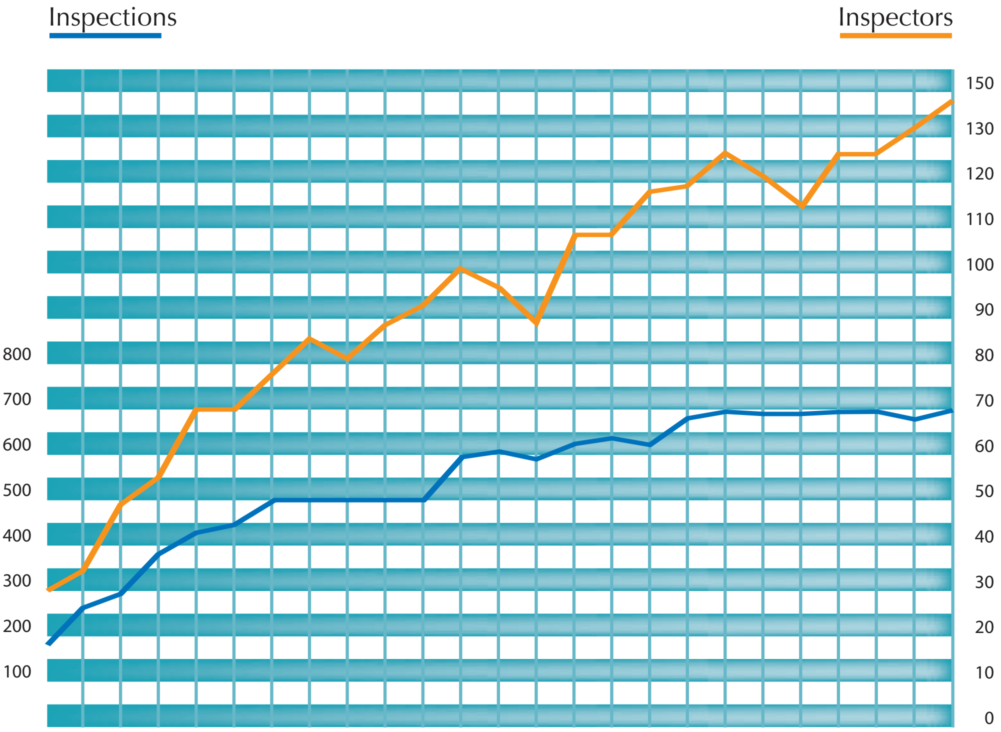
As at 31 December 2003, there were 143 BNI inspectors, including 76 at the DRIRE, 67 at the DGSNR, 1 on assignment with the United Kingdom's nuclear safety authority. The list of these inspectors is given in Appendix A.

In 2003, 670 inspections were carried out, 176 of which were unannounced. The breakdown according to various plant categories is illustrated in graphs on the following page.

The topics dealt with include the following, some of which were priority issues for 2003 and will be the subject of a summary analysis:

- Radiation protection, interventions (ALARA)	9 inspections
- Instrumentation and control, automatic device	13 inspections
- CEA internal authorisations system	4 inspections
- Safety management 15 inspections	15 inspections
- Radiation protection management - ALARA	16 inspections
- Maintenance/operation	17 inspections
- Application of the order of 10/11/1999	17 inspections
- Fire	46 inspections

Trends in numbers of inspectors and of inspections



Year		**80**		**82**		**84**		**86**		**88**		**90**		**92**		**94**		**96**		**98**		**00**	**01**	**02**	**03**
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
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

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.

1 | 2 | 2

PWR outage supervision

EDF takes advantage of refuelling outages to inspect all installations and check their condition by carrying out tests (see chapter 11, § 2|2|4). These operations, which are particularly important as indicators of the current state of installations, are closely followed by the ASN, notably in the course of site inspections, when the inspectors spot-check the conditions in which operations take place on various work sites, whether these concern plant renovation or modification, equipment in-service inspection or the periodic testing of components.

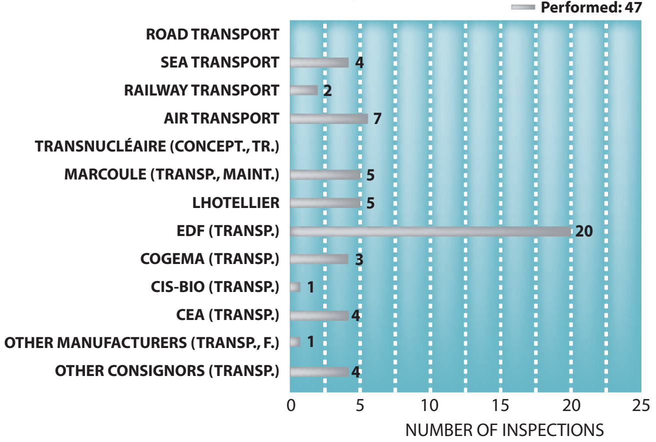
1 | 2 | 3

Pressure vessel supervision

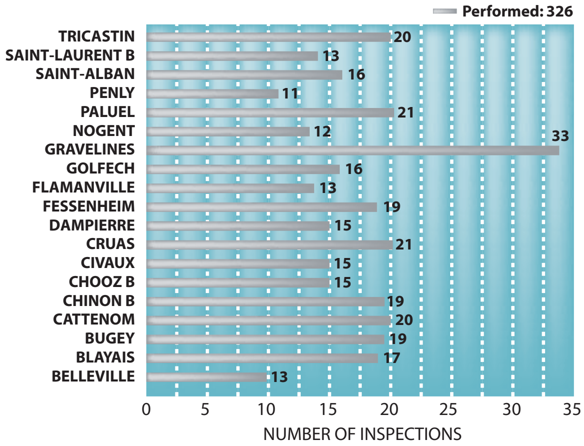
Within the ASN, the fifth sub-directorate (BCCN) supervises application of the relevant regulations covering PWR main primary and secondary systems, together with all nuclear pressurised systems.

INSPECTIONS 2003

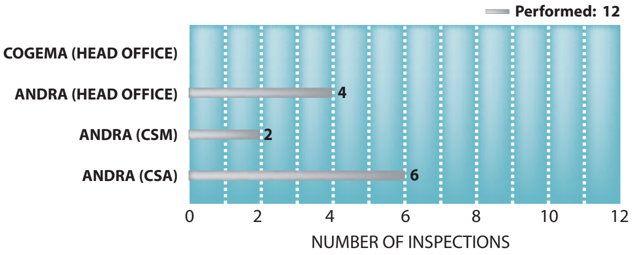
Transport



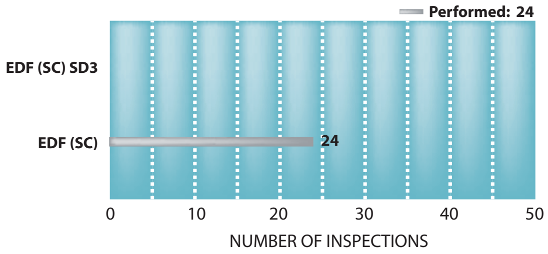
PWR



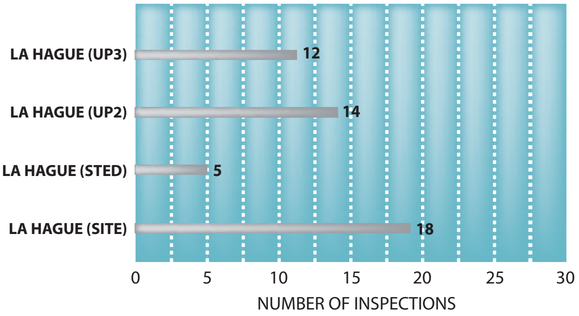
Wastes



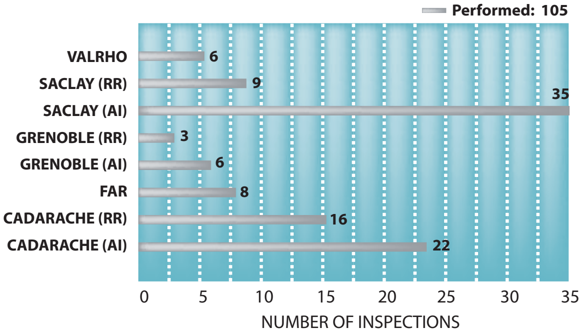
EDF contractors and Head office departments



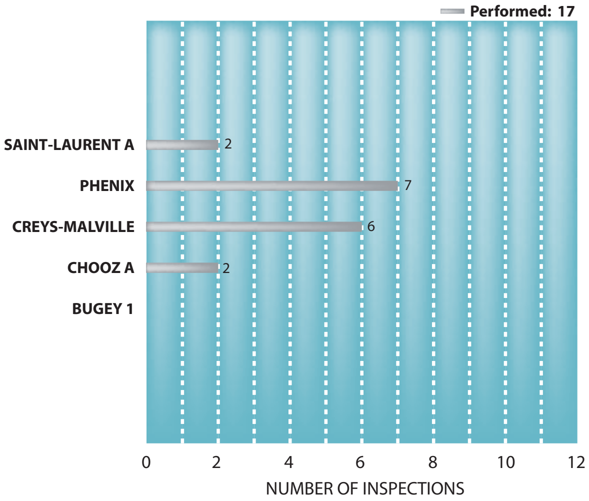
COGEMA La Hague



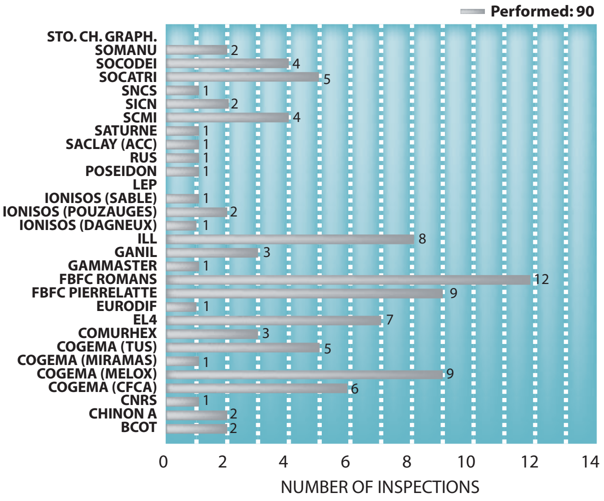
CEA nuclear research center



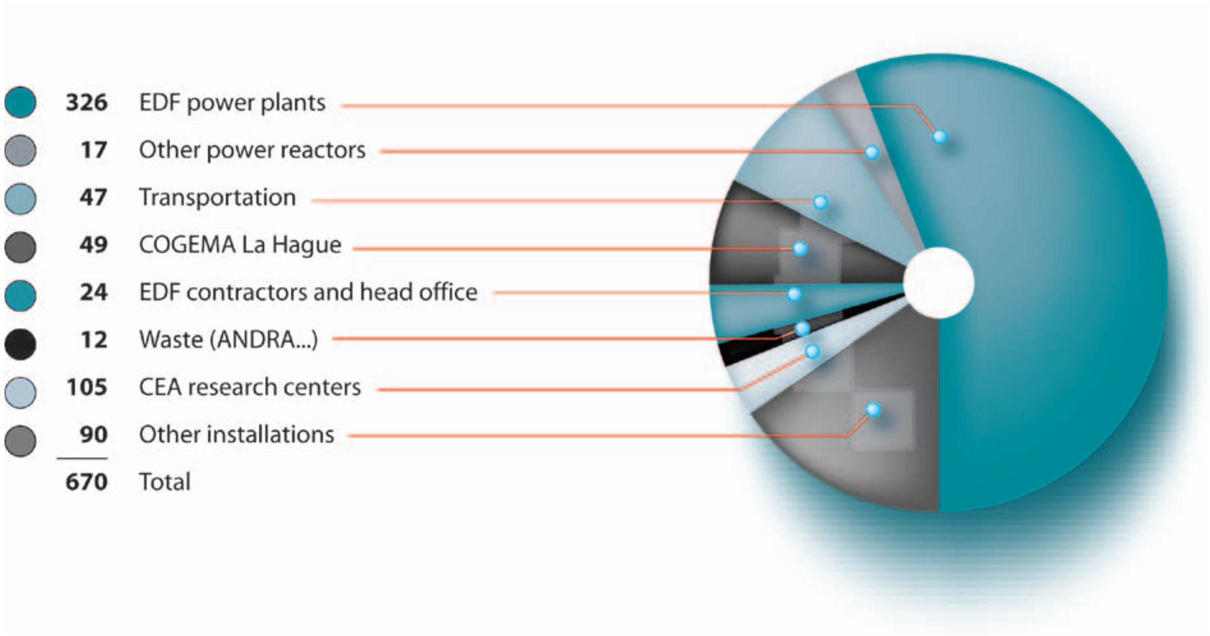
Other reactors



Other installations



Breakdown of inspections carried out in 2003



It directly supervises the construction (design and manufacture) of PWR main primary and secondary systems (see Chapter 10 § 3|1). 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 | 4

Technical examination of operator files

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

1 | 2 | 4 | 1

Main areas concerned

- **Significant incidents**

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

The immediate investigation of significant incidents at all Basic Nuclear Installations is entrusted to the 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 DRIRE 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.

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

Approval of outage programmes has been a 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 submits routine activity reports and summary reports on water intake, liquid and gaseous release and the waste produced.

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

1 | 2 | 4 | 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. This does not mean that consensus has to be reached at any price, but that arguments have to be exhaustively developed. When all the arguments have been exchanged, the regulatory decisions are imposed.

Ensuing actions include the following:
- granting or refusal of the requested authorisation;
- requests for 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 2003, we could mention the example of the 7 January 2003 decision concerning authorisation for the power increase in the Phénix reactor in Marcoule.

The formal notices are injunctions addressed to operators, notably further to non-compliance with:
- a general regulatory text;
- a text specific to a given installation;
- a decision;
- a commitment made to the ASN.

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

In 2003, we could mention the examples of formal notice to the Comurhex company owing to non-compliance with fire-protection requirements in its Pierrelatte plant, and the CEA in Saclay owing to non-compliance with technical requirements in the high-activity laboratory (BNI n° 149).

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 SUPERVISION OF NON-BNI RADIATION PROTECTION

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 in any way 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 Product 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

Since its creation in 2002, the DGSNR has concentrated on organising and developing inspection of radiation protection outside BNIs. At the same time, it identifies inspection priorities, defines intervention modalities and deploys the necessary staff.

The ASN will ensure that an effective and proportionate inspection system is set up, taking advantage of the experience of the members of the Permanent Secretariat of the CIREA and the OPRI who have joined it, and calling on the decentralised departments of the State, for whose field actions it is responsible. The ASN also listens closely to all parties concerned by the use of ionising radiation, and keeps an open mind on foreign practices.

The nuclear transparency and safety bill comprises requirements which will back up the regulatory tools in this inspection framework, which will achieve full maturity once the additional one hundred and fifty inspectors gradually become operational..

2 | 2 | 1 | 1

Current inspections

While preparing to develop inspection of radiation protection, the ASN in 2003 carried out the following non-BNI inspections:

2 | 2 | 1 | 2

ASN preparation for a radiation protection inspection

The Director General for Nuclear Safety and Radiation Protection decided that two DRIREs, those of the Basse-Normandie and Rhône-Alpes regions, were to conduct a “reconnaissance” mission, until the end of 2003, to launch radiation protection monitoring practices in non-BNI areas. This mission is being conducted in parallel with another, entrusted by the Director General for Nuclear Safety and Radiation Protection to an independent group of experts, responsible for proposing priority areas for action in the field of radiation protection. At the same time, a working group comprising representatives of the DRIREs, DRASS and DDASS was tasked with drawing up procedures for co-operation between these entities in this field. Finally, a working group comprising representatives of the ASN, DARPMI and DRIREs was tasked with considering the future organisation of the DRIREs in the light of their expansion to cover inspection of radiation protection.

Lessons of the reconnaissance mission

The main goal of the “reconnaissance” mission was to ascertain the scope of radiation protection inspection by the DSNRs, identifying the ASN’s local contacts and the radiation protection issues. It also began to define the content of radiation protection inspections. For the duration of this mission, the ASN’s role was that of observer rather than inspector.

This mission comprised two phases: learning and understanding, then preparing for inspection.

Learning and understanding

The purpose of this phase was to identify the local stakeholders concerned in one way or another by radiation protection supervision, to understand their roles and how they operate and to make the ASN known to them by explaining its role and functions. The local stakeholders are on the one hand institutions, in other words representatives of the State’s decentralised services in the regions and departments, and on the other the users of ionising radiation. Contacts were also made with organisations approved by the Ministry for Labour, which carry out first-level supervision of users of ionising radiation.

This phase highlighted the need for close cooperation with the many institutional stakeholders concerned, including the inspectorate for classified installations within the DRIREs, the decentralised departments of the Ministry for Health (DRASS et DDASS), the regional hospitalisation agencies, the regional social security agencies, the decentralised departments of the Ministry for Labour (DRTEFP, DDTEFP).

Summary of medical installation inspections

	Commissioning	Periodic	After incident	Total
Radiotherapy	30	46	1	77
Brachytherapy	10	13		23
Nuclear medicine	17	29	3	49
Irradiators	1	2		3
Radiology		3		3
Total	58	93	4	155

Summary of industrial and research installation inspections

Industrial or research establishments	9
Establishments supplying radioactive sources	8
BNI and transports (topic: radioactive source management)	6
Total	**23**

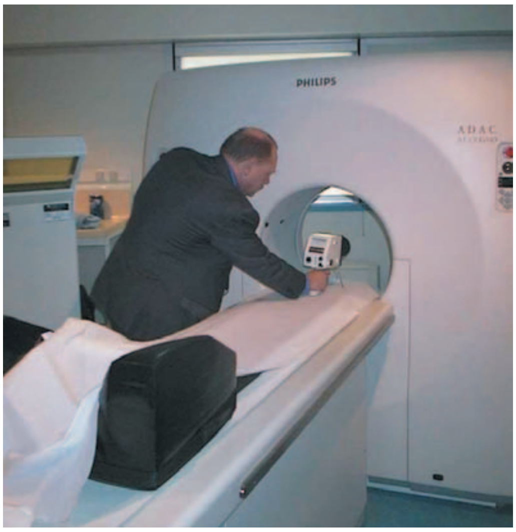
The reconnaissance mission also showed the key role of the organisations approved by the Administration for providing radiation protection training, first level inspections and analyses. For supervision of the safety of nuclear activities to be effective, two levels of outside inspection seemed to be desirable: systematic continuous supervision by approved organisations, themselves supervised by the State, and more detailed supervision conducted directly by the State, with the intensity of inspection being proportional to the risks inherent in the installations. The Lyon DSNR therefore set up a protocol with certain organisations, whereby the ASN is informed of any significant nonconformities. This could be the forerunner of the future relations between the ASN and the approved organisations.

Preparing for inspection

Another aim of the reconnaissance mission, which led to about a hundred reconnaissance visits to the users, was to prepare radiation protection inspection methodology and tools.

With regard to inspection methodology, the need became apparent for more diverse inspection modalities and types. Initial estimates indicate that each inspector could carry out about twenty inspections per year, with the frequency of the visits being tailored to the risks (for example, every 2 years for hospitals and universities). Inspection guides were also drawn up for certain standard installations (industrial gammagraphy) to make the inspectors’ task easier.

Although a number of questions still have to be answered, this mission led in 2004 to a radiation protection inspection program being set up in the Rhône-Alpes and Basse-Normandie regions. As for the other Regions, in which not enough DRIRE staff are yet assigned to radiation protection, they will continue the reconnaissance mission, taking account of the experience gained by the pilot regions. All these actions are coordinated by the DGSNR.



TEP inspection

Relations with the DDASS and the DRASS

The working group tasked with examining the working methods between DDASS/DRASS and DRIRE concluded that in the light of the emphasis being given by the Health Ministry's delegations in the regions to environmental health issues, the DDASS and DRASS would have every interest in concentrating on management of the radon-related risk in the home and in premises open to the public, and on radiological monitoring of water intended for human consumption. These departments will also take part in managing radiological emergency situations and contaminated sites and will continue to look closely at the radiological impact of the main nuclear activities. A DGSNR circular sent out to the DDASS and DRASS will formalise these duties.

DRIRE organisation

The working group tasked with looking at the future organisation of the DRIREs radiation protection inspection activities has submitted it conclusions. They were discussed with the DRIRE directors and ratified by the DGSNR. These conclusions were drawn up on the basis of the creation of 150 radiation protection inspector positions, the principle of which had already been accepted by the government in 2002. The organisation of DRIRE non-BNI radiation protection inspections will eventually be based around 11 inter-regional divisions, the 9 existing DSNRs and 2 new DRs, one in Paris and one in Nantes. In 2004 the available workforce will be divided among the inter-regional headquarters, to avoid over-diluting the resources; a DSNR or a DR will be placed at the disposal and under the authority of each DRIRE. Subsequently and according to the experience acquired and the staff available, units linked to the DSNRs will be set up in the other regions, in the vicinity of the installations.

2 | 2 | 2

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.

The ASN's actions in this field in 2003 are explained in chapters 8 and 9.

3 OUTLOOK

2003 was marked by intense work which, with respect to non-BNI nuclear activities, focused on preparations for setting up radiation protection supervision in 2004, to ensure that every user of ionising radiation in France fully assumes his radiation protection responsibilities and obligations.

At the same time as working towards radiation protection inspection, the ASN is continuing its efforts to improve supervision of nuclear safety, as part of a process of continuous improvement.

CHAPTER 5

1 DEVELOPMENT OF RELATIONS BETWEEN THE FRENCH 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 viewdata magazine MAGNUC
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 matters under close supervisions" exhibition

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 2003.

In this chapter, and since this report was first initiated, the ASN has striven to describe as accurately as possible the action it takes and the tools it uses for information of the public and to ensure transparency.

As of the 2003 report, to further emphasize its desire for transparency and plurality, the ASN also wished to present the tools and actions used by other stakeholders in the nuclear field to inform the public about nuclear safety and radiation protection.

The ASN aims to expand its actions without waiting for future regulatory provisions concerning nuclear safety and transparency, in particular those concerning information of the public as contained in the future guideline energy bill.

1 DEVELOPMENT OF RELATIONS BETWEEN THE FRENCH 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 Installations 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 and technology enables the information to be circulated faster than ever before. Through the media, the population is expressing a desire for ever more precise information and for its part, the ASN hopes to provide an increasingly clearer picture of what it is doing.

This naturally leads the French Nuclear Safety Authority to take further steps towards a more transparent approach, year after year.

Just as it tries to avoid saturating the information channels and strives to set up support, awareness and even training programs enabling the citizens or their representatives to gain easier access to information, the ASN whenever possible informs the various relays of opinion.

It in particular contributes to regular information of the media, by organising thematic press conferences as well as encourages the action of the Local Information Committees (CLIs). The French Nuclear Safety Authority also handles the secretarial duties of the High Council for Nuclear Safety and Information (CSSIN), reporting to it on a regular basis. The ASN maintains ongoing relations with elected representatives and environmental protection associations.

This desire for and action in favour of transparency by the French Nuclear Safety Authority are today reinforced by the content of the future nuclear safety and transparency bill, which will 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 in particular 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

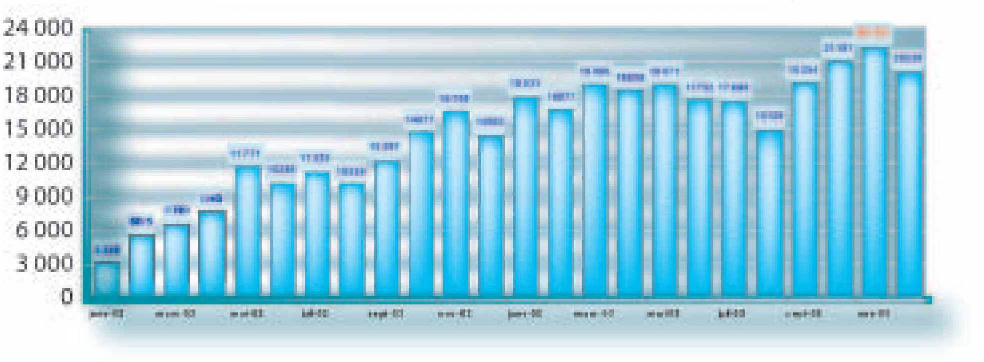
1 | 2 | 1

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.

As part of the ASN's desire for transparency, the www.asn.gouv.fr site has, since 1 January 2002 been publishing the results of all the inspections (about 650 annually) conducted on the basic nuclear installations by the ASN's engineers, along with the letters sent to the operators after each inspection. Along the same lines, the ASN aims in 2004 to put on-line information concerning its investigative work conducted during pressurised water reactor unit outages.

Home page of ASN web site : www.asn.gouv.fr



Monthly statistics for 2003 visitors to the ASN site

The CLIs and CSSIN also each have a section, for which they have editorial responsibility, accessible from the site's home page.

The number of visitors to the www.asn.gouv.fr site is constantly rising, with more than 225,000 in 2003.

1 | 2 | 2

The ASN s viewdata magazine MAGNUC

The MAGNUC viewdata magazine was set up by the ASN in 1987 at the recommendation of the CSSIN. It took over from a data bank created following the Chernobyl accident and which was consulted by more than 25,000 people. MAGNUC also provides the public with information on nuclear safety and radioactivity measurements in the environment.

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.

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 the steps taken during the previous year by the ASN to supervise and improve the safety of French civil nuclear facilities and of the transport of radioactive materials, and to monitor and limit exposure of the population and workers 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 web site 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 CLIs, 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.

Contrôle has a publication run of nearly 10,000 copies and 2003 was marked by a 20% rise in the number of subscribers, primarily due to those interested in radiation protection.

Contrôle consists of two parts.

The first part of *Contrôle*, devoted to news, comprises four sections which report on the ASN's activities over the last two-month period: site by site presentation of information concerning French facilities, the transport of radioactive materials, ASN decisions and formal notices, the activities of the CLIs, the CSSIN, the Interministerial Commission for Basic Nuclear Installations (CIINB), the advisory committees and finally international relations.

The second part of *Contrôle*, entitled "Dossiers de Contrôle", presents as special report on an aspect of nuclear safety or radiation protection. Apart from stating the ASN's position on the subject, Contrôle offers a forum for a wide-ranging spectrum 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 "face the press" sessions organised to coincide with each issue of *Contrôle*, are regularly attended by journalists from the general and specialised "nuclear" 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 2003 *Contrôle* covered the following subjects:

- January → Safety and competitiveness (n° 150)
- March → Nuclear safety and radiation protection in France in 2002 (n° 151)
- May → Dismantling of nuclear facilities: the new picture (n° 152)
- July → Radon: risk assessment and management (n° 153)
- September → Maintenance issues (n° 154)
- November → Probabilistic safety studies (n° 155)

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).

Covers of the issues of *Contrôle* published in 2003

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.

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, discipline ands transparency”. This brochure is widely distributed at the meetings and events in which the ASN takes part.

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.

The purpose of these sheets is to be distributed widely to various audiences: general public, a more informed public, professional public. They are available at the exhibitions and symposia attended by the ASN and from various outlets such as the CLIs and pedagogical documentation centres. They are also available to the DSNRs (Nuclear Safety and Radiation Protection Departments) for local communication operations.

The first of these sheets, intended for the general public, is devoted to “stable iodine intake in the event of a nuclear accident”. It in particular presents the absorption of stable iodine as a means of preventing the possible effects on the thyroid gland of a release of radioactive iodine.

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" brochure

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. This collection will comprise further issues in 2004.

"Medical, industrial and research uses of ionising radiation: declarations and authorisations" publication

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 fifth edition is planned for 2004.

Code of nuclear safety regulatory texts

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 edition, which will in particular take account of regulatory changes since 22 February 2002, is planned for 2004. The regulatory texts currently applicable are available on the ASN’s web site.

Code of ionising radiation protection regulations

1 | 3

The public information and documentation centre

The ASN has opened a public information and documentation centre in its Paris headquarters, at 6, place du Colonel Bourgoin, 75012 Paris (telephone +33 1 40 19 87 23).

This centre gives visitors an opportunity to consult documentation concerning the Nuclear Safety Authority’s areas of competence.

To gain a clearer idea of the assignments, duties and activities of the ASN, as well as the methods of supervising nuclear safety and radiation protection in France, visitors to this centre in particular have access to all ASN 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 (CLIs, 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.

Information and documentation center of ASN

Finally, certain categories of visitors, such as association representatives, elected officials, journalists and researchers, may want to consult original administrative documents. Again with transparency in mind, 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 information centre can accommodate 10 visitors at any time and offers web access, in particular for consulting the ASN's web site and those of the other stakeholders in the sector. Video documents can also be viewed there.

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, as the primary means of accessing public opinion. 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 facilities, environmental release authorizations, etc.);
- the decisions taken and stances adopted on sensitive nuclear safety and radiation protection issues;
- the loss or theft of radioactive sources;
- noteworthy incidents at French nuclear plants, especially those rated at level 2 and above on the INES scale.

In 2003, questions from journalists mainly concerned the consequences for nuclear power plants of the summer heat wave and drought and the problems posed by December's bad weather in the Rhone valley.

In order to optimise its media information performance, the ASN has increased the size of its communication team, who aim to offer the best answer as quickly as possible to questions from journalists and to satisfy requests for interviews.

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 2003, this communication training 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.

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.

In 2003, international discussions began on the creation of a severity scale for classifying radiation protection incidents. It could be applied in France during the course of 2004.

Use of the INES scale in France

All events with significance for nuclear safety are 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 web site;

- 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.

Niveaux	Réacteurs à eau sous pression	Autres installations	Transports	Total
3 et +	0	0	0	0
2	1	0	0	1
1	104	34	10	148
0	566	105	50	721
Total	671	139	60	870

Rating of nuclear events on the INES scale in 2003

1 | 4 | 2

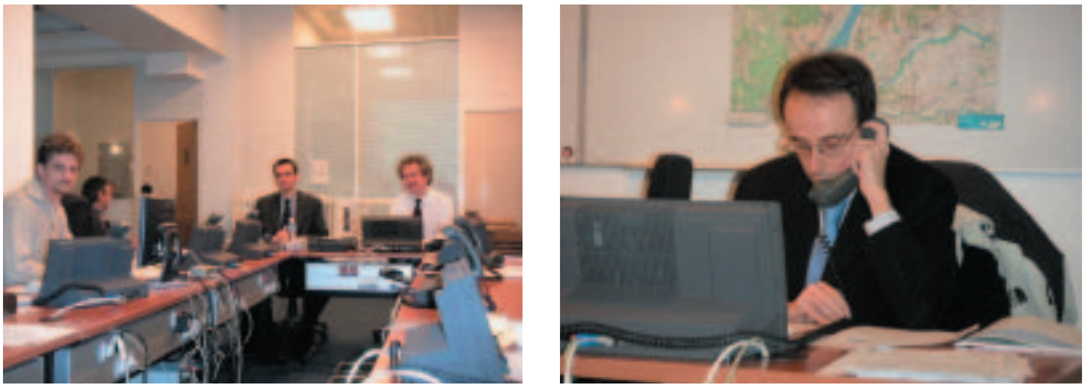
The ASN and the media in emergency situations

The ASN must be ready to deal with the urgent demand for information that would occur if there were 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 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, CLIs, 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 an opportunity to run a full-scale test of its emergency response organisation during the bad weather in the Rhone valley in December 2003. The ASN's emergency centre was in function for 2 days and the ASN had to answer questions from journalists concerning the shutdown of some reactors affected by the events.



ASN emergency centre

1 | 5

ASN regional actions

1 | 5 | 1

DSNR public information actions

The ASN aims to ensure greater involvement at a regional level by the Regional Directorates for Industry, Research and the Environment (DRIREs) and their Nuclear Safety and Radiation Protection Departments (DSNRs).

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 facilities 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 DSNRs also grant numerous interviews with local and regional media.

Some DSNRs also take part in training seminars designed to familiarise journalists with industrial risks. They more specifically deal with nuclear safety and radiation protection.

Similarly, DSNR statements at CLI meetings help to improve local media understanding of nuclear safety issues. In 2003, these CLI meetings were in particular an opportunity to present the reforms of radiation protection supervision and the reconnaissance missions conducted by the ASN.

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 matters under close supervision" exhibition

For more than 5 years now, the ASN and IRSN have been organising an exhibition travelling around the regions, more particularly aimed at schoolchildren and the general public. The purpose of the exhibition is to provide simple, attractive and direct information on the assessment and management of nuclear energy related risks and the corresponding means of surveillance. 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 2003, after a presentation in the cultural centre at the Givet town hall (Ardennes), the exhibition moved on to the exhibition centre in the town halls of Arles (Bouches-du-Rhône) and then Uchaud (Gard). More than 4300 visitors, including 1300 pupils and teachers, saw the exhibition.

ASN-IRSN exhibition
"Nuclear matters under close supervision"

The conferences organised at each stop involve the DSNRs of the DRIREs contributing to the inaugural events and disseminating information to elected officials, local press journalists and the general public. In 2003, more than 200 people in the towns of Givet, Arles and Nîmes attended the 5 conferences presented to the general public by the DSNRs of Châlons-en-Champagne and Marseille. The topics covered within this framework were checking of the safety of nuclear power plants, monitoring of radioactivity in the environment, management of hospital radioactive waste and the future of BNI radioactive waste.

Finally, to complete this overview of the public information system in the regions, all ASN publications were proposed, in particular to science teachers visiting the exhibition. The IRSN/ASN educational document which is given to schoolchildren visiting the exhibition was also revised to incorporate the changes made to the organisation, assignments, duties and activities of the ASN.

2 THE LOCAL INFORMATION COMMITTEES AND THE NATIONAL ASSOCIATION OF LOCAL INFORMATION COMMITTEES

2 | 1

The Local Information Committees

The Local Information Committees (CLIs) are located near the main power facilities, most of which are nuclear. These committees were set up by the “conseils généraux” (County Councils), following recommendations in a circular from the Prime Minister dated 15 December 1981. Their purpose is two-fold: to monitor the impact of large power generation units and to inform the populations by any means they consider to be most appropriate.

In order to do this, they must be provided with:
- all necessary information, especially that provided by the industries concerned and by the government departments which supervise them;
- funding which, according to the above-mentioned circular, must be provided by the local authorities reaping economic benefits from the facility considered.

These committees must strive to develop their own lines of discussion and adopt a questioning attitude with regard to their various contacts. They comprise locally elected representatives (generally about half the members), representatives from environmental protection associations, trade unionists, socio-professionals and representatives of the public authorities.

To assist the CLIs in expanding their actions, financial assistance in the form of a special annual grant, which in 2003 stood at € 380,000, has been allotted to them from 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 CLIs requesting assistance, and up to 100 % of the cost of public information activities. Furthermore, the DRIREs provide them with technical support as and when needed.

The volume of CLI activity was sustained during 2003.

All the CLIs held a plenary session at least once in the year, with the common topic being a review of the operation and safety of the BNIs concerned. External risks such as intrusion or terrorist attack, the risks of earthquake, flooding, oil spills, post-accident situations and application of the “Vigipirate” heightened security plan were dealt with by the CLIs at Blayais, Bugey, Chinon, Fessenheim, Flamanville, Gravelines, Nogent, Paluel-Penly, Saint-Laurent and Tricastin. The preventive distribution of stable iodine tablets was discussed at the meetings of the Blayais, Cattenom, Cruas, Fessenheim, Flamanville, Gravelines, Paluel-Penly, Saint-Alban and Saint-Laurent CLIs. The conclusions of emergency response exercises were presented at the meetings of the Tricastin, Saclay, Chooz, Paluel-Penly, Chinon, Bugey, Romans and Civaux CLIs. Renewal of the ministerial orders authorising waste discharge and water intake was debated at the meetings of the Blayais, Cadarache, Cattenom, Fessenheim, Golfech and Gravelines CLIs. The new off-site emergency plans (PPI) were presented at the CLI meetings at Belleville, Cattenom, Paluel-Penly and Saint-Alban.

Various public events were organised by the CLIs, a few examples of which are mentioned below:
- the Cadarache, Fessenheim, Gard, Gravelines, La Hague, Paluel-Penly and Valduc CLIs, as part of the national energy debate and sometimes with the assistance of members of the CSSIN, organised local debates attracting between 50 and more than 300 people, on the basis of a booklet issued by the Council and entitled "Sûreté des centrales et des déchets nucléaires – éléments de débats" (Safety of nuclear power plants and nuclear waste – The key questions);
- the Golfech CLI hosted the ANCLI symposium;
- the Gard CLI organised 4 public conferences on the BNI licensing procedures, the economic and social impact of the Marcoule power facility, the collapse of the Marcoule G1 stack and radioactive waste;
- the Nogent CLI organised 2 public conferences, one to present the new PPI and the new brochures describing how to act in an emergency situation, the second to present the IRSN's CD-Rom concerning management of the nuclear risk;
- the CSCSM (Manche repository monitoring commission) organised a meeting open to environmental protection associations concerning tritium releases;
- the Chooz CLI contributed to the ASN/IRSN's "Nuclear matters under close supervision" exhibition.

The Blayais, Cadarache, Civaux, Flamanville, Golfech, Gravelines, Gard, La Hague, Nogent, Paluel-Penly, Romans, Saclay and Valduc CLIs publish a newsletter at least once a year. Committees such as the CLIS (local information and monitoring committee) at Bure release information via their web site.

Members of the Fessenheim and Gravelines CLIs dealing with external hazards, and Nogent dealing with the 3 topics of fire, safety management and radiation protection management accompanied the ASN's inspectors on a visit. Members of certain CLIs visited other nuclear sites: the CLIS at Bure organised visits to repositories in Sweden and Spain, the Flamanville CLI visited the IRSN's radioecology laboratory in Cherbourg, the Golfech CLI visited a nuclear power plant in Spain, the Gard CLI visited the Tricastin site, the Nogent CLI visited the CSA and the new VLL centre in Morvilliers, while the Paluel-Penly CLI visited the Brennilis dismantling work site.

In terms of independent assessment work, that done by the following should be mentioned:
- the Blayais CLI concerning the condition of the Blayais 1 NSSS during its 2nd ten yearly inspection,
- the Bure CLIS concerning the ANDRA's research program;
- the CLE (local environment commission) at Romans concerning examination by its members of the environmental monitoring plan;
- the CSPI (special permanent information committee) at La Hague concerning environmental measurements and measures and the work of the Nord-Contentin radioecology group,
- the Fessenheim CLS (local monitoring committee) concerning earthquakes;
- the Golfech and Nogent CLIs concerning environmental measurements and measures in particular with regard to amoeba;
- the Gard CLI on radioactivity measurements in the sands of the Camargue area;
- the Saclay CLI on the campaign to analyse tritium in the Fontainebleau sands aquifer;
- the Valduc CLI on tritium measurements in drinking water and vegetable crops around the site.

The Saint-Alban CLI assisted the department's communes with drafting the communal safeguard plans and certain CLIs, such as that at Saclay, have active working groups.

The Nogent CLI set up a monitoring unit, comprising representatives of the various categories of CLI members, which meets every month and asked the scientific committee of the National Association of Local Information Committees (ANCLI) to look at the problem of amoeba proliferation in the exchangers and condensers and at means of reducing it.

Finally, three topics were discussed by many of the CLIs:

CLI information brochures

- the 24 July 2003 order on the protection of national defence secrecy in the field of protection and supervision of nuclear materials, in particular by the Blayais, Cadarache, Romans, Golfech, Nogent, Saclay and Valduc CLIs;
- the interministerial order of 12 August 2003 concerning the exceptional conditions for water discharges from nuclear power plants, in particular by the CLIs at Chooz, Cruas, Golfech, Gravelines, Fessenheim, Nogent and Saint-Alban;
- the bad weather in the Rhone valley which affected the Cruas and Tricastin nuclear power plants.

2 | 2

The National Association of Local Information Committees

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 CLIs, to provide a resource centre and to act as the interface with the public authorities and national and international nuclear organisations.

In the field of public information and transparency, the ANCLI's activities in 2003 were as follows:

- DÉCLIC magazine

6000 copies of this magazine are distributed free of charge. In 2003, issues 6 and 7 came out in June and November, with the subjects of their special reports being assessment and the role of the scientific committee.

- INFO information sheets

These information sheets are distributed as part of the DÉCLIC magazine, or on request. Sheet n° 1 of December 2002 concerned radioactivity and n° 2 of May 2003 the nuclear directory. Sheet n° 3 concerning radioactivity applications should be coming out shortly.

15th Conference of Local Informaiton Committee Chairmen

The 15th Conference of Local Information Committee Chairmen was held on 10 December 2003 in Paris, at the initiative of the ministers for Industry, Ecology and Health.

Apart from the CLI chairmen, this conference brought together representatives of the County Councils and prefectures of the departments in which CLIs are set up, and from other ministries concerned by the topic to be discussed at this 15th conference, which focused on worker radiation protection. This event was also attended by members of parliament, including a representative from the Parliamentary Office for Assessment of Scientific and Technological Options, members of the High Council for Nuclear Safety and Information (CSSIN), IRSN representatives, representatives of the medical professions and representatives of the DRIREs. In all about a hundred people.

The Conference was scheduled over a full day. The morning session was devoted to presentations in plenary session. Before the lunch break, a video on the government's energy policy was presented by Ms Nicole Fontaine, Minister Delegate for Industry. It. The afternoon was devoted to various workshops. After review of the workshops in plenary session, the participants attended the IRSN's presentation of its CD-Rom dealing with management of the nuclear risk.

During the plenary sessions, the participants heard and debated papers on:

- the ANCLI;
- the ASN;
- the new regulations concerning worker radiation protection;
- radiation protection in nuclear power plants and the progress achieved in the last ten years;
- coordination of radiation protection checks;
- medical monitoring of workers exposed to ionising radiation in the BNIs and in outside companies.

The workshops covered the role of the CLIs in the field of worker radiation protection.

The event was closed by the Director General for Nuclear Safety and Radiation Protection.

15th conference of CLI chairmen

- ANCLI annual symposium

The ANCLI held its 3rd annual symposium on 17 and 18 September in Golfech (Tarn-et-Garonne) on the subject “The CLI, the operator and the others”. Nearly a hundred people debated the sensitive topic of the links between the various organisations concerned by a nuclear facility.

- Training

From 19 to 21 May, the ANCLI organised basic training on nuclear safety and radiation protection aimed at CLI members. This training was given by the IRSN.

- Web site

This site was recently created. It contains all information about the ANCLI and offers a separate section for each CLI.

- 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 CLIs.

- Annual visit to a nuclear centre

On 14 May 2003, the ANCLI organised a visit to COGEMA’s spent fuel reprocessing plant at La Hague and met members of the La Hague Special Permanent Information Committee (CSPI).

3 THE HIGH COUNCIL FOR NUCLEAR SAFETY AND INFORMATION

As part of its duty to inform the public, the High Council for Nuclear Safety and Information (CSSIN) at the 6 May 2003 regional meeting in Rennes contributing to the national energy debate on the subject “Nuclear power: energy for the future or dead-end”, distributed 500 copies of the booklet entitled “Sûreté des centrales et des déchets nucléaires - éléments de débats” (Safety of nuclear power plants and nuclear waste - The key questions) which was the result of considerable work done by the Council in 2002. This booklet is in the catalogue of *La Documentation française* which published the work.

Members of this Council also took part in a number of debates around this booklet in the 2nd half of the year, during meetings organised by a number of nuclear site Local Information Committees.

In the face of deregulation of the electricity market, the CSSIN on 23 April 2003 issued its following nuclear safety recommendation, sent out to the ministers concerned:

“The on-going national and European deregulation of the electricity market subjects the producers to new constraints of economic competitiveness which could lead them to cut spending, which in turn is likely to have an impact on the safety of nuclear facilities.

1 - The CSSIN hopes that the authorities will publicly express their desire to maintain safety requirements which are at least as stringent as those currently applying to nuclear facilities nationwide and ensure that the efforts for permanent improvement initiated by the operators are continued.

2 - The CSSIN asks that the various steps in implementation of the deregulation process be subject to particularly vigilant scrutiny and be accompanied by appropriate emergency response exercises.

3 - The CSSIN considers that given this context, it is all the more urgent for France to pass a true basic nuclear law without delay, similar to those which exist in other European countries.

4 – The CSSIN recommends that safety requirements within the European Union be gradually harmonised at the best level achieved in one or other of the member countries."

With the aim of transparency, information concerning the CSSIN, in particular the minutes of its sessions, are accessible on the ASN's web site, in the CSSIN section.

The mandate of the CSSIN's members ended on 12 September 2003. The new CSSIN will be meeting in the first quarter of 2004.

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 programs to ensure that the national public assessment capability is soundly based on the most advanced scientific knowledge in these fields at an international level, its role being to provide technical support for the public authorities with competence for safety, security and radiation protection in both the civilian (under the authority of the DGSNR) and Defence sectors (nuclear facilities on the national territory, weapons systems and nuclear-powered ships, non-proliferation monitoring). Finally, its instituting decree gives it certain duties outside the scope of research, in particular in monitoring of the environment and of populations exposed to ionising radiation. These duties especially concern radiation protection training.

In accordance with this same decree, the IRSN publishes the results of its R&D programs, primarily through its web sites, which are currently being extensively modernised to facilitate topic-based access to the various publications.

In 2003, these web sites received more than 400,000 hits, both in French and English.

At a wider level, the IRSN reports to the public on its activities through its annual report, which it officially transmits to the five ministers concerned by its activities (ministers for the Environment, Industry, Health, Defence and Research) as well as to the High Council for Nuclear Safety and Information, the High Council for Public Health in France and the High Council for the Prevention of Professional Risks. This annual report is available on the IRSN's web site and can also be obtained from the Institute on request.

It should also be noted that in 2003, the "Nuclear matters under close supervision" travelling exhibition jointly managed with the DGSNR continued and was presented in a number of towns, giving rise to conferences and meetings with experts (see § 1|5|2). Another initiative concerns the development of close technical cooperation with the National Association of Local Information Committees (ANCLI). This is designed to enable these bodies to access the scientific and technical documentation base which is essential if they are to be able to discuss complex issues such as the seismic risk, how radionuclides evolve in the environment, transportation of nuclear materials, waste, and radiation protection goals.

While consolidating its research and assessment roles, the IRSN - through an open pedagogical approach – thus helps society assess how the nuclear and radiological risk is managed in our country, and more generally at a European level.

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 by in particular by consulting the web sites 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.

With the aim of ensuring transparency, the ASN wished to present a non-exhaustive list of the main web sites dealing with the nuclear field in the broadest sense:

- Local Information Committees (CLIs) 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 CLIs).

- Parliamentary Assemblies (reports from the Parliamentary Office for Assessment of Scientific and Technological Options, bills, work of committees, etc.).
  - www.assemblee-nationale.fr;
  - www.senat.fr.

- 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 Compagnie générale des matières nucléaires);
  - 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 (site of the Greenpeace association);
  - www.wise-paris.org (site of a Wise association);
  - 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 French Nuclear Safety Authority believes that the public has a strong desire for information about the nuclear industry and its supervision. To answer this need, the ASN will in 2004 aim to initiate new forms of information in its various fields of activity, in particular monitoring of radiation protection.

With a proactive approach to the public among its priorities, the ASN is today resolutely committed to developing a transparent approach, which in particular leads it to publish various information about its supervision actions on its web site (inspections, site visits during reactor outages, formal notices, etc.).

At the same time, the ASN has decided to expand the public's options for easier consultation of the various administrative documents involved in certain administrative procedures, particularly public inquiries, with the support of its public information and documentation centre.

The Nuclear Safety Authority also wishes to expand consultation of the parties concerned when drafting general regulatory texts. Experiments will be conducted in 2004.

Finally, the ASN hopes that the "nuclear safety and transparency" bill will help transparency and information of the public progress further, by giving the population the right of access to information in the possession of nuclear facility operators.

CHAPTER 6

1 MULTILATERAL RELATIONS
1|1 The International Atomic Energy Agency (IAEA)
1|2 OECD Nuclear Agency (NEA)
1|3 European Union
1|4 The convention on nuclear safety
1|5 The Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management
1|6 International Nuclear Regulators’ Association (INRA)
1|7 Western European Nuclear Regulators’ Association (WENRA)
1|8 Framatome nuclear regulators association (FRAREG)

2 ASSISTANCE TO THE EASTERN EUROPEAN COUNTRIES
2|1 Nuclear safety in the Eastern European countries
2|2 Assistance programmes and their coordination

3 BILATERAL RELATIONS
3|1 Staff exchanges between nuclear safety authorities
3|2 Special technical fields
3|3 Geographical areas (outside Eastern Europe)

4 OUTLOOK

Since its creation in March 1973, the Nuclear Safety Authority (ASN) has been entrusted with international assignments which, like its other activities, have developed and expanded with the passing years. The international assignments of the ASN were confirmed in decree 2002-255 of 22 February 2002 which created the DGSNR. The original objectives are still valid:

- 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 release;
  - to assist countries wishing to create or modify their nuclear safety authority, such as the countries of the former USSR, the Central and Eastern European countries, and emerging countries on other continents;
  - when requested, to help foreign nuclear safety authorities required to issue permits for nuclear equipment of French origin or design.

- To provide the countries concerned with all relevant information on French nuclear installations located near their frontiers.

These objectives are pursued within the framework of bilateral agreements but also through ASN participation in proceedings organised by international bodies 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.

1 MULTILATERAL RELATIONS

1 | 1

The International Atomic Energy Agency (IAEA)

The IAEA is a United Nations agency with 133 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 16 Member States and required to propose standards to the Director General of the Agency. France is represented on this commission by the Director General of the DGSNR. 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 Director General of the IAEA, comprise three levels of documents: Safety Fundamentals, Safety Requirements and Safety Guides. By the end of 2003, 51 revised safety guides had been published, 11 others had been approved and 32 further guides were being drafted 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, etc. missions. In 2003, an OSART mission (assessment of the operational safety of a nuclear power plant) took place in January at the Nogent nuclear power plant, with another at the Civaux nuclear power plant in May. A preparatory OSART mission took place in the Penly NPP in October, with a follow-up mission to the Tricastin NPP in November. Reports on the OSART missions carried out in France since 1995 are currently available in English, the original language, on the ASN web site (www.asn.gouv.fr). A PROSPER mission (evaluation of the corporate services safety assistance program) also took place at EDF in November 2003.

1 | 2

OECD Nuclear Energy Agency (NEA)

The NEA, set up in 1958, comprises all OECD countries except New Zealand and Poland, that is 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). In the course of its two annual meetings, the CNRA notably discussed efficiency in licensing and supervisory activities and improved incorporation of experience feedback. In June, it also organised a seminar on the use of indicators by the Safety Authorities.

During its two meetings in 2003, the Working Group on Inspection Practices (WGIP) focused its attention on the inspection of research reactors, the inspection of conformity with design specifications and the inspection of subcontracted work.

The ASN also takes part in the proceedings of the group examining radioactive waste related problems, the Radioactive Waste Management Committee (RWMC), which brings together nuclear safety authorities and organisations responsible for waste management.

Finally, since 2002, the ASN has been taking part in the work of the Committee on Radiation Protection and Public Health (CRPPH) which discusses draft international recommendations in this field and provisions for emergency situations.

1 | 3

European Union

In June 2001 the European Union Council approved a report from the Atomic Questions Group of the Commission which for each candidate country, covered the regulatory system and the status of the Safety Authority, the safety of the nuclear power reactors (for Bulgaria, Hungary, Lithuania, Romania, Slovakia, Slovenia and the Czech Republic) and that of the research reactors and the radioactive waste management installations. This report, which contained detailed recommendations for achievement of the “high nuclear safety level” expected within the Union, was transmitted to the candidate countries, asking them to indicate the measures they intended to take to comply with these recommendations. Their replies were examined in 2002 by the Atomic Questions Group, which summarised its position in a report approved by the Council in June 2002 (These reports are available on the European Union’s web site: www.europa.eu.int.)

In November 2003, a DGSNR representative took part in an expert mission organised by the European Commission to examine supplementary data supplied by Bulgaria, aimed at demonstrating the progress made by the country in this area.

The ASN took part in drafting the European directive on the control of high-activity radionuclide sources.

The ASN is also taking part in three working groups chaired by the European Commission, the purpose of which is to compare certain safety practices in the member states of the Union.

The European Commission recently distributed its "nuclear package", a set of draft regulatory texts covering nuclear safety and the nuclear installation decommissioning funds, the future obligation on the Member States to build and operate facilities for disposal of radioactive waste, and finally a negotiating mandate requested by the Commission concerning the trade in nuclear materials with Russia. Concerned as it is by the first two texts, the ASN is participating in the debate to define the French position on these projects, which are being discussed in the appropriate formations of the Council with a view to adoption, if possible before May 2004.

In 2003, the ASN initiated contacts with the Commission (DG/TREN) with a view to organising regular meetings for a mutual exchange of information. The first meeting reviewed the progress made in the work to transpose the 96/29 and 97/43 Euratom directives.

Finally, the ASN is taking part in the debate initiated by the ministries concerned on the future of the Euratom treaty, within the framework of the work of the Convention on the future of the European Union.

1 | 4

The convention on nuclear safety

The Convention on Nuclear Safety was negotiated further to the Chernobyl disaster. Its articles describe good nuclear safety practice for land-based civil nuclear power reactors. When they ratify it, the contracting parties undertake to provide a report describing their implementation of these recommendations. The reports from the various contracting parties are examined in the course of a review meeting when each party can raise the questions it wishes to discuss. The Convention came into force in October 1996. By the end of 2003, it had been ratified by 54 countries, 29 of which had at least one nuclear power reactor in service.

The second meeting of the contracting parties took place at the IAEA headquarters in Vienna, from 15 to 26 April 2002. The next preparatory meeting will be held in September, to pave the way for the third examination meeting scheduled for April 2005.

1 | 5

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. By the end of 2003, it had been ratified or approved by 33 countries, 20 of which had at least one nuclear power reactor in service.

In 2003, one of the ASN's main tasks was to finish preparing the French report, available on the ASN's web site, to coordinate drafting of the answers to the questions received and to present them at the first review meeting of the contracting parties, which was held in Vienna from 3 to 14 November 2003. Like the French reports for the Convention on Nuclear Safety, this report contains contributions from the various French government departments concerned, as well as the operators involved in spent fuel and radioactive waste management.

Unlike some countries, the French report did not attempt to draw a veil over any of the difficulties, and it was the subject of the most detailed and most fruitful discussions (20 countries tabled a total of more than 200 questions). France's strategy with regard to installation decommissioning and the overall management of radioactive waste was remarked on by many countries and led the plenary session to include a recommendation in its general conclusions that all countries implement an exhaustive decommissioning plan and a national radioactive waste management plan.

The examination meeting for the second national reports will be held in May 2006.

A.-C. Lacoste presents the French report for the Joint Convention

The participants at the Joint Convention plenary examination meeting

1 | 6

International Nuclear Regulator's Association (INRA)

The INRA, which brings together the senior executives from the nuclear safety authorities of Canada, France, Germany, Japan, Spain, Sweden, the United Kingdom and the United States of America, met on two occasions in 2003, chaired by Mrs Linda Keen, chair of the Canadian Nuclear Safety Commission. Apart from presentations about the key events in their respective countries, the INRA members discussed the ASN's role in promoting the safety culture, problems of organisation and management at the operators, and their respective approaches to installations inspection, their credibility in the eyes of the public, the transport of radioactive materials and declassification of the installations and the waste produced.

At the close of their last meeting, the INRA members nominated their Japanese counterparts Messrs Matsuura (NSC) and Sasaki (NISA, METI) as new joint chairmen.

1 | 7

Western European Nuclear Regulators' Association (WENRA)

WENRA was formally established in February 1999. It brings together the senior executives of the safety authorities of Belgium, Finland, France, Germany, Italy, the Netherlands, Spain, Sweden, Switzerland and the United Kingdom. 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 expand the association, bringing in the senior executives from the seven "nuclear" countries (operating at least one nuclear reactor to produce electricity) applying for membership of the European Union: Bulgaria, Hungary, Lithuania, Czech Republic, Romania, Slovakia and Slovenia.

The objectives defined by the WENRA members when the association was created are:
- to provide the European Union with an independent capability to examine nuclear safety and regulation in candidate countries;
- 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 definition of the stance adopted by the Council of the European Union (see § 1/3), and for the immediate future, WENRA does not envisage examining this subject again, unless it is specifically asked to do so.

For the second task assigned to it, WENRA in 2003 continued to develop its activities towards harmonising national safety approaches for electricity generating nuclear reactors and for management of radioactive waste and decommissioning operations.

The working group responsible for harmonising approaches concerning reactors completed a pilot study in September 2002: the WENRA members examined the corresponding report and approved the guidelines for future activities proposed by the working group. A concise version of this report is now available on the ASN's web site.

The working group responsible for harmonising waste management safety approaches set up a system of cross-inspections to improve knowledge of various national practices in the field. Work also continued into harmonising approaches to decommissioning and interim storage of spent fuel and waste.

1 | 8

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.

The association met on 27 and 28 March in Brussels. For organisational reasons, particularly owing to the SARS epidemic, the Chinese delegation was unable to take part in this meeting.

2 ASSISTANCE TO THE EASTERN EUROPEAN COUNTRIES

2 | 1

Nuclear safety in Eastern European countries

With the assistance of the IRSN, the ASN continues to contribute to the improvement of nuclear safety in Eastern Europe. The initial aim was to help set up effective nuclear safety authorities and promote a safety culture based on the prime responsibility of the operator and a complete separation between nuclear safety authority and operator. States which are scheduled to join the European Union in 2004 will by then have attained a level of development meaning that they should no longer require assistance.

In the other countries of Central Europe and the ex-USSR, this fundamental goal will only be attained in the longer term, since it implies deep-seated changes: structural adaptation of the State itself, changes in mentality to allow acceptance of nuclear safety authority independence and thereby underpin the credibility of these authorities, with the ensuing reinforcement of their status and the means at their disposal.

Although the DGSNR has concluded bilateral administrative arrangements with the Safety Authorities of some of the countries concerned (Czech Republic, Russia, Slovakia, Slovenia, Ukraine), collaboration is primarily within the framework of the European Commission's assistance programmes.

2 | 2

Assistance programmes and their coordination

The G7 Summit in Munich in July 1992 had defined three priority areas for assistance to Eastern European countries in the nuclear field:
- contribute to improving the operating safety of existing reactors;
- provide funding for short-term improvements to the least safe reactors;
- 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.

Within this framework, efforts are also deployed to secure firm commitments on the shutdown of the oldest reactors.

As regards assistance to safety authorities, covered by the third G7 priority area, the ASN takes part in the RAMG (Regulatory Assistance Management Group) programmes funded by the European Union within the framework of two budgets; PHARE (mainly concerning countries wishing to join the European Union) and TACIS. The ASN is leader for the Czech, Slovak and Ukrainian programmes. The Ukrainian programme (TACIS budget) resumed in July 2001. After an interruption in European Commission funding of more than three years, the PHARE programmes resumed at the beginning of 2003.

Within this framework, on 6 and 7 February in Prague, the ASN chaired the kick-off meeting for the last year of the PHARE programme for assistance to the Slovak and Czech Safety Authorities.

As regards the TACIS program, at the end of April in France, the ASN received a delegation from the beneficiary SNRCU (Ukrainian nuclear safety authority) with a view to defining what action was to be taken during the rest of this program. After acceptance by the European Commission, the corresponding project kick-off meeting was held in December in the DGSNR's premises.

During its 13 and 14 May meeting in Brussels, under the chairmanship of Mr Jukka Laaksonen, director general of STUK (Finland), the RAMG group elected a new chairman, Mr Marcel Maris, of the Association Vinçotte nucléaire (AVN, Belgium).

The ASN is also a member of the CONCERT (Concertation on European Regulatory Tasks) group, which brings together the nuclear safety authorities from Eastern and Western European countries. This group met on 5 to 7 May in Prague (Czech Republic) and on 11 and 12 December in Brussels. The technical discussions covered the safety approach of these Authorities, in particular during final shutdown of nuclear installations.

The ASN also provides advice on nuclear safety issues to the French delegation to meetings of the G7 Nuclear Safety Working Group (NSWG), chaired by France in 2003. The DGSNR took part in the meetings in London on 2 April (with the participation of a Russian delegation) and then on 4 April, which enabled a mandate to be defined for a new 8-strong group, as the G7 is scheduled to become the G8 by 2006. This group, to be called the NSSG (Nuclear Safety and Security Group), will take over from the NSWG while fully incorporating the nuclear safety aspect.

The ASN is also contributing to the ongoing debate on the topics making up the "Global Partnership" program of the G7/G8.

The ASN also took part in the meetings of the nuclear safety multilateral fund managed by the European Bank for Reconstruction and Development (EBRD) as well as those of the Chernobyl shelter fund, also managed by the EBRD.

Within this latter framework, an ASN representative participates in the consultative group set up in 1999 to advise the Head of the Ukrainian nuclear safety authority on the difficult regulatory decisions to be made in connection with the reinforcement of the shelter. This group, the ICCRB (International Consultative Committee of Regulatory Bodies), comprises representatives from the safety authorities of Canada, Finland, France, Germany, Italy, Spain, Switzerland, the United Kingdom and the United States.

Relations with Russia for the most part take place within the RAMG programme for assistance to the nuclear safety authority of this country. This programme is run by Germany, with participation by the United Kingdom, Finland and the ASN and IRSN representing France.

However, another area for cooperation is to assist the Russian safety authority to construct the regulatory framework needed for licensing of the nuclear installations to be built to eliminate the military plutonium declared to be excess to Russian defence requirements. The ASN therefore took part in meetings organised between Germany, the United States and France, in the presence of a representative of the European Commission which will be helping with financing of the planned actions.

From 16 to 18 September 2003, the ASN organised a seminar for the Russian Safety Authority (GAN) on the safe use and transport of mixed uranium and plutonium oxide based fuels (MOX). Eight GAN inspectors (as well as five Americans) followed this seminar, during which the system of investigating fuel cycle installation licenses was presented.

3 BILATERAL RELATIONS

3 | 1

Staff exchanges between nuclear safety authorities

The ASN is endeavouring to develop its relations with other safety authorities, notably with a view to improving its understanding of the actual working procedures of these nuclear safety authorities in order to be able to learn useful lessons for its own procedures.

One of the means adopted to achieve this objective is to promote staff exchanges between the ASN and nuclear safety authorities in other countries.

The foreign nuclear safety authorities so far concerned are those of Belgium, Canada, China, Germany, Spain, Switzerland, the United States of America and the United Kingdom..

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 2003, cross-inspections were carried out in France, while others were in particular conducted in Belgium and the United Kingdom. With a view to collecting foreign experience of radiation protection supervision practices, French inspectors along with their counterparts from the British ministry of health, took part in inspecting medical equipment and its uses in Northampton hospital in July 2003. In the field of worker radiation protection, we could mention the participation of French inspectors in an inspection in Belgium on the Tihange 3 reactor in April. In September, the Orleans DSNR carried out an inspection together with a Spanish inspector, on the management of radioactive waste in the CEA's Saclay centre;

- short-term assignments (3 weeks to 3 months), aimed at studying a specific technical topic: an assignment from the American nuclear safety authority (NRC) took place from 26 May to 13 June 2003, on the subject of reactor periodic safety reviews;
- long-term exchanges (about 3 years), aimed at studying in detail the working procedures of foreign nuclear safety authorities.

After the first two secondments from 1997 to 2000, an ASN engineer took up a similar assignment in the United Kingdom from 1998 to mid-2002 when he was replaced by a new engineer in the summer. Similarly, an engineer joined the Spanish nuclear safety authority from the beginning of 2000 until mid-2003.

The first lessons learned from these exchanges have benefited French practice, for example with the introduction of review inspections in 2000.

Such exchanges must obviously be reciprocal, which is why an engineer from the Spanish nuclear safety authority joined the ASN from September 2000 to June 2001, followed by his successor in September 2002. Finally, an engineer from the UK Nuclear Safety authority joined the ASN from February 2001 to August 2002. His replacement arrived in January 2003.

3 | 2

Special technical fields

Actions in the field of radiation protection

Owing to the new roles of the DGSNR as defined in its creation decree, the ASN sought to benefit from experience abroad in the field of radiation protection monitoring in the broadest sense of the term. The delegations sent in 2002 to Canada, the United States, Finland and Sweden, were followed in 2003 by missions to the United Kingdom and Germany. Apart from the reciprocal exchanges of information about the possession and utilisation of sources of ionising radiation and the inspection systems in place, a detailed examination was made of the inspections conducted in the United Kingdom.

Fuel fabrication plants

As part of the periodic safety review of the FBFC fuel fabrication plant in Romans-sur-Isère and in order to benefit from foreign experience of operation of similar facilities, an ASN and IRSN delegation was sent to the European countries which operate this type of facility: Belgium, Germany, Spain, Sweden and the United Kingdom. These missions were an opportunity for technical discussions between safety organisations and the operators of the facilities visited. The lessons learned from these visits were incorporated into the report presented to the Advisory Committee in 2003 when it meets to examine the safety of the FBFC plant. The DGSNR intends to organise a seminar in 2004 to present them to the nuclear safety authorities of the countries concerned.

Uranium enrichment plants

In France, COGEMA intends to acquire a plant enriching natural uranium through ultracentrifugation which will eventually replace the Eurodif plant which uses a gaseous diffusion isotope separation process. As the new plant is to use a process developed by the European URENCO consortium - comprising Germany, Great Britain and the Netherlands - the ASN director, followed by an ASN and IRSN delegation, met the nuclear safety authorities of these countries and visited the corresponding plants. The lessons learned from these visits will be incorporated into the safety analysis when the operator submits its application for the construction licence for its future plant.

Situation of border countries during the drought and heatwave of summer 2003

Conventional and nuclear electricity production resources in France were faced with problems of drought and excessively high river temperatures. EDF therefore asked for waivers to the discharge temperature limits authorised by current orders. When these requests were examined, the DGSNR made sure that its answers were consistent with decisions taken in neighbouring countries operating nuclear power plants and faced with similar climatic conditions. Specific contacts were made in early August with the Belgian, British, German, Spanish and Swiss authorities.

3 | 3

Geographical areas (outside Eastern Europe)

The ASN maintains relations with its counterparts entailing mutual exchanges of information on subjects of common interest and recent events in the installations under their supervision.

In addition to action involving the countries of Eastern Europe (see § 2 above), the following examples should be mentioned.

3 | 3 | 1

South Africa

Relations with the South African nuclear safety authority NNR (National Nuclear Regulator) were established at the latter's request, further to the construction by Framatome of the two Koeberg plant reactors.

In 2003, the NNR-ASN steering committee met at the DGSNR's headquarters in Paris, from 11 to 13 September. In addition to their traditional discussion of power reactors, the ASN and its technical support body presented their experience in the field of evaluating digital instrumentation and control systems, the periodic safety review of experimental reactors and the decommissioning of nuclear installations. Discussions also concerned the safety requirements of future reactors, both EPR (European Pressurised water Reactor) and PBMR (Pebble Bed Modular Reactor).

3 | 3 | 2

Germany

Franco-German relations in the nuclear safety field go back to the early seventies. They take place within the framework of the Franco-German Committee for Nuclear Plant Safety Questions (DFK), for specifically frontier-related matters, and that of the Franco-German Management Committee (DFD) for general matters.

In 2003, the plenary session of the DFK was held in Paris, during which the 2 delegations visited the SPRA (armed forces radiological protection service) and certain installations at Percy hospital designed to care for contaminated persons.

3 | 3 | 3

Belgium

Franco-Belgian relations in the nuclear safety field began in the mid-sixties. They mainly take place within the framework of the Franco-Belgian working party on nuclear safety, which holds two meetings each year, with as the main partner the approved organisation AVN (Association Vinçotte nucléaire). In 2002, these technical ties were supplemented by exchanges with the Federal Nuclear Supervisory Agency (AFCN), the recently created Belgian safety authority. In 2003, these relations between the ASN and the AFCN became the reference framework for cooperative actions and an administrative arrangement signed in April by the DGSNR and the AFCN made this situation official. The working groups already set up are continuing their work and now report to ASN-AFCN meetings.

2003 was an opportunity to take cooperative work further in the fields of safe waste disposal, management of emergency situations and probabilistic safety assessments.

3 | 3 | 4

Canada

Franco-Canadian relations in the nuclear safety field provide for technical discussions and staff exchanges.

2003 in particular was the opportunity for a visit to Canada by an ASN delegation on the subject of nuclear safety authority relations with the public and public participation in the drafting of regulatory texts.

3 | 3 | 5

The People's Republic of China

Franco-Chinese relations in the nuclear safety field were initiated at the request of the Chinese nuclear safety authority (NNSA) at the time of the construction by Framatome of the two Daya Bay reactors, followed by the two Lingao reactors.

In 2003, cooperation mainly concerned an exchange mission to look at decommissioning of research reactors. Two ASN inspectors went to China to meet their colleagues in Guangdong who are supervising the Daya Bay and Lingao reactors. Finally, the Director General of the ASN went to China in September to meet a number of senior executives and, with his Chinese counterpart, examine the progress of cooperative programmes. This meeting involved visits to the Lingao, Qinshan 2 and Qinshan 3 power plants, as well as a research reactor near Beijing.

3 | 3 | 6

South Korea

Nuclear safety co-operation between France and South Korea began at the request of the Korean nuclear safety authority during the construction by Framatome of the Ulchin 1 and Ulchin 2 reactors.

In August 2003, the ASN received a Korean delegation and presented its actions in the field of public relations.

3 | 3 | 7

Spain

Relations between France and Spain in the nuclear field are both longstanding and close. These relations are governed by the administrative arrangement signed by the ASN and the Consejo de Seguridad Nuclear (CSN), which is regularly renewed.

The Franco-Spanish Steering Committee met in Cherbourg in early October 2003. The two delegations agreed to continue staff exchanges for BNI supervision and radiation protection, in particular through participation in cross-inspections and in crisis management exercises.

The two delegations visited the COGEMA installations in La Hague and the AT1 shop decommissioning site.

3 | 3 | 8

United States of America

The Nuclear Regulatory Commission (NRC) is one of the ASN's main partners. High level meetings are organised every year.

The new Chairman of the NRC, Mr Nils J. Diaz, and the Director General of the DGSNR signed a five-year administrative arrangement in April.

The Director General of the DGSNR headed an ASN delegation which went to the United States from 13 to 18 April, under the bilateral arrangements with the NRC and the NRC's annual Regulatory Information Conference (RIC).

In terms of reactor safety, discussions concerned application of the regulatory approach based on probabilistic studies (Risk-informed regulation) and on the need to improve the level of safety in existing installations (ASN's position), rather than simply maintaining the initial level of safety. The NRC also confirmed its desire to continue discussions with the DGSNR about the safety requirements to be applied to future reactors.

Mr Lacoste also took part in two round-tables during the NRC's annual conference (RIC) at which he presented French practice in the field of the periodic safety reviews conducted on reactors in service, and then the DGSNR's viewpoint concerning review of EDF power plants by international teams (IAEA's OSART missions).

This visit was also an opportunity to formalise cooperation in fields other than reactor safety, such as management of radioactive waste, installations decommissioning, decontamination of polluted sites and radiation protection. Other official bodies took part in these discussions: the DOE (Department Of Energy) and the EPA (Environmental Protection Agency).

With regard to radiation protection, the French delegation was received by the Florida State officials in charge of supervision of industrial and medical radiation protection in this State (State qualified by the NRC in this field).

On 21 and 22 May, a deputy director of the DGSNR took part in the public hearings organised by the NRC in Washington to debate radioactive materials management regulations and exemption thresholds.

From 26 May to 13 June, the ASN received the director of the NRC division in charge of the nuclear installation inspection programmes, who had come to look at existing French regulations and French

Signing of the DGSNR-US/NRC agreement

practice in the field of periodic safety review of power reactors, in order to adapt this to the situation in the United States.

From 24 June to 2 July, the 5th sub-directorate of the DGSNR (BCCN) in Dijon received a delegation of NRC materials specialists, who had come to examine the French Nuclear Safety Authority's experience of the problems of 600 alloy stress corrosion. The American delegation in particular visited Framatome's Chalon-sur-Saône plant which manufactures large nuclear power plant components.

On 31 October, the DGSNR-NRC/NMSS steering committee met at the DGSNR headquarters, to discuss exchanges of information on safety and radiation protection in installations other than reactors (fuel cycle plants, decommissioning of nuclear installations, clean-up of polluted sites, interim storage and disposal of radioactive waste, transports and radiation protection). The previous day, the American delegation had visited the decommissioning site in the Monts d'Arrée nuclear power plant in Brennilis. This concrete experience was useful in comparing French and American approaches to reactor decommissioning.

On 3 and 4 December 2003 the DGSNR-NRC/NRR steering committee met at DGSNR headquarters, to discuss exchanges of information on reactor safety. Three new areas for cooperation were decided on: the risk of sump filter clogging in the event of a primary system pipe break, international safety standards (and harmonisation of safety rules and practices) and, at the NRC's request, inspection techniques to be employed during manufacture of large components for the construction of new reactors.

3 | 3 | 9

Finland

Relations between the ASN and its Finnish counterpart, the STUK, were formalised by an administrative arrangement signed in 1996 and renewed in 2001.

In 2002, Finland decided to build a new reactor. This situation opens the door for extensive future co-operation on the regulatory safety requirements applicable to the future reactors.

In 2003, the ASN and the STUK held working meetings on the subject of safety requirements applicable to the future reactors. The preference of the Finnish electricity utility

A.-C. Lacoste and J. Laaksonen sign the new administrative arrangement

(TVO) for an EPR reactor led to closer ties in 2003 between the ASN and the STUK on the subject of the safety of this reactor. These relations will continue in 2004.

In October 2003, the STUK took part in the ASN and SKI (Swedish safety authority) meeting to discuss the safety of radioactive waste management.

In November, the ASN and STUK signed a new administrative arrangement including safety and radiation protection.

3 | 3 | 10

India

Relations with the Indian Safety Authority, the Atomic Energy Regulatory Board (AERB) are formalised by an administrative arrangement, signed in July 1999.

In 2003, the AERB and the DGSNR met in January and April, to define the programme of future exchanges.

3 | 3 | 11

Japan

ASN co-operation with its Japanese counterparts takes place within the framework of two administrative arrangements, one signed with the Ministry for Economy, Trade and Industry (METI), which includes the Nuclear and Industrial Safety Agency (NISA), responsible for the safety supervision of nuclear reactors and fuel cycle and waste installations, the other with the Ministry for Education, Culture, Sport, Science and Tourism (MEXT), which includes the Nuclear Safety Division responsible for supervision of the safety of research installations and of the use of radioactive isotopes. Both agreements were renewed in July 2002 for a period of 5 years.

On 23 May, the ASN received a MEXT delegation in Fontenay-aux-Roses, to look at incorporation into French regulations of European radiation protection directive n° 96/29 and its effective application. This visit was part of the exploratory mission conducted by the MEXT in the leading European countries, in order to revise current Japanese regulations in this field.

On 2 October, with the assistance of the IRSN, the DGSNR received a delegation from the PGAERI (Prefectural Government Association of Environmental Radioactive Investigation and Monitoring around Nuclear Power Facilities of Japan), comprising radioactivity measurement instrumentation systems specialists, for an information meeting about environmental monitoring in the vicinity of nuclear sites, both in normal and post-accident situations. The Japanese delegation then went to the Dampierre nuclear power plant and the COGEMA plant at La Hague. This visit was part of a study tour of France and Spain.

3 | 3 | 12

Luxembourg

Relations with Luxembourg were initiated in the early 1980s to provide answers to the questions raised by the Cattenom power plant.

In February 2003, a meeting of the Franco-Luxembourger technical group took place in Luxembourg on the subjects of safety and radiation protection.

3 | 3 | 13

Morocco

ASN relations with its Moroccan counterpart, the Ministry for Energy and Mines (MEM), are developing within the framework of the construction of the Maâmora Nuclear Research Centre.

In 2003, relations were extended to the field of radiation protection, and the ASN received a trainee from the national centre for radiation protection, the organisation in charge of radiation protection within the Moroccan Ministry for Health.

3 | 3 | 14

United Kingdom

ASN relations with its British counterpart, the Nuclear Safety Directorate (NSD) within the Health and Safety Executive (HSE), are conducted within the framework of an agreement signed in 1980 and regularly renewed. These relations have deepened and intensified from year to year. They are based on two annual top-level meetings, the "Chief Inspector" meeting, on the one hand, and the NSD-ASN Steering Committee meeting, on the other.

From 23 to 25 June in Avignon, the DGSNR organised the annual meeting with its British counterpart, Mr Laurence Williams, Chief Inspector of the Nuclear Safety Directorate (NSD). During the meeting, topical issues in both countries were raised and cooperation between the ASN and the NSD over the past year was reviewed. The meeting was preceded by a COGEMA presentation of its decommissioning and clean-up policy for Marcoule and a visit to this fuel reprocessing installation decommissioning site.

The Franco-British Steering Committee met in Bootle, near Liverpool, in October, to examine significant events in the two countries over the past year. The meeting was preceded by a visit, on 16 October, to the Heysham nuclear power plant, which operates four AGR (Advanced Gas cooled Reactors), the two oldest of which have received considerable safety improvements (in particular with respect to earthquake resistance) following their periodic safety review.

3 | 3 | 15

Sweden

ASN relations with its Swedish counterpart SKI (nuclear safety authority) were formalised by an administrative arrangement signed in July 1999 and will doubtless grow, particularly in the area of radioactive waste. In 2003, relations between the ASN and its counterpart SSI (radiation protection authority) were formalised by an administrative arrangement signed in June.

In October, the ASN and SKI held a meeting to discuss waste safety, and for the first time the STUK (Finnish safety authority) took part in the meeting.

3 | 3 | 16

Switzerland

Relations with Switzerland are longstanding and were formalised in 1989 in the form of the Franco-Swiss Commission for Nuclear Safety, which meets annually.

Participants in the Franco-Swiss Commission

On 1 July, the Franco-Swiss Commission for Nuclear Safety held its 14th annual conference in Wuerenlingen, near Zurich, under the joint chairmanship of Mr Mayor, deputy-director of the Federal Energy Office (OFEN), and Mr Lacoste, Director General of the DGSNR.

The delegates discussed recent developments in nuclear policy and in the administrative organisation of nuclear safety and radiation protection in their respective countries.

In terms of the safety of nuclear reactors and of certain fuel cycle components such as transport and waste, the participants reviewed significant events of the past year. The heads of the Safety Authorities restated the importance of harmonising their practices given pending market deregulation, as in all probability they will shortly be required to supervise operators with nuclear installations located in various countries.

For the first time, a decision was taken to carry out radiation protection exchanges and inspections on subjects not directly linked to nuclear reactors. In particular, exchanges on industrial equipment and radioactive source inspection practices was decided on.

On the second day, the delegates visited with great interest the Beznau nuclear power plant, in the canton of Argovie, which comprises 2 reactors which have both been in service for more than 30 years. In a context of increased service life for power plants in Europe, and upgrading of older installations, the plant management presented the work it has carried out for about the past 10 years, in order to modernise the instrumentation and control system and reactor protection systems installed at the time of construction.

3 | 3 | 17

Vietnam

On 23 October, a delegation from the Vietnamese Ministry of Science, Technology and the Environment and the Vietnamese Atomic Energy Commission, was at its own request received at the DGSNR headquarters to examine the role of a national safety authority in setting up and developing a civilian nuclear power program.

4 OUTLOOK

In 2004, the ASN aims to continue its international nuclear safety activities and to continue to develop radiation protection activities.

In this latter field, there are indeed few bilateral agreements and “multibilateral” arrangements (associations of radiation protection authority senior executives) need 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.

Furthermore, when 10 new members join the European Union in 2004, the PHARE assistance programmes from which they currently benefit, will have to be replaced by new forms of cooperation.

Finally, the globalisation of the economy, including in the field of nuclear power and radioactive materials, demands that steps be taken towards harmonising nuclear safety and radiation protection principles and standards.

CHAPTER 7

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3 OUTLOOK

CHAPTER 7
RADIOLOGICAL EMERGENCY SITUATIONS

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 taken to mean a situation arising from an accident or which is likely to lead to the emission of radioactive materials or a level of radioactivity such as to jeopardise public health. 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. This emergency arrangement, which is regularly tested and appraised, undergoes considerable modifications on the basis of experience feedback from drills, and from management of incidents, such as those which occurred at the Civaux plant on 12 May 1998, at the Le Blayais plant on 27 December 1999, and at the Cruas and Tricastin plants on 2 and 3 December 2003 following 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 2003, the ASN responded to several radiation protection incidents (non-BNI) which, even if they entailed no health risks, did nonetheless justify 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 14.

2003 was marked by publication of decree 2003-865 of 8 September which created the Interministerial Committee for Nuclear or Radiological Emergencies (CICNR) which reorganised interministerial coordination of accident situations.

1 NON-BNI RADIOLOGICAL EMERGENCY SITUATIONS

1 | 1

Response to radiological emergency situations

Outside BNIs, 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;
- if radioactive sources are stolen.

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

Responses 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 treat any injured, 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. These steps are decided on and implemented under the responsibility of the Prefect, with advice from the ASN, and/or the 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, and/or the owner supervised by the ASN;
- action taken under the responsibility of the Prefect and/or the owner;
- communication by the various parties involved, including the ASN.

The Prefect (and/or 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 owner] 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 and/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 [and/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.

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 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) and 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 document is intended for training all those liable to be concerned by a nuclear or radiological event.

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. In 2003, the DGSNR took part in a number of training days carried out in the defence zones and intended for emergency care personnel.

1 | 2

Responses in 2003

2003 saw the ASN continue to set up organisational measures to deal with radiological incidents outside basic nuclear installations (BNI). The ASN has thus opened a telephone hot-line (toll-free number 0 800 804 135) which will take calls notifying incidents involving sources of ionising radiation used outside BNIs. This toll-free number is open round the clock, 7 days a week, and the information transmitted by the caller is sent to an ASN senior executive who will manage the incident. The ASN has also started talks with the IRSN, the CEA and the Directorate for civil defence and security,

Contamination incident in the Heineken brewery in Marseille (13)

During maintenance of a device monitoring the filling level of beer kegs, an incident occurred in April 2003 in the Heineken brewery in Marseille. The establishment had called in the company which supplied the device, which contained a sealed caesium 137 radioactive source of 37 MBq, in order to repair it. This source was incorrectly handled by the company's technician, leading to the source packaging being cut andradioactive particles being disseminated in the establishment's premises.

Initially, the Marseille maritime fire department sealed off the area of the establishment concerned in order to prevent any further dispersal of radioactive material outside and to limit personnel exposure to radiation.

The ASN then intervened the following day, with the support of the IRSN and in conjunction with the DRIRE, to assist the prefect's departments in taking all necessary measures to protect the workers and evaluate the exposure of the personnel concerned.

The results of the measurements taken by the IRSN, the fire department and the Cadarache CEA on the personnel most exposed revealed slight internal contamination requiring no particular medical treatment. Given the low level of radioactivity of the damaged source, the consequences of this incident were limited.

As a result of this incident, the production line concerned was stopped. The ASN asked the Heineken brewery to have a specialist contractor carry out decontamination of the premises and take away the radioactive waste. Following these operations, the ASN was able to approve restart of the production line and normal resumption of activities in the workshops concerned.

Break in a radioactive liquid pipe in the Nantes (44) university hospital (CHU)

Following the February 2003 discovery of a liquid leak in a corridor on the ground floor of the Nantes CHU, this leak was found to be the result of a break in a pipe carrying radioactive liquid effluent.

This effluent originated in the sanitary installations of the rooms of patients being treated for thyroid problems. This effluent is taken through the pipe in question to buffer tanks in which it undergoes radioactive clean-up before being sent to the sewers.

The person with competence for radiation protection in the establishment, and then the fire department's mobile radiological response unit (CMIR) secured the premises (measurement of radiation field, cordoning off, absorption of the liquid with absorbent powders, etc.).

The ASN, together with the Pays de la Loire DRIRE and the DRASS, carried out an inspection to find out the causes of the incident and the steps already taken or planned, to ensure a return to a normal situation. Examination of the pipe revealed a break in an elbow in a technical room on the ground floor. This break would seem to have been caused by a falling heavy foreign body which had got into the pipe.

Based on these findings and the information collected, the ASN asked the CHU to take various steps to check the possible exposure of hospital personnel who were involved in initial steps to secure the area, to undertake decontamination of all areas concerned by this leak and to repair the pipe. The CHU called in a specialist contractor to decontaminate the premises and repair the leak, which enabled the ASN to authorise reuse of the protected rooms and the radioactive effluent collection installations.

Discovery of drums carrying radiation markings in Saint-Avold commune (57)

When called out to deal with a brush fire in the commune of Saint-Avold in May 2003, the fire-fighters discovered three abandoned drums out in the open carrying ANDRA labels indicating the presence of radioactive materials. Two other drums were then found in a building near the fire zone. Measurements taken by the Moselle fire department's mobile radiological response unit (CMIR) revealed a level of radiation higher than the normal ambient level: the maximum dose rate received on contact with these drums was 60 µSv/h. No trace of radioactivity was detected on the ground around the drums. After repackaging, the drums were transferred to a municipal storage area in Saint-Avold. According to the markings on the drums, the contents were radioactive lightning rod tips.

At the request of the Lorraine DRIRE, the Strasbourg DSNR which is linked to it carried out a variety of checks, mainly with the ANDRA, which established that:

- the drums discovered had been supplied by the ANDRA in 1998 and 1999 to a company in Nancy for packaging and removal of radioactive lightning rod tips;

- this company, which went into receivership in 2001, had stored its drums on the land of one of its customers in Saint-Avold without informing them of the contents. However, it would seem that it did so without intending simply to get rid of them;

- the receiver of the company stated that it would cover the cost of having ANDRA take the drums away.

Following this discovery and at the request of ASN, the ANDRA recovered these lightning arresters which have since been stored in its installations within the SOCATRI premises in Pierrelatte.

which have radiological emergency response units, so that information circulates correctly and the response resources are coordinated.

At the same time, the ASN continued to monitor events which could lead to a radiological risk. Of the various events which required action on the part of the ASN, those in the boxes above should be mentioned.

2 BNI EMERGENCY SITUATIONS

2 | 1

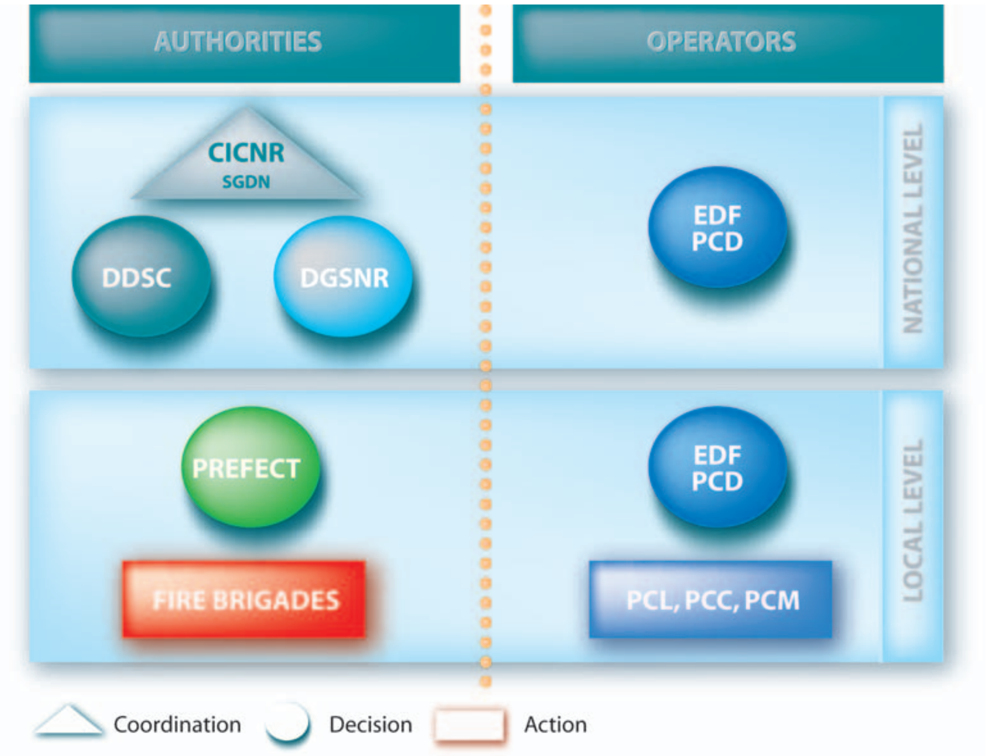
General emergency response provisions

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.

It should be noted that 2003 saw the publication of decree n° 2003-865 of 8 September creating the Interministerial Commission for Nuclear or Radiological Emergencies (CICNR) which reorganises interministerial coordination of accident situations. This decree does away with the Interministerial

Committee for Nuclear Safety and hands secretarial services for the CICNR over to the Secretariat General for National Defence (SGDN).

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 authorities 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 and information required by the international conventions on informing foreign countries of a radiological emergency;
- the SGDN, which performs secretarial duties for the 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 exercises are scheduled and then assessed.

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 for situations in which the above measures would be insufficient owing to the extent of the release.

To give an example, the maximum credible PWR accident could result in a decision, to be taken within 12 to 24 hours, to shelter populations and organise absorption of stable iodine 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 of certain foodstuffs or the reclaiming of contaminated zones.

2 | 2

The role and provisions of the ASN

2 | 2 | 1

ASN assignments in an emergency context

In an accident 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, viewdata system (Minitel), press conference). It is obviously important that this should be done in close collaboration with other organisations concerned (Prefect, local and national operator);
- 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 organisations, 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 (Convention on Early Notification of a Nuclear Accident, which was ratified by France on 26 September 1986, and the decision of the Council of European Communities of 14 December 1987, concerning community procedures for rapid exchange of information in the event of a radiological emergency). In this respect it collects and summarises information with a view to ensuring the notifications and information 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

EIn 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 unit or management command post (known as the DGSNR PCD in Paris) located at the DGSNR emergency response centre and managed 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 Communications Directorate 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. One or more engineers are delegated to it by the DGSNR. 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:

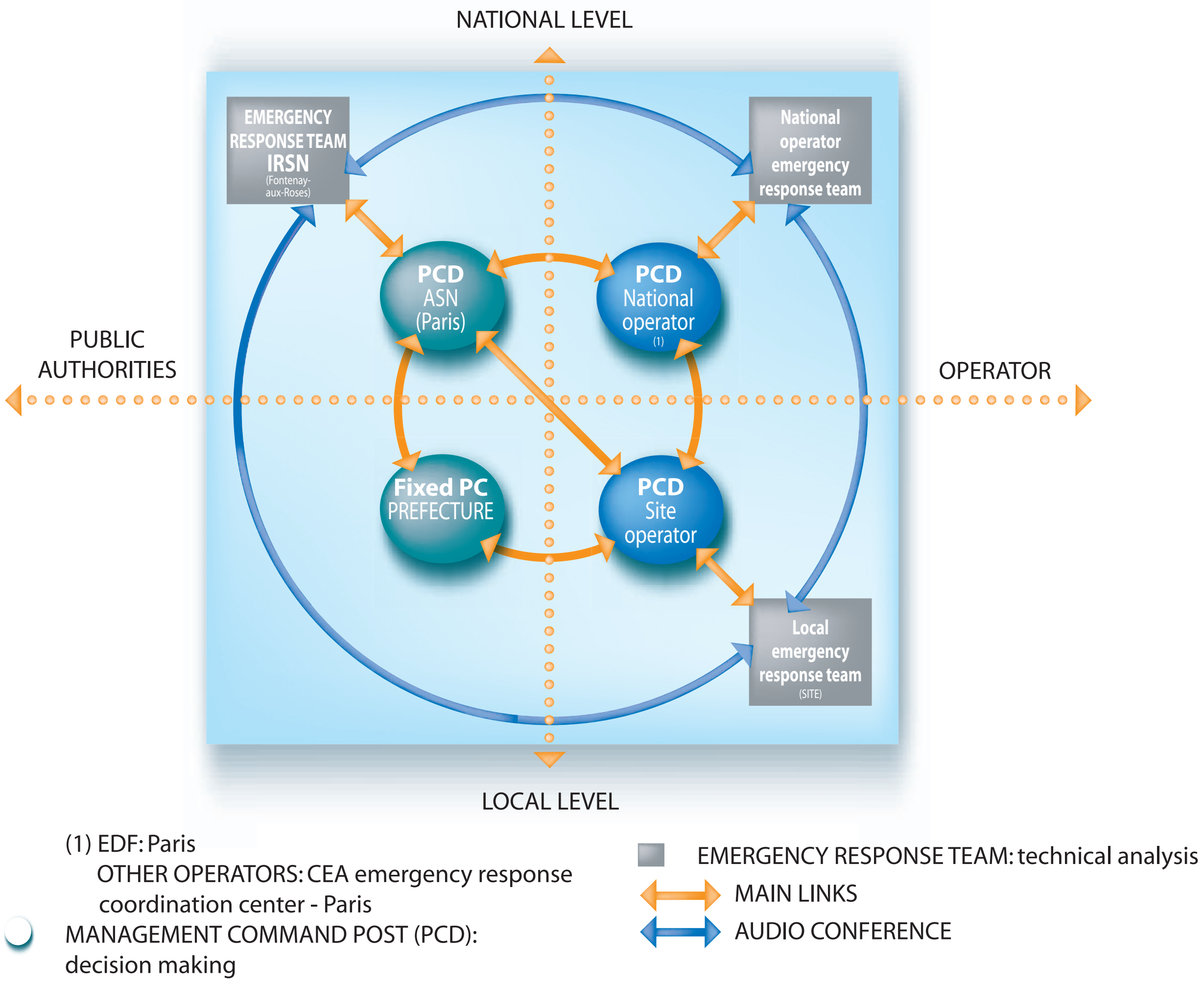
• a local team at the prefecture, consisting mainly of representatives from the decentralised services of the DGSNR, whose purpose is to assist the Prefect in making his decisions and implementing his communication actions by providing explanations enabling understanding of the technical aspects involved, in close collaboration with the DGSNR PCD;

• a local team at the affected plant site, also consisting of DSNR engineers, possibly with DGSNR and IRSN representatives, assisting the site PCD head. It takes no part in operator decisions, but ensures that responsibilities are correctly assumed, notably as regards the 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.

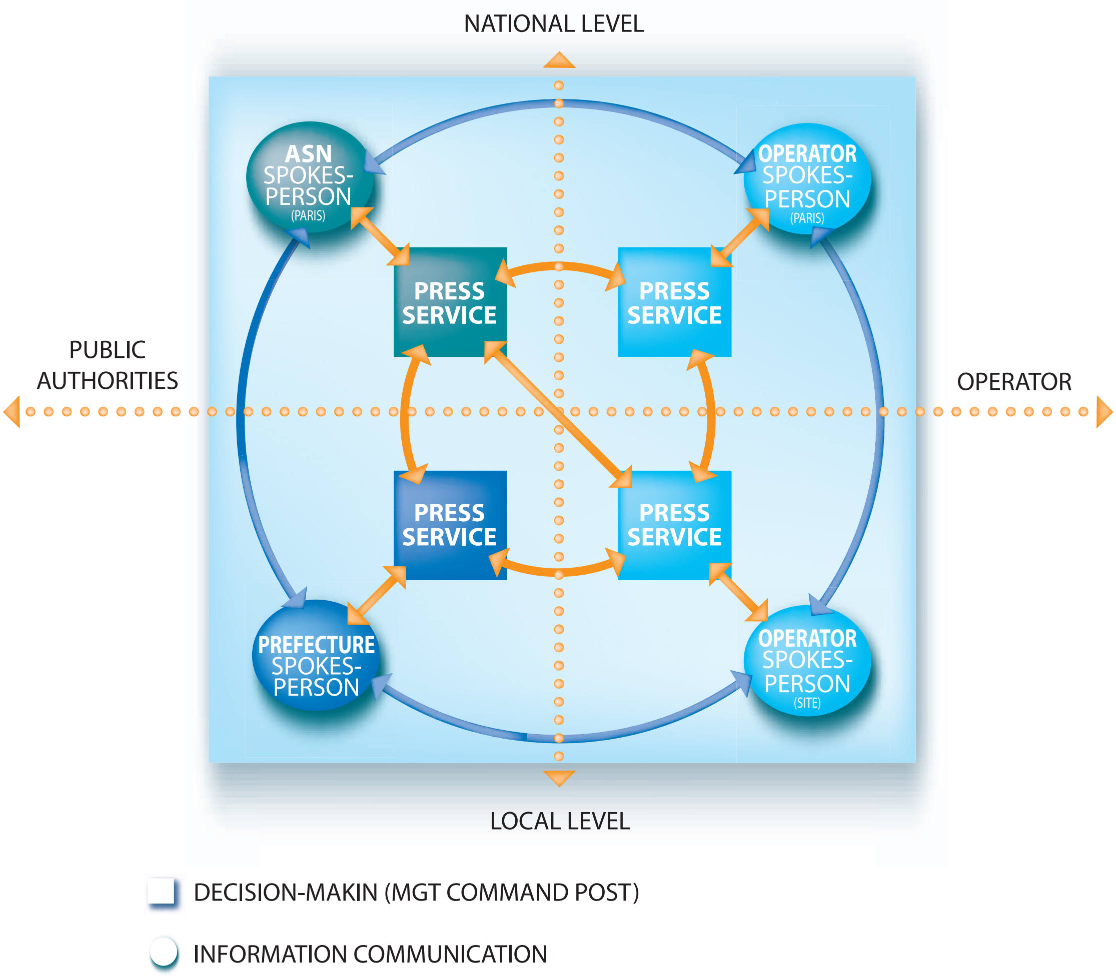
The diagram below presents the overall emergency response structures set up, in collaboration with the Prefect and the operator. It shows that the operator has a local PCD on the site and usually a national PCD in Paris, each connected with its own emergency response team. The various connections shown on the diagram indicate information exchanges.

Nuclear safety organisation



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 | 2 | 2

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

The DGSNR emergency response centre during the storms in the Rhone valley

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.

- **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. Videophone conference equipment is also mainly used between the DGSNR PCD and the IRSN response centre. The DGSNR PCD also makes use of data processing equipment adapted to its assignments.

2 | 2 | 3

Role of the ASN in the preparation of emergency plans

2 | 2 | 3 | 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 | 3 | 2

Participation on 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 (see § 4|2). Within this context, the ASN approved the fast-developing accident scenarios defined by the operators, liable to result in environmental release within less than 6 hours, necessitating population protection measures, based on the intervention levels defined by the Minister for Health.

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. Exercises 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 exercises described below and undergoes unannounced tests.

2 | 3 | 1 | 2

National nuclear accident simulation drills

In 2003, 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 DDSC and the SGCISN.

Two types of exercise are involved:
- exercises targeting “nuclear safety”, involving no actual population actions and mainly aimed at testing the decision process on the basis of a freely established technical scenario;
- exercises targeting “civil defence”, involving actual application, on a significant scale, of PPI countermeasures for population protection (alert, sheltering, evacuation) built around a technical scenario based on the population participation conditions adopted.

During most of these exercises, simulated media pressure is placed on the main parties concerned in the exercises, in order to test their ability to communicate.

The following table describes the key characteristics of the national drills conducted this year.

In addition to the national exercises carried out on an average every three years on each nuclear site, the prefects are asked to conduct local exercises in collaboration with the sites in their vicinity, with a view to better preparing for emergency situations.

NATIONAL NUCLEAR ACCIDENT SIMULATION DRILL SESSIONS IN 2003

NUCLEAR SITE	DATE OF THE DRILL	PRIME TARGET	CHARASTERISTICS OF THE DRILL
Tricastin (EDF)	21 January	Civil defence	Test of new PPI and alarm system
Saclay (CEA)	25 March	Nuclear safety	Test on evacuation of 8 injured persons
Chooz (EDF)	12 June	Nuclear safety	Implementation of Belgian emergency provisions
Paluel (EDF)	16 September	Nuclear safety	
Eure-et-Loir Department	23 September	Transport	Transport of radioactive materials
Chinon (EDF)	9 October	Nuclear safety	
Bugey (EDF)	23 October	Nuclear safety	Test of an automatic call device supplementing the alarm system
Romans (FBFC)	22 November	Nuclear safety	
Civaux (EDF)	5 and 11 December	Nuclear safety	On 5/12 local civil defence drill

2 | 3 | 1 | 3

International drill sessions and cooperation

The year 2003 also witnessed the continuation and expansion of international cooperation in emergency response and drill sessions. In particular Franco-Belgian coordination was tested during the Chooz drill and Swiss observers attended the Bugey drill.

Generally speaking, the ASN is of the opinion that emergency situation co-operation should be reinforced with States with which France has common frontier zones. Discussions were therefore held to define relations between France and Switzerland in the event of an accident at a nuclear installation in one or other of these countries. Information and co-operation procedures in a similar situation are also under discussion with Germany and Luxembourg. A technical protocol with Belgium, tested during the 12 June drill, is currently being finalised.

2 | 3 | 2

Lessons learned from the drill sessions

Many lessons can be learned from these exercises, some of which are recurrent from one exercise to another. To this end, each exercise is the subject of careful assessment, concluded by a general national assessment meeting held one or two months after its completion. In addition, various observers (civil servants, persons from neighbouring countries, qualified personalities) often see things in a new light, from an original angle.

With a view to summarising the lessons learned and deriving new lines of action to be adopted, the DGSNR leads a national working group on feedback from these exercises, associating the main national public organisations (IRSN, SGCISN, DDSC, Météo-France) and the operators. This group met twice in 2003.

Among those lessons learned from the drills of the previous year, it is worth noting the need to vary the drill scenarios to avoid routine, particularly for those at the national level who take part in several drill sessions every year.

The following paragraph describes the main developments envisaged for the future, based on the lessons learned from drills conducted in recent years.

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 exercises 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 in Japan on 30 September 1999).

2 | 4 | 1

Rules for onsite plan initiation and public authority alerting by the operators

The work initiated by the circular of 10 March 2000 (see § 2|4|1) allowed clarification of the conditions under which the authorities should be alerted by the operators in the event of fast-developing accidents justifying triggering of the PPI reflex stage.

2 | 4 | 2

Revision of the offsite emergency plans for nuclear sites

Since 1997, the DSIN had led a discussion group involving the DDSC, the DGS, the IPSN, the OPRI, the SGCISN and the BNI operators, with the aim of updating the offsite emergency plans for nuclear sites, taking into account feedback from the nuclear accident drill sessions. This led to signature of the interministerial circular of 10 March 2000.

The main innovations presented in this circular are as follows:
- the creation of a reflex stage, which corresponds to a decision of the Prefect to trigger an immediate previously defined action, in the case of accidents liable to cause radioactive release resulting in the offsite action level being exceeded within a period of less than 6 hours. The operator relies on objective criteria approved by the ASN comprising parameters identified beforehand and easily accessible to the operating staff;
- limitation of PPI initiations in reflex or concerted mode to cases where population protection measures are required. In all other cases, the Prefect sets up a “watch committee”;
- definition of new intervention levels, based on the most recent international recommendations.

The prefects had a period of 2 years, starting from receipt of the circular, 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.

Application of these measures to the context of each PPI will provide a further opportunity for informing the general public and the local councillors, notably through the Local Information Committees.

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”.

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 Secretary of State 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. Under these conditions, another preventive distribution of stable iodine tablets took place in 2000 under the same conditions as in 1997, but with the shelf-life of the tablets extended to 5 years.

At the end of this new distribution campaign, about 50% of those living near the nuclear installations had iodine tablets at home. With a level as low as this, the population protection measure involving sheltering and absorption of iodine is not applicable, which, even in the event of a low 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, and to plan the stockpiling in each department with a view to improving provisions for the protection of children, adolescents and young adults against radioactive iodine beyond the PPI zone. To create these stocks, the Ministry for Health ordered 60 million tablets from armed forces central pharmaceutical supplies. Delivery of the tablets began in 2002 and should be completed in 2004 (by end of November 2003, 27 million tablets had been manufactured and delivered in 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. Furthermore, the DGSNR has also begun a survey with the DDASSs in order to obtain a more accurate evaluation of the effectiveness of the new iodine distribution program within the PPI zones.

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.

Since accidents can occur in areas where the regional DRIRE concerned has no DSNR, the ASN has provided all DRIREs with an action guide for radioactive material transport accidents. This guide provides staff from DRIREs without DSNRs with information enabling them, in co-operation with the ASN, to advise local authorities concerned by the accident.

Furthermore, with a view to progressing in the field of emergency plans covering transport accidents, a special exercise associating COGEMA Logistics as transporter, COGEMA La Hague as consignor and all the public authorities, notably the Prefecture of Eure-et-Loir which was the department concerned, was conducted on 23 September 2003.

"Radioactive materials transport" emergency drill on 23 September 2003 (AREVA/J.M. TAILLAT)

The ASN also took part in an interministerial working party responsible for preparing guidelines to assist the Prefects in drafting specific emergency plans for the transport of radioactive materials (PSS-TMR). This aspect is developed further in chapter 10.

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" exercise 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 exercise 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 exercise 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. Within this context, an experimental "post-accident" delegation was set up by the Aube prefecture. Four working groups run by key players in the department were created and given the task of examining the following subjects respectively: questions of administrative and economic organisation; environmental measurements and monitoring public health; questions of decontamination, clean-up and contamination of the food chain; questions of movements around the zone. The concrete proposals for action presented by the groups are being analysed by the ASN with a view to including them in a national post-accident doctrine.

Following examination of the subject by the DGSNR with the support of the IRSN, the SGDN will in early 2004 be initiating an action plan designed to ensure progress in the post-accident field.

2 | 4 | 6

Updating of regulatory texts governing nuclear installation 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 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 imply substantial interministerial work which has just been started under the authority of the SGDN and which should be completed in 2004.

3 OUTLOOK

Publication of decree 2003-865 of 8 September, creating the CICNR, constitutes a significant change in the provisions organised by the public authorities in their response to a nuclear accident, by entrusting the SGDN with extensive powers of coordination. This should lead in 2004 to revision of the interministerial texts governing the management of an emergency response, drawing on the lessons learned from the numerous national drill sessions conducted with the active participation of the ASN.

When dealing with radiological emergencies outside nuclear installations, the ASN is working on setting up appropriate emergency provisions for managing events of widely different types and scales. The ASN will ensure that these provisions are then tested during drills.

CHAPTER 8

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CHAPTER 8
RADIOLOGICAL AND BIOMEDICAL ACTIVITIES

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 in sealed or unsealed sources.

In medical applications of ionising radiation, it should be recalled that one of the three fundamental principles of radiation protection, that is the principle of dose limitation, 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. It is therefore up to the practitioner to make a case by case 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 nonetheless make a significant contribution 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. This framework changed considerably in 2003, with the publication of decrees 2003-270 of 24 March 2003 and 2003-296 of 31 March 2003 modifying the Public Health Code and the Labour Code, which specify requirements concerning protection of exposed patients and of workers against the dangers of ionising radiation, and which thus contribute to completing the bulk of the work involved in transposing directives 96/29 and 97/43 Euratom.

In 2003 the ASN concentrated on making this new regulatory framework known to the medical profession. Installation supervision actions continued although given current resources, focus was on radiation protection in nuclear medicine and radiotherapy units. At the same time, the ASN increased its efforts to set up long-term radiation protection supervision provisions which are particularly aimed at allowing the 2004 launch of a program of regional inspections. With this in mind, the ASN has initiated a process of expansion of its resources both centrally and in the regions.

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 morphology of the human body 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 collected either on radiological films or – as is increasingly the case – on digital media.

Radiodiagnosis, which is the oldest of the medical uses of radiation, occupies pride of place in the field of medical imaging, 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 at the disposal of modern medicine should not however make the practitioners 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. In addition to the following presentation of the main radiodiagnosis techniques, paragraph 1|5 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, and that these devices must be scrapped (see § 4|2|1).

· Surgical radiology

These are radiological techniques which use radioscopy and require special equipment making it possible 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 in certain cases lead to some of the deterministic effects of radiation (burns, etc.). The operating personnel are also exposed to higher levels than during other radiological practices. In these conditions, in the light of the risk of external exposure it poses for the operator and the patient, surgical radiology must be justified by clearly determined medical necessity and its practice must be optimised in terms of radiation protection.

· Digital angiography

This technique, which is primarily used to explore the blood vessels, uses the digitisation of analogue images before and after the patient is injected with contrast. The images undergo computer processing so that they can be compared by superposition.

· Mammography

Given the composition of the mammary gland, 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.

Mammography appliance

- **Tomography**

Using a closely collimated beam of X-rays, emitted by a generating tube rotating around the patient, combined with 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 structure of the organs.

Tomography appliance

When first used, this technique revolutionised the world of radiology, in particular in the field of neurological exploration, 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.

In general, although tomography examinations only account for a small percentage of the total number of radiological procedures, they constitute a significant contribution 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 increasingly 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.

· Cranial tele radiology

These generators are more rarely used by practitioners. They operate with a focus – film distance 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) combined with 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). On the basis of these standards, the walls of radiology rooms must in particular be sufficiently opaque to radiation and may require the installation of reinforced lead protection. It should however be pointed out that in the light of changes to radiation protection regulations, which have in particular led to a lowering of the exposure limits for the general public and for workers, revision of these standards is now necessary.

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, in or very close to the area to be treated.

1 | 2 | 1

External radiotherapy

The irradiation sessions are always preceded by drafting of a treatment plan, which for each patient clearly defines the dose to be delivered, the target volume to be treated, the dosimetry, the ballistics of the irradiation beams 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 radiophysicist.

Irradiation is from either a particle accelerator producing beams of photons or electrons, with an energy of between 4 and 25 MeV and delivering dose rates which can vary from 2 to 6 Gy/h, or – albeit now to a lesser extent – telegammatherapy appliances equipped with a cobalt 60 source, the level of which is about 200 terabecquerels (TBq). In recent years, these appliances have been gradually phased out in France and are being replaced by particle accelerators, which higher performance offers a wider range of possible 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, in the case of some accelerators, auxiliary technical premises.

The protection of the premises, in particular the treatment room, must be determined so that the annual exposure limits for the workers and/or the public are met around the premises. A specific study must be performed for each installation by the supplier of the machine, together with the radiophysicist and the person with competence for radiation protection 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 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, a set of systems must indicate the machine status (operating or not) or must shut down emission of the beam in an emergency, or if the door to the irradiation room is opened.

Radiotherapy particle accelerator

1 | 2 | 2

Sealed source 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 completely replaced the radium 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.

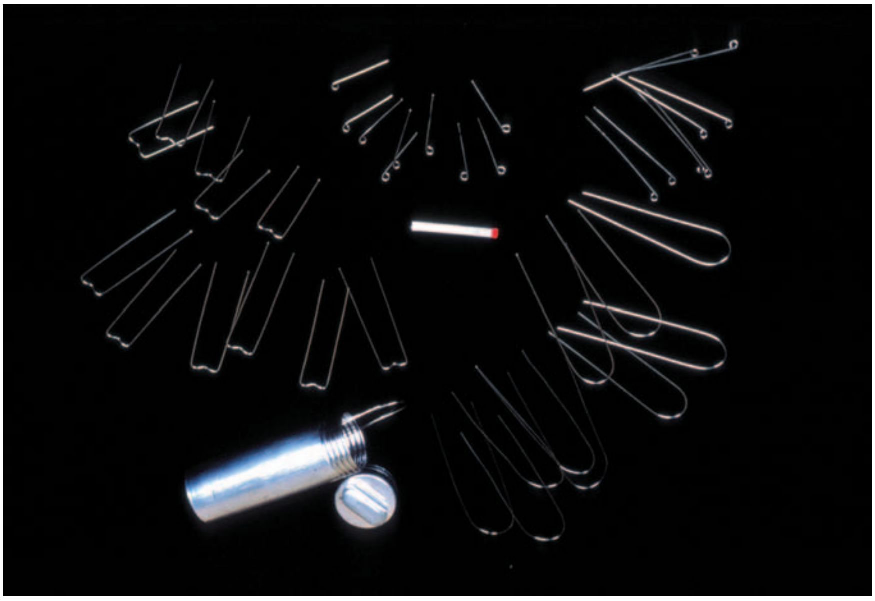
Low dose rate brachytherapy, requiring patient hospitalisation for several days, gives dose rates of 0.4 to 2 Gy/h. The iridium 192 sources are intended for interstitial applications (inside the tissues). The sources generally come in the form of wires 0.3 to 0.5 mm in diameter, with a maximum length of 14 cm and which linear activity is between 50 MBq/cm 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.

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



Iridium 192 source used in low dose rate brachytherapy

a 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.

Iodine 125 sources used for prostate brachytherapy

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 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 appliance

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.

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 radionuclides 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 is classified as a drug, will depend on the organ being examined. The radionuclide can be used directly, or fixed to a carrier (molecule, hormone, antibody, etc.). For example, the following table presents some of the main radionuclides used in the various investigations.

Type of investigation	Nature of radionuclide	Type of carrier
Metabolism of the thyroid	Iodine 123, technetium 99m	
Myocardial perfusion	Thallium 201	
Pulmonary perfusion	Technetium 99m	Macroaggregated albumin
Pulmonary ventilation	Xenon 133, krypton 81m	
Osteo-articular process	Technetium 99m	Phosphonate

Technetium 99m, delivered to nuclear medicine departments in the form of a generator, is by far the most commonly used radionuclide. Moreover, its short half-life of 6 hours and limited gamma radiation energy (140 keV) are highly favourable to the patient from the dosimetric standpoint. 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, using the same principle as for the X-ray scanner.

Scintillation camera

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. Radioimmunology is currently being strongly challenged by techniques which make no use of radioactivity, such as immuno-enzymology.

1 | 3 | 3

Metabolic radiotherapy

Metabolic radiotherapy administers a radiopharmaceutical that emits β radiation, which will deliver a significant dose to a target organ, as a remedial or palliative measure.

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 in 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 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, 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 follow specific construction and organisation rules, the main provisions of which - for the in-vivo diagnosis units - are as follows.

Shielded chamber for handling unsealed radioactive sources used in nuclear medicine

I Location and layout of premises

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 personnel, 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.

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 will 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 25 grays per minute.

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.

1 | 5

Medical exposure

Patient exposure to ionising radiation can be differentiated from other exposure (population, workers) in that there is no strict limit, even if the principles of justification and optimisation remain applicable. The situation also differs whether one is considering the field of diagnostic applications (radiology, diagnostic nuclear medicine) or radiotherapy, be it external or internal: in the first case, optimisation is required by looking for the minimum dose able to provide pertinent information, while in the second, the dose needed to sterilise the tumour must be delivered while maximising preservation of the neighbouring healthy tissue.

The patient dose depends on the quality of the equipment used, which fully justifies scrapping obsolete equipment and implementing quality control of the medical devices employed, not only the irradiating equipment, but also that used for these exposures (if a viewer used to visualise a radiology film is faulty, it can lead to a rise in the doses delivered to produce these 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 accurately identify the overall exposure of medical origin, as we do not know precisely the numbers of each type of examination practice and the doses delivered for the same examination can vary widely. However, worldwide statistics (UNSCEAR 2000 report, volume 1) established for 1.530 billion inhabitants (1991-1996 data) indicate an effective annual dose 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 effective annual dose per inhabitant in France is 1 mSv while it is 0.33 mSv in the United Kingdom and 1.9 mSv in Germany.

The studies conducted hitherto 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 scintigraph 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.

To improve the radiation protection of exposed patients, the ASN is preparing a plan of action particularly aimed at gaining a clearer picture of the doses delivered during examinations and treatments.

2 INVENTORY OF INSTALLATIONS

2 | 1

Medical and dental radiology installations

	Medical radiodiagnosis	Dental radiodiagnosis	Total
Private sector	9176	32296	41472
Public and quasi-public sector	6423	949	7372
Total	15599	33245	48844

2003 saw the continued fall in the number of radiological installations with a 3.9% drop in relation to 2002. On 31 December 2003, the breakdown of declared radiological installations was as follows.

The private sector recorded a significant drop of 4.9% whereas the public sector saw a slight rise of 1.7%.

The regional breakdown shows that those regions with the highest density of installations are still Île-de-France, Rhône-Alpes, Provence-Alpes-Côte d'Azur and Nord-Pas-de-Calais with 21, 10.3, 10 and 5.18% respectively of the installed equipment base.

Medical radiodiagnosis

	Private sector	Public and quasi-public sector	Totals	% variation in relation to 2002
Cat. A (radioscopy)	0	0	0	– 100 %
Cat. B and C (simple radiodiagnosis)	1280	2457	3737	+ 1,2 %
Cat. D (sophisticated radiodiagnosis)	5766	3558	9324	– 5,15 %
Cat. N (mammography)	2125	413	2538	+ 0,55 %
Totals	9171	6248	15599	– 3,11 %

The following tables give the breakdown of radiological installations on 31 December 2003, per category of appliance.

Dental radiodiagnosis

	Private sector	Public and quasi-public sector	Totals	% variation in relation to 2002
Cat. E	32296	949	33245	– 4,3 %

Region	Medical radiodiagnosis		TOTAL I	Dental radiodiagnosis		TOTAL II	TOTAL I and II
	Public	Private		Public	Private		
Alsace	180	267	447	18	1181	1199	1646
Aquitaine	230	546	776	43	1693	1736	2512
Auvergne	164	174	338	18	678	696	1034
Basse-Normandie	157	133	290	25	510	535	825
Bourgogne	195	191	386	27	705	732	1118
Bretagne	315	383	698	47	1559	1606	2304
Centre	242	312	554	30	1142	1172	1726
Champagne-Ardenne	168	180	348	31	576	607	955
Corse	24	42	66	1	89	90	156
Franche-Comté	90	146	236	8	594	602	838
Haute-Normandie	165	186	351	22	728	750	1101
Île-de-France	1353	1827	3180	211	6848	7059	10239
Languedoc-Roussillon	209	406	615	40	1303	1343	1958
Limousin	101	78	179	11	370	381	560
Lorraine	312	231	543	50	1144	1194	1737
Midi-Pyrénées	227	529	756	29	1678	1707	2483
Nord-Pas-de-Calais	393	527	920	38	1575	1613	2533
Outre-Mer	127	142	269	18	396	414	683
Pays de la Loire	289	376	665	35	1497	1532	2197
Picardie	189	211	400	34	669	703	1103
Poitou-Charentes	199	225	424	25	751	776	1200
Provence-Alpes-Côte d'Azur	481	1170	1651	116	3131	3247	4898
Rhône-Alpes	613	894	1507	72	3479	3551	5058
TOTAL	6423	9176	15599	949	32296	33245	48844

Further to publication of the order of 17 July 2003, all radioscopy installations must now have been shutdown and removed from service (see § 4|2|1).

The fall observed in previous years in the installed base of dental radiology installations continued in this sector in 2003. However, an increase in the public sector over 2002 (+7.7%) should be noted, whereas the private sector fell by 4.6%.

2 | 2

Tomography appliances

The national radiological inventory comprises 608 tomography installations, which represents a rise of more than 3.5% over 2002. It should be noted that there are practically twice as many installations in the public sector as in the private.

2 | 3

External radiotherapy installations

In 2003, there were no significant changes in the radiotherapy installations inventory. The trend that has been under way for a number of years continued with rising number of particle accelerators, now standing at 332 units (+8.8% in relation to 2002) and a regular fall in the number of telegammatherapy machines, which is now down to 61 (-21%).

2 | 4

Brachytherapy units

The number of brachytherapy units fell in 2003 (112), following the closure of small units with limited activity, but the split between public (64) and private (48) sectors remained stable. Development of the prostate brachytherapy technique using iodine 125 sources should be noted. In 2003, it was used in 4 units.

2 | 5

Nuclear medicine units

A slight rise of about 0.7% should be noted in this field, with a total of 291 units as against 289 in 2002. The split between public and private sectors is 224 and 67 respectively.

10 nuclear medicine units are equipped with positron emission tomography installations (PET cameras or PETSCAN - PET camera coupled with a scanner) using fluoride 18 in the form of fluorodesoxyglucose (^{18}FDG).

From the procedural viewpoint, use of this imaging technique must be preceded by updating of the radionuclide possession and utilisation files in the nuclear medicine units, usually leading to updating of the corresponding licences, it being understood that PET or PETSCAN scintillation cameras still require sophisticated equipment licensing by the Minister for Health. Primarily through an on-site inspection, the ASN attaches importance to checking that the nuclear medicine units concerned have made the necessary arrangements and are in possession of the necessary equipment.

2 | 6

Blood product irradiators

Blood product irradiators

The situation in this field has stayed relatively stable, with about forty installations in operation in the blood transfusion centres.

3 REGULATORY PROVISIONS 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 gone over again.

3 | 1

Declaration or licensing of radiation sources used for medical purposes

The Public Health Code (articles R. 1333-17 to R. 1333-44) sets the licensing and declaration provisions regarding all nuclear activities, in particular those linked to medical and biomedical research applications of ionising radiation (sub-sections 1 - articles R. 1333-17 to R. 1333-20 - and 2 - articles R. 1333-21 to R. 1333-25), whether or not the sites are subject to the regulations applicable to installations classified on environmental protection grounds (see article L. 1333-4 of the Public Health Code).

These procedures do not replace those already in force under other provisions of the Public Health Code, in particular that arising from implementation of the “health map” and the health organisation scheme articles L. 6121-1 to L. 6121-12), which instituted the principle of licensing prior to acquisition of certain “sophisticated” equipment. This licence is granted, on a case by case basis, either by the Minister for Health, or by the Director of the regional hospitalisation agency concerned, in accordance with the requirement indices for each type of “sophisticated” equipment. This enables installation of this type of equipment to be planned, so that distribution of the resources according to the needs of the population of a given region is optimised. This planning meets radiation protection concerns by avoiding large numbers of installations which could lead to unnecessary patient exposure.

The following table presents the procedures governing the various medical and biomedical research applications, it being understood that they cannot benefit from any exemption from these procedures.

The licences or declarations will be valid for no more than 5 years, renewable. The licence delivered to the head of an installation is personal and non-transferable. Any modification to this licence concerning either the beneficiary, or the installation, or its operating conditions, must be the subject of a new application, in application of article R.1333-36 of the Public Health Code. The beneficiary of a licence or the person declaring use of a radiology installation shall take steps to protect, inform and provide radiation protection training for those persons likely to be exposed to ionising radiation, specified in articles L. 1333-8 and L. 1333-11 of the Public Health Code.

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, it should be noted that the ASN in 2003 set up a telephone hot-line specifically for emergencies (toll-free number: 0 800 804 135) which is open round the clock (see chapter 7, § 1|1|2). It can also of course be used for any radiological incident occurring in a medical installation.

Furthermore, article 2 of the decree of 4 April 2002 introduced a modification to article R.162-53 of the Social Security Code, which states that: "Practitioners and establishments which, for therapeutic or diagnostic purposes, use appliances generating ionising radiation or involving the use of radionuclides or products containing them, may only conduct examinations on or treat those insured by social security schemes if the appliances and installations have first been declared or licensed as mentioned in articles R.1333-22 and R.1333-24 of the Public Health Code. Only radiological examinations and radiotherapy treatments carried out using appliances and installations declared or licensed in the conditions stipulated in the previous paragraph will be reimbursed or paid for."

Activities covered in the Public Health Code	Types of application or installation	Applicable procedure	Competent authority	Article of the Public Health Code
Manufacture of radionuclides, or products and appliances containing them, as well as their distribution, import or export (1)	Manufacture and distribution of radiopharmaceuticals, telegammatherapy appliances, brachytherapy source applicators	Licence	AFSSAPS	R. 1333-17
Use of electrical appliances generating X-rays for diagnostic purposes, except sophisticated equipment (2)	Conventional medical and dental radiology equipment	Declaration	Prefect	R. 1333-22
Use of sophisticated radiological installations (3)	Scanners, digitised angiography units	Licence	DGSNR	R. 1333-24
Possession and utilisation of radionuclides or products and appliances containing them, for medical, biological analysis or biomedical research purposes (4)	Nuclear medicine, telegammatherapy, brachytherapy	Licence	DGSNR	R. 1333-24
Use of radiotherapy installations producing radiation from an electric generator (3)	Radiotherapy particle accelerators	Licence	DGSNR	R. 1333-24

(1) It should be noted that the licensing system applies irrespectively to companies or establishments which have radionuclides on-site, as well as to those which trade in them without directly possessing them. The licence is issued by the French health product safety agency (AFSSAPS); it falls within the framework of the roles and prerogatives of this agency in the field of health products.

(2) The declaration procedure takes the place of the approval procedure instituted by the order of 23 April 1969.

(3) These installations are now subject to a utilisation licence as stipulated by the radiation protection regulations. This licence comes in addition to the licence granted according to the sophisticated equipment procedure.

(4) Biomedical research as defined in article L.1121-1 of the Public Health Code: tests or experiments organised and practiced on the human being, with a view to expanding the scope of biological or medical knowledge.

Paragraph 3|3 describes the contents of the declaration and licence application files specified in articles R. 1333-22 and R. 1333-24. An order currently under preparation and based on article R. 1333-44, will detail the modalities for implementation of these procedures.

3 | 2

Radioactive source management rules

These rules, already presented in chapter 3, § 1|4, of course also apply to the medical and biomedical fields, remembering that they concern:
- the obligation to have a licence for all 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.

3 | 3

Declaration or licensing procedures

3 | 3 | 1

Declaration dossiers

The procedure for declaration to the Prefect of the department covers utilisation of electrical appliances generating X-rays for medical or dental diagnostic purposes – except for installations requiring licensing as sophisticated equipment (article R.1333-22). The corresponding dossier is to be drawn up on the basis of a form produced by the DGSNR, and to be collected from the Prefecture in the department concerned. For each establishment possessing and using medical or dental radiology installations, only a single declaration mentioning all the radiological installations needs to be presented.

This form should be used whatever the nature of the establishment (public or private) and the installations (medical or dental). The dossier is to be submitted in duplicate to the Prefecture of the department in which the establishment using the appliances to be declared is located. When the dossier is considered to be complete by the examining department, an acknowledgement of receipt of a radiodiagnosis installation declaration, recalling the general conditions to which the installations are subject, is sent to the declaring party by the Prefect.

After a five-year period, a further declaration must be submitted in the same conditions as the initial declaration. 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 comprise the reports of the inspections conducted in application of articles R.1333-43 and D.665-5-1 to D.665-5-12 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 and carrying CE markings 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).

3 | 3 | 2

Licensing application dossiers

These dossiers concern the following installations:
- 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.

These installations require prior licensing by the Minister for Health (article R.1333-24), issued by the DGSNR to the practitioners with responsibility for them.

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.

Granting of the licence depends on various criteria: suitability (in particular the case for installations covered by the sophisticated equipment procedure), competence of the practitioner in charge and conformity with the technical construction and layout rules.

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 from the date they first entered 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 will apply.

4 2003 SUMMARY OF DOSSIERS EXAMINED CONCERNING MEDICAL INSTALLATIONS USING IONISING RADIATION

4 | 1

Dossiers dealt with in 2003

4 | 1 | 1

Radiodiagnosis

Dossiers examined

Pending the forthcoming publication of an order initiating the declaration procedure for medical and dental radiology installations introduced by article R. 1333-22 of the Public Health Code, the dossiers were still examined on the basis of the approval system introduced by the order of 23 April 1969. In this respect, more than 6,000 radiodiagnosis installation licensing applications were examined. As in the past, the vast majority of applications were for dental installations.

CE Marking

For information, CE marking is a procedure applied in all Member States of the European Union to guarantee conformity with essential health and safety rules of all medical appliances, including those which employ sources of ionising radiation. This procedure, which is the subject of a European directive, has been transposed into French regulations and came into force in June 1998.

With the registration of 38 new models, the file of radiological generator types comprised more than 1,400 types on 31 December 2003, 285 of which carry CE marking.

Licence	Particle accelerator	Telegamma-therapy	Brachy-therapy	Nuclear medicine	Tomography	Blood product irradiator
Commissioning (including equipment replacements)	48*	2	6**	14***	101	
Renewal		8	24	34		8
Change in person in charge			1	9		2
Cancellation		1	1			
Total	**48**	**11**	**32**	**57**	**101**	**10**

* This heading also covers new licences issued in application of article R.1333-24 to installations already in operation.
** 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.

4 | 1 | 2

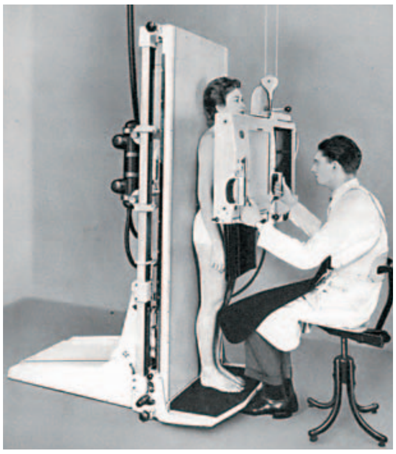
Tomography, radiotherapy, nuclear medicine and blood product irradiation installations

The DGSNR issued 259 notifications, broken down as shown in the following table.

4 | 2

Changes in 2003: elimination of simple radioscopy installations

Publication in the *Journal Officiel* on 22 August of the order of 17 July 2003, based on article R. 1333-58 of the Public Health Code, finally put an end to the use of radioscopy appliances which do not use image intensification (simple radioscopy), which are now prohibited. This ban also concerns radiophotography appliances using



Medical examination with a radioscopy appliance

radioscopy techniques. This step is the culmination of a process to eliminate these appliances that has been under way for a number of years at the instigation of the Ministry for Health and the medical profession. Changing medical techniques and radiological equipment, particularly with the increasingly widespread use of brightness amplifiers, have made simple radioscopy obsolete, as it was the cause of significant exposure of both patients and operating staff. This technique no longer being justified, it should be prohibited.

In 2003, 35 radioscopy installations were still declared (56 in 2002, more than 9000 in 1976). The ASN sent a letter to the establishments concerned to inform them of this ban and their obligation to scrap their appliances. This letter was also sent to establishments which in 2001 declared possession of simple radioscopy appliances. The establishments returned to the ASN a statement of removal from service of their simple radioscopy equipment. The ASN may carry out checks in 2004 to ensure that this measure has been correctly implemented.

5 SUPERVISION OF INSTALLATIONS

5 | 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 - of which in 2003 there were 17 - 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 then installation declaration dossiers, if necessary accompanied by a report confirming implementation of measures to remedy the inadequacies observed during these inspections. The 17 organisations approved by the DGSNR conducted about 6000 such inspections on medical and dental radiology installations.

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. Chapter 4, § 2|2 specifies the number and nature of the inspections conducted in 2003, broken down per type of medical installation. A total of 155 inspections were carried out in 2003.

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 installathe nature of the sources, the installations and the type of inspection to be performed.

Electrical generators for medical radiology

Type of inspection	**Public Health Code (art. R. 1333-7 and R. 1333-43) Check on organisation and technical measures ensuring compliance with radiation protection rules**	**Labour Code (art. R. 231-84) Check on sources and appliances, protection and alarm systems and measuring instruments (art. R. 231-86) Ambient check**
	Inspector	**Inspector**
Check 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 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 PCR
Periodic	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: annual
Ambiant check in supervised area		Organisation approved (R. 1333-43) by DGSNR/DRT or PCR Inspection frequency: monthly to annual

(1) This is a check on 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).

(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.

Radiotherapy and nuclear medicine units

Type of inspection	**Public Health Code (art. R. 1333-7 and R. 1333-43) Check on organisation and technical measures ensuring compliance with radiation protection rules**	**Labour Code (art. R. 231-84) Check on sources and appliances, protection and alarm systems and measuring instruments (art. R. 231-86) Ambient check**
	Inspector	**Inspector**
Check 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 PCR
After overshoot of public or worker exposure limits	DGSNR(3)	Labour inspectorate and/or DGSNR(3)
After formal notice	Organisation chosen by the examining service (DGSNR, prefect)	Organisation chosen by the labour inspectorate or check by DGSNR and labour inspectorate
After modification	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 PCR
Periodic	Radiotherapy or nuclear medicine installation: approved organisation (R. 1333-43) or DGSNR	Appliances(4): organisation approved by the AFSSAPS, Protection and alarm systems and measuring instruments: IRSN or organisation approved (R. 1333-43) by DGSNR/DRT Inspection frequency: annual
Cessation of activity	DGSNR (check on future of sealed sources)	Organisation approved (R. 1333-43) by DGSNR/DRT or PCR for issue of a certificate of radiological cleanness if unsealed sources are used (nuclear medicine)
Ambient check in supervised area		Organisation approved (R. 1333-43) by DGSNR/DRT or PCR Inspection frequency: monthly to annual

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(1) This is a check on 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).

(4) In the case of medical devices such as radiology appliances, decree n° 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

5 | 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 (surface area of premises, nature and thickness of walls, layout of rooms, types of coverings on floors and walls, 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 protection equipment appropriate to each installation is actually installed and functional (visible and/or audible alarm signalling, marking out of supervised and controlled areas, emergency stops, door safeties, radioactive source storage and handling 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.

5 | 3

Impact of medical installations

Currently, the ASN has little data enabling it to assess the impact of uses of ionising radiation sources for medical purposes, other than with regard to worker exposure (the case of patient exposure was mentioned in paragraph 1|5).

According to the existing data collected by the IRSN on exposure of staff using sources of ionising radiation for medical purposes, this sector includes about 135,000 people who receive dosimetric surveillance. 95% of the individuals monitored (IRSN 2002 figures) received a dose of less than 1 mSv during the course of one year, and 31 instances were recorded in which the future annual limit of 20 mSv was exceeded. The increasingly widespread use in the medical field of operational dosimetry should, by improving dosimetric monitoring, enable these results to become more detailed.

Barring special circumstances, there is no specific monitoring of the impact of medical applications on the environment and the population. The available information concerns general environmental monitoring conducted by the IRSN, in particular the measurement of ambient gamma radiation, which on the whole reveals no significant exposure levels above variations in background natural radioactivity. However, checks on rivers and sewage plants in the large towns and cities occasionally brings to light the presence of artificial radionuclides used in nuclear medicine above the measurement thresholds (iodine 131, technetium 99 m). The available data on the impact of these discharges show that they are estimated at a few microsieverts per year for the most exposed individuals (staff working in the sewerage networks) and that no presence of these radionuclides has ever been measured in water intended for human consumption.

The gradual development of the ASN's radiation protection inspections, combined with environmental monitoring targeted on certain installations and the use of appropriate calculation models, should provide a more accurate picture of the impact of medical uses of ionising radiation sources. These actions should be the subject of multi-year programs.

6 SUMMARY - OUTLOOK

2003 saw the build-up of ASN resources devoted to supervision of radiation protection concerning the various applications of ionising radiation, particularly for medical purposes. This process should continue in the coming years, because the ASN is as yet unable to perform all of its duties in this field. With the planned extra personnel, and apart from continuing with actions already carried out in previous years, a number of programs already started by the ASN will intensify in 2004:

- continued regulatory work with the publication of new orders implementing decrees for protection of the general public, workers and exposed patients;
- launch of a regional inspection program;
- development of information programs for health professionals concerning changes to radiation protection regulations;
- launch of an action plan to specify the modalities for supervising application of the radiation protection requirements applicable to exposed patients.

CHAPTER 9

INDUSTRIAL AND RESEARCH ACTIVITIES

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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, utilisation and disposal of the sources, from fabrication up to retirement. The investigations carried out by the ASN in 2003 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 therefore 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 handling all its radiation protection supervision duties.

1 PRESENTATION OF INDUSTRIAL AND RESEARCH ACTIVITIES USING IONISING RADIATION

Industry and research employ sources of 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 physiological process of decomposition of fresh fruits and vegetables.

At medium doses, ionisation by irradiation prolongs the self-life of fresh fish and strawberries, eliminates deterioration agents and pathogenic micro-organisms in shellfish, poultry 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, poultry 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 (BNI).

1 | 1 | 2

Non-destructive testing

This technique primarily involves gamma radiography and is used in about 40% of checks of this type. It is used to inspect homogeneity defects in metal, particularly in weld beads. It uses sources of iridium 192, with activity not exceeding 4 GBq and cobalt 60, with activity not exceeding 18 GBq. 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.

Gamma radiography device 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:

- density measurement and weighing;
- 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;
- 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 indicates 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;

- measurement of thin layer geometry;
- 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

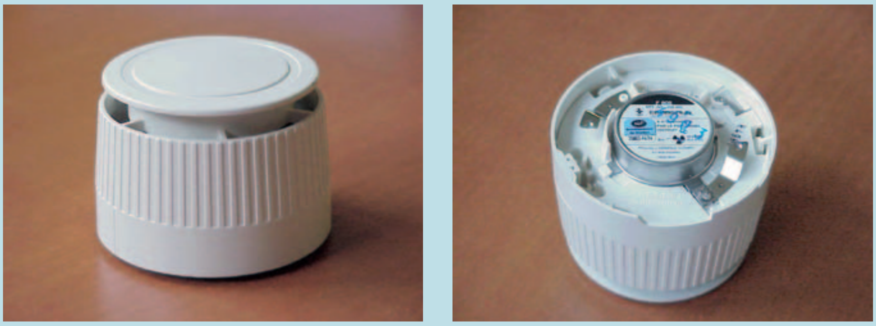
Sealed sources can also be used for:
- eliminating static electricity;
- smoke detection (see box);
- calibration of measuring instruments (radiation metrology);
- practical teaching work concerning radioactivity phenomena;
- chromatography;
- electron capture detectors using sources of nickel 63 or 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. These appliances are low-energy gamma emitters. This technique is notably used to detect lead in paint (see box).

Smoke detection

The aim is to signal an outbreak of fire as early as possible, by detecting the smoke produced. The devices used comprise 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. The profession and the ASN are also closely monitoring progress achieved in optical detection methods, with the eventual aim of substituting this type of detector for those which use radionuclide sources.



Smoke detector with radioactive source

Lead detection in paint

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.

Licence applications come from 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-ray fluorescence appliance for detecting lead in paint

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 pets

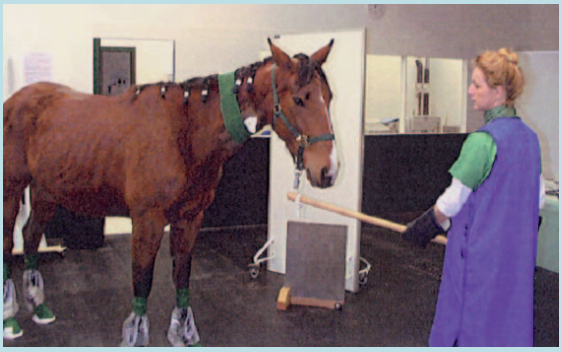
This entails application to the animal of human nuclear medicine techniques (see chapter 8, § 1|3), both for diagnosis (scintigraphic examinations primarily using technetium 99m) and for therapy (metabolic radiotherapy by administration of sources of iodine 131 or yttrium 90). It should be noted that there are also external radiotherapy or brachytherapy irradiation techniques.

Scintigraphy is one of the imaging tools which can be used for veterinary medicine (radiology, echography, x-ray computed 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 and P. Devauchelle) 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 scintigraphic imaging

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 weld 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.

Finally, certain applications require the use of particle accelerators which produce beams of photons or electrons.

The inventory of particle accelerators, which can be either linear (linacs) or circular (cyclotrons and synchrotrons), stands in France at about 50 installations which can be used in a wide variety of fields.

Unlike equipment used in the medical field, there is no CE marking obligation allowing free circulation of these appliances throughout the European Union. To date, only construction standard NFC 74-100 (construction and testing) setting the technical requirements to be complied with by the generators is made mandatory by the order of 2 September 1991. The order of 30 August 1991 determines the equipment installation conditions which are specified in standards NFC 15-160 (general

INDUSTRIES	PROCESSES	PRODUCTS
Chimistry Petrochemistry	Crosslinking 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	Crosslinking Thermal memory Modification of semiconductors	Constructions, instruments, telephone wires, power cables, insulating tape, shielded cable splices, Zener diodes, etc.
Food	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	Crosslinking Manufacture of foam Thermal memory	Heat-shrink food wrapping, gymnastics apparatus, pipes and ducts, moulded packaging, flexible laminate packaging
Environment	Disinfection – Precipitation 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

rules) and NFC 15-164 (rules specific to industrial radiology devices); compliance with these standards is mandatory.

1 | 4

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.

Snow height measuring device equipped with a caesium 137 source

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, which specifies 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, were 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 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. The ASN therefore 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 INSTALLATIONS INVENTORY AND SOURCE MOVEMENTS

2 | 1

Sources of ionising radiation

2 | 1 | 1

Radionuclides

The following tables specify the number of establishments licensed to use sources in the applications identified. They illustrate the diversity of these applications.

It should be noted that a given establishment can operate several applications.

Main uses of sealed sources	in 2002	in 2003
Gammagraphy	189	192
Density measurement and weighing	455	457
Thickness measurement	229	221
Atmospheric dust measurement	96	94
Thin layer thickness measurement	39	33
Basis weight determination	261	271
Level measurement	467	449
Humidity and density measurement	363	339
Logging	10	9
Elimination of static electricity	26	27
Smoke detectors	2	2
Implementation of neutron sources	55	55
Analysis	111	113
Calibration	846	875
Teaching	132	148
Research	19	21
Chromatography	516	521
Electron capture detectors	64	69
X-ray fluorescence analysis	1037	1343

Table 2: use of sealed sources

Main uses of unsealed sources	in 2002	in 2003
Research	1076	1082
Use of tracers	19	21
Calibration	95	103
Teaching	25	23

Table 3: use of unsealed sources

2 | 1 | 2

Electrical generators of ionising radiation

In the light of changing regulations, the ASN does not yet have sufficiently precise 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 coming years provide the ASN with this information and thus provide an accurate picture of the inventory of this type of equipment.

2 | 2

Radionuclide manufacturers and suppliers

In the field of radioactive source distribution, it is relatively rare for the supplier, who is also very rarely the manufacturer, to deliver an isolated source. It generally 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.

Number of suppliers identified per year	
2002	2003
183	202

Table 4: supplier licences

2 | 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. It should be noted that a given licence may cover simultaneous use of both sealed and unsealed sources.

Number of users identified for each type of source per year			
Sealed sources		Unsealed sources	
2002	2003	2002	2003
3554	3800	758	1165

Table 5: users per type of source

3 REGULATORY REQUIREMENTS CONCERNING INDUSTRIAL AND RESEARCH APPLICATIONS

The requirements of the public health code (sub-section 3, articles R. 1333-26 to R. 1333-28) concerning industrial and research applications are recalled below.

3 | 1

Licensing frameworks for ionising radiation sources used for industrial and research purposes

The following table presents the procedures governing the various industrial and research applications, including for veterinary purposes. It should be noted that unlike medical applications, industrial and research applications may not simply be declared, but always require licensing, barring some which 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 set at 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 application of article R. 1333-36 of the Public Health Code. The beneficiary of a licence must take measures 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.

Finally, any incident or accident likely to lead to over-exposure of a person shall be immediately declared to the department Prefect and the ASN. For information, the ASN in 2003 set up a telephone hot-line for emergency situations (toll-free number: 0 800 804 135) open round the clock (see chapter 7, § 1|1|2), which can also be used for any radiological incident occurring in any industrial or research installation using ionising radiation sources.

Paragraph 3|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 corresponding 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.

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 6: 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 n° 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.

Areas for application of the main particular conditions

- 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 release tubes;
- 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.

The most frequently used of these CPEs will then be incorporated into ministerial orders, with the others remaining 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 will shortly be published, updating the conditions of use for gammagraphy appliances and will supersede the corresponding CPE.

3 | 2

Radionuclide source management rules

These rules, already presented in chapter 3, § 1|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 any source movement;
- detailed accounting by the licensee of the sources in its possession and their movements;
- immediate declaration to the prefect and to the ASN of any loss or theft of radioactive sources;
- for any sealed sources that are expired, damaged or no longer needed, return by the user at its own expense to the suppliers - who are obliged to take them (see § 5|3).

3 | 3

Licensing procedures

For each nuclear activity mentioned in the table 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, limitation and optimisation stated 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 the appliances containing the sources in question;
- radiation protection provisions;
- drafting of the safety instructions;
- the precautions taken to deal with the risk 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.

This expertise will primarily be required for assessing:
- the design of the radionuclide sources and generators in their intended conditions of use;
- the possibility of extending the service life of the sources beyond ten years after the date the first supply form was signed, which - barring waivers - is the latest date for return of the source to its supplier;
- radiological supervision of fixed, mobile or portable appliances.

Prior selection of these experts is currently based on a protocol. The ASN checks that the organisation has the necessary resources and skills for compliance with it..

4 2003 SUMMARY OF DOSSIERS EXAMINED AND SOURCE MOVEMENTS

4 | 1

Suppliers

In 2003, the ASN gave priority to suppliers of radionuclide sources or devices 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 2003, 9 supplier licences were issued and 4 withdrawn. Several dozen dossiers are also currently being investigated by the ASN. It should be pointed out that it can take a relatively long time to investigate this type of dossier, given the combination of various negative factors, particularly:

- the problem in identifying the right people to talk to and then obtaining pertinent data about the sources and appliances;
- the complexity of the analyses linked to radiation protection of appliances and radionuclide sources;
- the problem with obtaining precise guarantees concerning effective recovery of used or unwanted sealed sources.

However, the extensive work currently under way on this type of dossier will make it easier to examine them subsequently when renewing licences or when licence modifications are requested.

4 | 2

Users

Investigation by the ASN of about 2200 licence applications for possession and utilisation of radionuclides led to notification of 485 licences and 200 withdrawals. 800 dossiers concerning an industrial or research activity are currently being examined by the ASN. Table 7 shows the licence notification and withdrawal trends for the past two years.

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 take place in accordance with the licences issued to 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 take place. The ASN is contacted in the event of any difficulty.

"User" licence trends		
Year	2002	2003
New licences	407	485
Renewals-updates	1127	1165
Withdrawals	168	200

Table 7: "user" licence trends

National movements of sealed sources are illustrated in table 8.

2003 saw a rise in the number of dossiers handled and notifications issued, in particular new licences linked to the growing number of users of devices equipped with sealed sources for detecting lead in paint.

Sealed sources in service	
On 31/12/2002	On 31/12/2003
26108	24508

Sealed sources distributed during the year	
2002	2003
3195	2243

Sealed sources collected by suppliers during the year	
2002	2003
2365	2682

Table 8: sealed source movements (IRSN data)

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 in 2003 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. After this experiment, which is scheduled to last for six months, and if it proves conclusive, examination of this type of dossier will be entrusted to all the DSNRs. At the same time, the ASN conducted a study to identify the various types of electrical generators of radiation and the corresponding construction and utilisation standards.

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 2003 to issue the CEA with twenty four source supplier and user licences.

5 SUPERVISION OF RADIATION SOURCES AND INSTALLATIONS

5 | 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.

5 | 1 | 1

Design checks

For unsealed sources, which can be considered “consumable”, supervision will chiefly take place during manufacture, with the user checking that the products delivered correspond to the support documents and its 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.

5 | 1 | 2

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 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 below specifies the various inspectors likely to intervene according to the nature of the sources, the installations and the type of check to be carried out.

Type of checks	Public Health Code (art. R. 1333-7 and R. 1333-43) Supervision of organisation and technical measures to ensure compliance with radiation protection rules	Labour Code (art. R. 231-84) Supervision of sources and appliances, protection and alarm systems and measuring instruments (art. R. 231-86) Ambiance checks
	Inspector	Inspector
Check 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 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): approved organisation (R. 1333-43)	Appliances, protection and alarm systems and measuring instruments: IRSN or organisation approved (R. 1333-43) by DGSNR/DRT or PCR
Periodic	Installation using sources of ionising radiation:(2) organisation approved (R. 1333-43) by DGSNR/DRT	Protection and alarm systems and measuring instruments: IRSN or organisation approved (R. 1333-43) by DGSNR/DRT Inspection frequency: annual
Cessation of activity	DGSNR (check on disposal of sealed sources)	Organisation approved (R.1333-43) by DGSNR/DRT or PCR to produce a certificate of radiological cleanness if unsealed sources are used
Ambiant check in controlled area		Organisation approved (R.1333-43) by DGSNR/DRT or PCR Inspection frequency: monthly to annual

Table 9: source inspectors

(1) This is a check on 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).

5 | 2

ASN checks carried out in 2003

During the course of 2003, the ASN inspected 23 industrial or research establishments using sources of ionising radiation, with 8 inspections concerning companies distributing radionuclide sources and 6 concerning BNIs (the subject being radioactive source management). Chapter 4, § 2|2|1 describes the number and nature of the checks, broken down according to type of installation.

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.

5 | 3

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.

5 | 4

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 24,000 and 7,000 exposed individuals respectively in these sectors, who are the subject of dosimetric monitoring. In industry, 86% of those monitored (IRSN 2002 figures) received an effective dose of less than 1 mSv over the course of a year and 36 instances were recorded in which the annual limit of 20 mSv was exceeded, while no such instances were recorded in research, where virtually all the staff monitored were not exposed to an annual effective dose in excess of 1 mSv.

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, barring special cases. The available information concerns general environmental monitoring as performed by the IRSN, in particular measurement of ambient gamma radiation, 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 should be part of multi-year programmes..

6 INCIDENTS

The incidents declared 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.

There were about fifteen such incidents in 2003, including:
- 5 losses during transport;
- 2 sealed sources stolen from their place of use;
- 1 incident linked to destruction of a sealed source as a result of a human error;
- discovery of a natural uranium source in non-authorised location;
- 4 sealed sources lost from their place of use;
- 2 contamination incidents linked to the use of unsealed sources.

7 SUMMARY AND OUTLOOK

In the field of supervising application of ionising radiation in industry and research, 2003 was a year in which the ASN identified working priorities based on its available resources. Efforts were therefo-

Heineken Brewery - Marseille

This incident, described in chapter 7 (§ 1|2), was caused by inappropriate maintenance by the contractor responsible, on a source of caesium 137 fitted to a level monitoring device installed on the beer keg filling line. As part of its follow-up to this incident, the ASN inspected the company which supplied and maintained the device, in order to examine the level of training of its technicians and its various maintenance procedures. Further to this inspection, the ASN asked this company to take a number of corrective measures.

re targeted on examining the situation of the 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 carry out all its duties.

With the extra staff already received and those planned for 2004, 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 estalbish approval criteria and check compliance with them.

RADIOACTIVE MATERIAL TRANSPORTATION

1 GENERAL INTRODUCTION

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1 | 4 | 2 Assessment of safety documents

1 | 4 | 3 Inspection and field supervision

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2 REGULATIONS

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3 | 2 Quality assurance policy

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CHAPTER 10

CHAPTER 10
RADIOACTIVE MATERIAL TRANSPORTATION

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;

- 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. Safety supervision falls within the competence of the ASN.

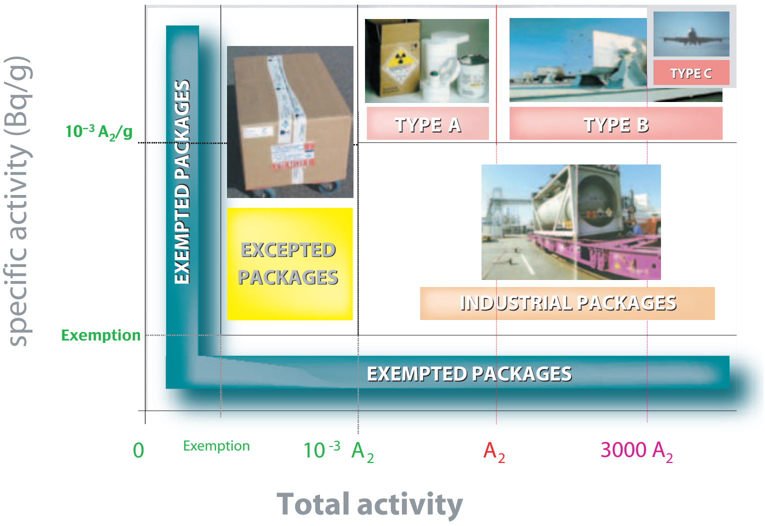
In application of the decree of 5 July 2001, supervision of the transport of radioactive and fissile materials for national security purposes falls to the Delegate for Nuclear Safety and Radiation Protection for activities and installations concerned by National Defence provisions (DSND).

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.



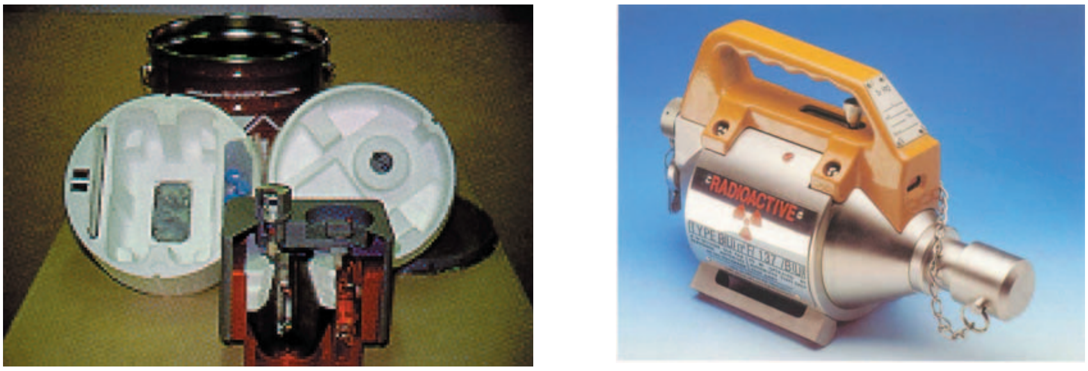
Types of package depending on total and specific activity

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 level of contents, below 10^{-3} A1 or 10^{-3} A2,
- industrial packages: low specific activity of contents, below 2.10^{-3} A1/g or 2.10^{-3} A2/g,
- 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 materials having spe-

Type A and B packages



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 accident conditions. These accidents are represented by the following tests:
- a series of three 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. Such accidents are represented by the following tests:
- a series of three 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;
- 90 m/s impact test on a rock target;
- immersion in 200 m deep water for 1 h.

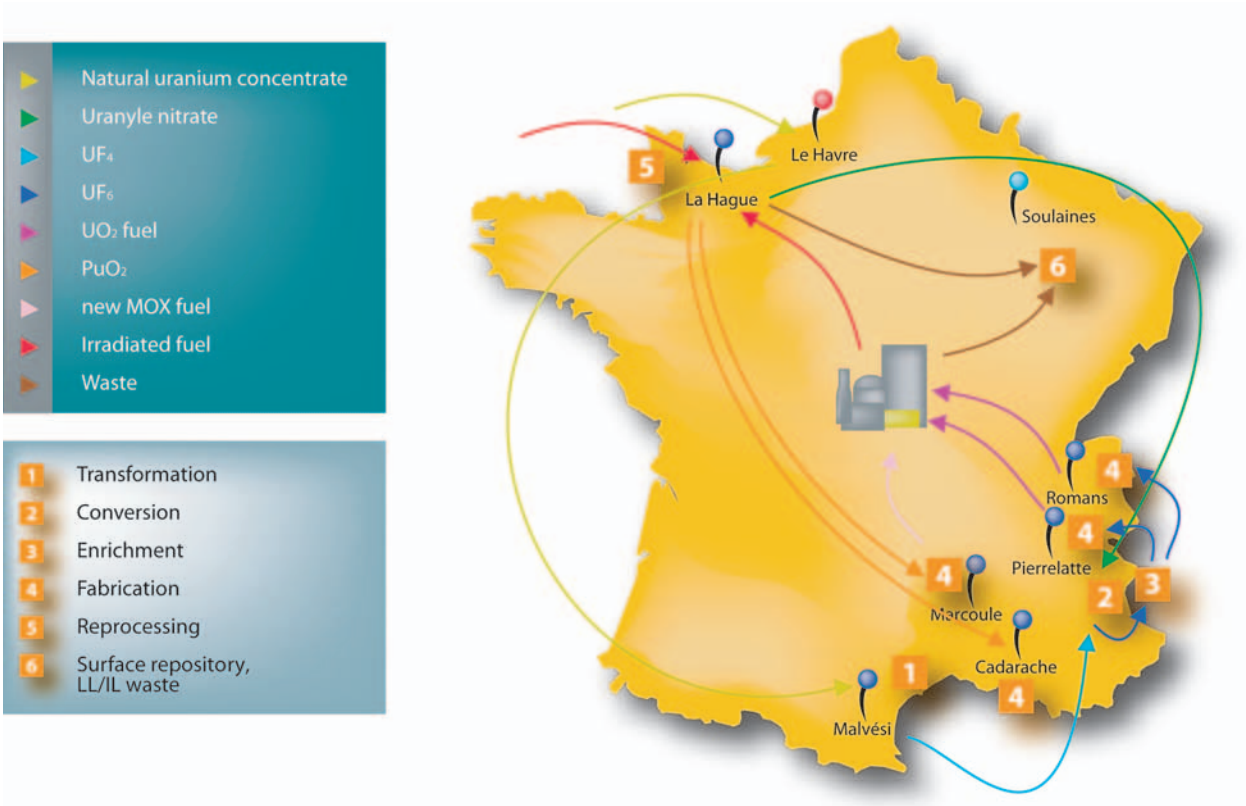
1 | 2

Annual traffic

300,000 radioactive material packages are transported in France annually, representing a few percent of the dangerous good traffic. Most (two-thirds) consist of radioisotopes for medical, pharmaceutical or industrial use. They are extremely varied and characterised by a radioactivity spectrum exceeding twelve orders of magnitude, i.e. ranging from a few thousand becquerels (pharmaceutical packages) to 1015 Bq (spent fuel) and varying in weight from a few kilograms to about one 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.

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 nuclear operator as consignor 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. The next stage consists in preparing the safety file, to be remitted to the competent authority with the application for authorisation;
- 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. In particular, the drivers of road-haulage vehicles require a training certificate before undertaking assignments of this nature.

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 can act 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.

1 | 4 | 1

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).

COLLECTION NORMES DE SURETE DE L'AIEA

Règlement de transport des matières radioactives

Edition de 1996 (Révisée)

PRESCRIPTIONS

Nº TS-R-1 (ST-1, révisée)

AGENCE INTERNATIONALE DE L'ENERGIE ATOMIQUE VIENNE

Code IMDG Édition de 2002

Code maritime international des marchandises dangereuses

OMI

Instructions techniques pour la sécurité du transport aérien des marchandises dangereuses

Organisation de l'aviation civile internationale

IAEA TS-R-1 regulations and maritime (IMDG) and air (ICAO IT) regulations

Transport safety is based on three main factors:
- first and foremost, on the engineered toughness of the packages,
- on transport reliability and certain specially equipped vehicles,
- on an efficient emergency response in the event of an accident.

Regulations are based on IAEA recommendations, which specify package performance criteria. The safety functions to be assured are containment, radiation protection, prevention of thermal hazards and criticality.

The degree of safety of the packages is adapted to the potential harmfulness of the material transported. For each type of package (excepted packages, industrial type packages, type A packages, type B packages, type C packages), the regulations define the associated safety requirements, together with test standards to be reached (see box on page 230). In its latest recommendations in 1996, the IAEA introduced a new type of package (type C), designed for air transport of large quantities of radioactive material. These recommendations came into force on 1 July 2001.

These regulations cannot be other than international, considering the number of trans-boundary movements involved. The ASN will consequently endeavour to involve itself with decisions as far upstream as possible in the drafting of these regulations, in co-operation with the IRSN, and notably at the IAEA Transport Safety Standards Committee (TRANSSC), where the ASN has a qualified expert.

1 | 4 | 2

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 dispersable 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 60 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).

1 | 4 | 3

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 2002. They will be periodically provided to maintain inspector qualification.

Inspection at Orly airport

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.

1 | 4 | 4

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.

COGEMA Logistics equipment for heavy package recovery

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.

1 | 4 | 5

Information of the public

As provided for in decree 93-1272 of 1 December 1993, amended by decree 2002-255 of 22 February 2002, the ASN is responsible for proposing and organising information of the general public on nuclear safety. In the field of transportation, the ASN will therefore rely on the methods and tools which, in the nuclear plant supervision field, enabled it to introduce regular, constructive exchanges with the general public and the media, marked by constant concern for clarity and rigour. Such provisions include notably:

- the "Transport" section of the *Contrôle* publication, which gives details of recent authorisations and incidents;
- the publication of information on the Magnuc viewdata server and the ASN's web site;
- exchanges with the media: conferences, communications, public reports;
- the introduction of transport issues into Local Information Committee debates;
- the development of communication tools, such as the INES scale.

However, it should be noted that particular transport operations may benefit from a certain level of confidentiality on nuclear material security grounds. The provisions concerning confidentiality were stipulated in the 25 July 2003 order from the Minister delegate for Industry.

2 REGULATIONS

2 | 1

National regulations

The orders applicable to each mode of radioactive material transport are as follows:
- the order of 5 December 2002 as modified, concerning the transportation 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 23 November 1987 as modified, division 411 of the regulations for the safety of ships (RSN);
- 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 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.

LÉGISLATION ET RÉGLEMENTATION

Arrêté du 5 décembre 2002
relatif au transport
des marchandises dangereuses
par route
(dit : arrêté ADR)

Volume 1

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MINISTÈRE DE L'ÉQUIPEMENT, DES TRANSPORTS, DU LOGEMENT,
DU TOURISME ET DE LA MER

Transport
des marchandises dangereuses
par fer

Annexe I à l'arrêté du 5 décembre 2002
(dit « arrêté RID »)
(*Journal officiel* du 27 décembre 2002)

ADR and RID regulations

The new orders which were signed or co-signed by the DGSNR during the course of 2003 are recalled below, in chronological order.

Land 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 with the Director for Land Transports:
- the order of 6 March 2003 modifying the order of 5 December 2002 concerning the transportation of dangerous goods by road (known as the “ADR order”) published on 9 April 2003 in the *Official Gazette*,
- the order of 7 July 2003 modifying the order of 5 December 2002 concerning the transportation of dangerous goods by road (known as the “ADR order”) published on 6 August 2003 in the *Official Gazette*,
- the order of 7 July 2003 modifying the order of 5 June 2001 as modified, concerning the transportation of dangerous goods by rail (known as the “RID order”) published on 17 August 2003 in the *Official Gazette*.

Certification of organisations

By delegation of the Minister for the Economy, Finance and Industry and the Minister for Ecology and Sustainable Development, the le DGSNR signed the following:
- the order of 9 October 2003 approving the Bureau Veritas as competent to certify conformity of the packages designed to contain 0.1 kg or more of uranium hexafluoride, published on 28 October 2003 in the Official Gazette;

- the order of 9 October 2003 approving the APAVE Group as competent to certify conformity of the packages designed to contain 0.1 kg or more of uranium hexafluoride, published on 28 October 2003 in the Official Gazette.

2 | 2

International regulations

The ASN endeavours to concern itself with decisions as far upstream as possible in the drafting of these regulations, notably by participating in the various international or multinational working parties dealing with the transportation of dangerous 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 17 to 21 February 2003 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) which took place from 10 to 14 November 2003.

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 two meetings of this group in 2002 on 26 March and 25 September 2003.

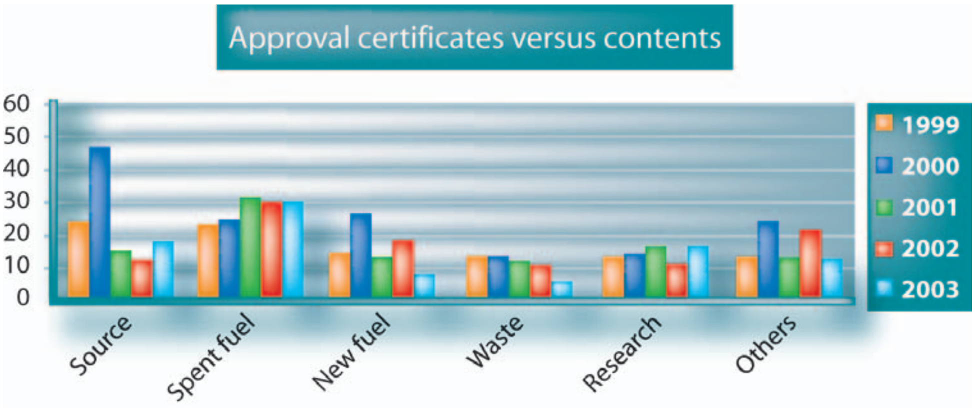
The ASN also took part in the RTSG (Radioactive material Transport Study Group) in Stockholm from 2 to 4 June 2003.

3 ASSESSMENT OF SAFETY FILES

3 | 1

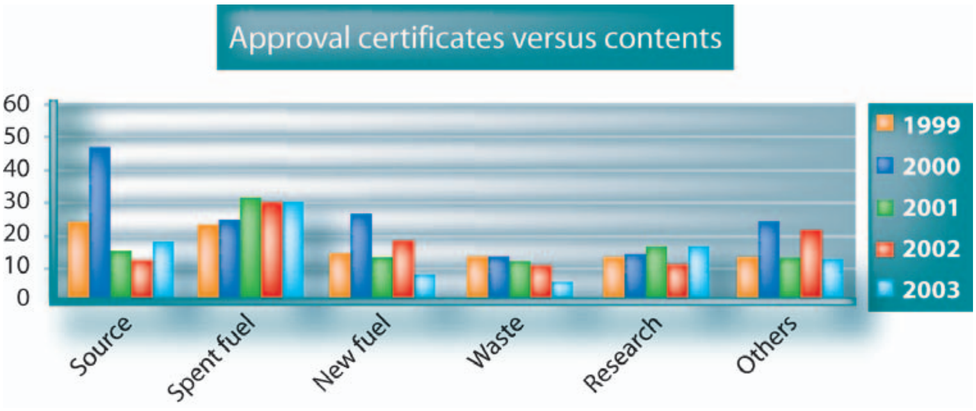
Issue of package design approval certificates

In 2003, the ASN issued 85 certificates as follows:
- 2 new approvals;
- 32 extensions of scope of approval;
- 11 extensions of approval validity;
- 22 validations of approvals;
- 18 special arrangements.



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:
- 18 certificates concern transportation of radioactive materials for medical, pharmaceutical or industrial use;
- 67 certificates concern transport operations connected with the nuclear power industry, including:
• 29 for spent fuel,
• 7 for new fuel,
• 4 for waste from fuel cycle plants,
• 16 related to research activities,
• 11 for other fuel cycle materials (UF6, PuO2, etc.).



Continuation of the COGEMA Logistics move to renew its package models led to application for approval of the new TN 81 package model. The TN 81 package is designed for transportation of vitrified waste produced by reprocessing of spent fuel assemblies. After assessment of the safety file, the ASN on 3 June 2003 issued approval certificate F/366/B(M)F-96T (Aa), valid for a period of 5 years.

Loading of a TN 81 onto a dolly

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. A copy of the record sheets was sent 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 2003 results estimate shows that 11,828 packages were registered, as against 4,758 in 2002. This significant rise is primarily due to registration of 48Y cylinders, which account for 51% of the packaging inventory. These packages fall into 91 different package models, as against 88 in 2002. The most widely used packages are the 48Y cylinders designed to transport natural uranium hexafluoride (6,734 packages, of which 5,937 are the property of a single owner, Eurodif Production). Moreover, more than 70% 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.

4 INSPECTION AND FIELD SUPERVISION

The BNI inspectors' role in monitoring radioactive material transports, was in 2003 based around two key 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 transporters. At a more general level, inspections also took place at the manufacturers and on the maintenance sites.

A total of 50 inspections was carried out in 2003 in the field of radioactive material transport.

With regard to drafting of radiation protection programmes, the situation is still not satisfactory. Even if those in the nuclear industry transport sector benefit from radiological monitoring under the terms of already applicable common law requirements enabling the objective set by the radiation protection programmes to be achieved, in most cases these programmes are not formalised. Furthermore, the checks performed outside the nuclear industry show a relatively widespread lack of radiation protection programmes and thus a lack of monitoring of those working in radioactive material transports, even if progress has been made. The action started by the ASN in 2002 will be continued in this area. Inspection carried out in airports also revealed marked inadequacies concerning stowage of packages and personnel training. This situation can only encourage the repetition of the transport incidents currently being observed in the airports. Airport surveillance needs to be reinforced in the future.

The observations and findings of the inspections concerning conformity with approval certificates show that the consignors are not always able to provide exhaustive proof that the content of the packages being shipped is in conformity with the package model approval certificate. Surveillance of package conformity with the approval certificates will therefore be maintained.

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:
- traceability of checking operations;
- quality plan, procedures, established practice;
- handling of deviations;
- supplier audits.

As regards documentation, the responsibilities of the various parties concerned and compliance with procedures or regulations, observations mainly concern:
- inadequate training of transport operation staff;
- failure to designate a security adviser;
- the duties of the security adviser;
- delegation procedures for signing dispatch notes;
- sharing of responsibilities between consignor and suppliers;
- lack of checking procedures,
- procedures for declaring events and incidents.

Within the framework of its special assignment, referred to in § 1|4|3, the 5th sub-directorate of the DGSNR carried out two further visits to suppliers chosen by the Framatome company to manufacture the FCC containers designed to transport new fuel for power reactors. The purpose of these inspections was to examine manufacturing conditions, container conformity with manufacturing data, together with the quality system provisions of the manufacturers.

5 INCIDENTS AND ACCIDENTS

Following the publication of new regulatory requirements, revision of the declaration procedure for events involving radioactive materials (class 7 hazardous goods) was undertaken.

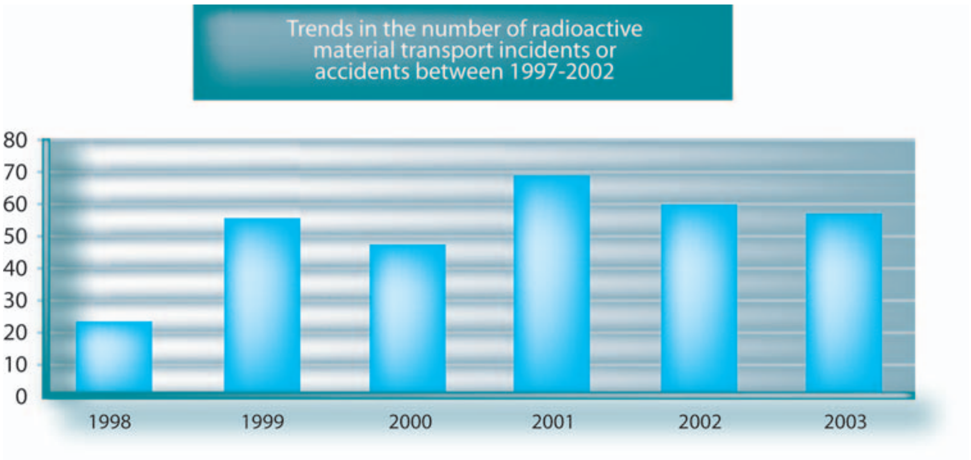
The circular letter of 28 August 2003, sent out by the ASN to all consignors and transporters, redefines the incident and accident declaration criteria initially sent out in the circular of 7 May 1999. It also reuses the incident report model proposed in the ADR and RID orders.

All transport discrepancies are thus declared to the ASN. Apart from this declaration, a detailed incident report must be sent to the Authority within two months. Events concerning regulatory nonconformities but which do not impair the safety function are not concerned by this report. In the case of contamination, an analysis report is to be sent to the ASN within two months.

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 seven 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 (see § 7 below).



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.

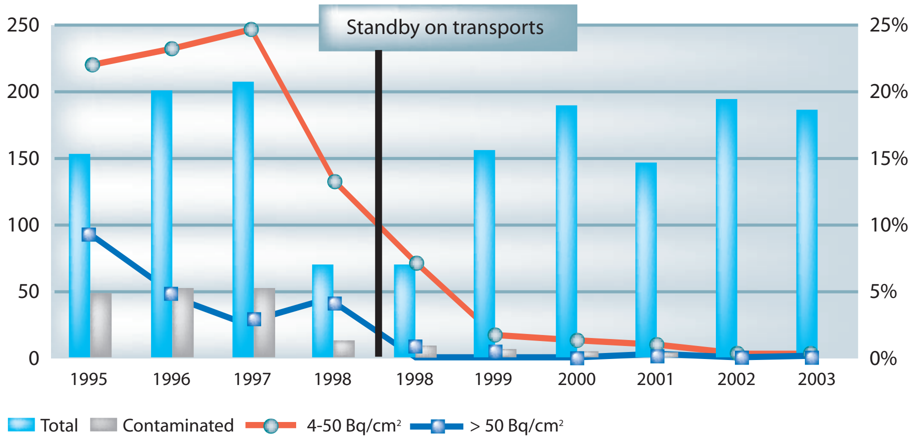
Spent fuel is continuing to be transported normally from foreign countries to La Hague and to Sellafield (Great Britain).

5 | 2

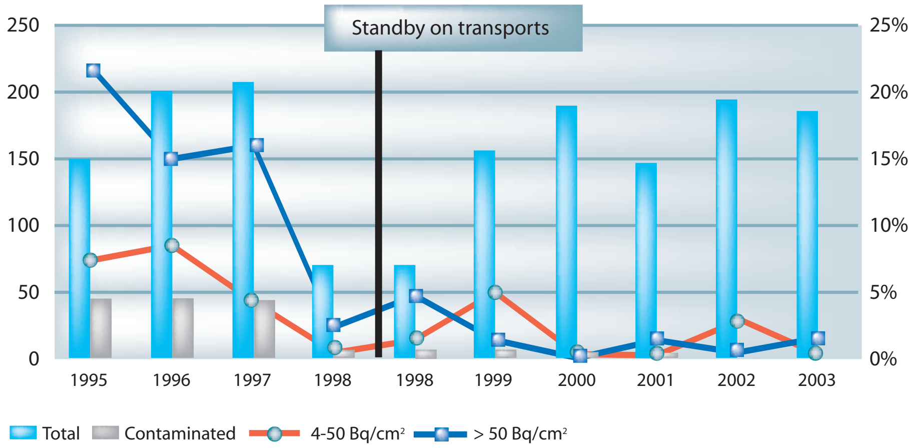
Package handling events

Airport handling incidents

Wagon and trailer contamination
Results in 2003



Package contamination
Results in 2003



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 2003, 20 incidents of this type were identified at Roissy-Charles-de-Gaulle, Orly and Lyon-Saint-Exupéry 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 transporters 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.

Contamination in an air cargo warehouse

On 15 October in Roissy airport, an excepted package loaded with radioactive material fell off the pallet, to which it was not secured, and was crushed by a fork-lift truck. The package was completely crushed, leading to leakage of the radioactive content. It contained a few millilitres of iodine 125, with an activity of 111 kBq. Excepted packages are not designed to withstand transport accident conditions, but as they contain very little radioactive material, the radiological consequences of an incident are extremely limited. The area was cordoned off and radiological measurements confirmed the presence of highly localised contamination of an area of about twenty square centimetres: decontamination took place the following day, by removal of material. These measurements revealed no trace of contamination of the personnel who had been in contact with the crushed package. This incident was ranked level 1 on the INES scale.

Contamination of a service road at Roissy airport

On the night of 27 to 28 November, an excepted package loaded with radioactive material fell off its lorry and was crushed by the following lorries. The package was totally crushed on a Roissy airport internal service road, leading to leakage of the radioactive liquid it contained, which was 106 MBq of iodine 125 in 204 bottles intended for medical use and produced by the Immunotech company. A safety perimeter was established around the area. Radiological measurements confirmed the presence of several contamination spots over a distance of about forty metres. The following day a specialist company carried out decontamination by removal of material. Measurements revealed no trace of contamination of the personnel who had been in contact with the crushed package. The package and its content were repackaged and then stored at Saclay before being returned to the consignor Immunotech. This incident was ranked level 1 on the INES scale.

5 | 3

Incidents and accidents during actual transport

The following incident is a good example of those which occur during actual transport.

Slippage of three packages, with one of them falling and tipping over into the transport trailer

During transport of contaminated tools, placed in type A packages and originating from an EDF site, three poorly secured packages slipped in the lorry trailer. One of them tipped over and fell. The retaining straps were not attached to anchor points. Nonetheless, the containers remained closed and showed no signs of impact or deformation. Radiological surface contamination and dose rate measurements were below regulation limits. A new packing plan was implemented and the convey dispatched again. This incident was ranked level 0 on the INES scale.

The importance of stowing and securing packages during all stages of the transport process was described in a circular letter sent out by the ASN on 10 September 2003 to all consignors and transporters.

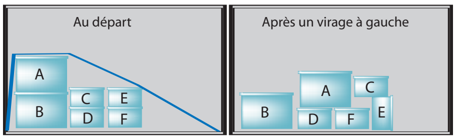


Diagram showing poor stowage

6 EMERGENCY RESPONSE PROVISIONS

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).

REPUBLIQUE FRANCAISE
Liberté Egalité Fraternité

PREFECTURE du Cher

PLAN DE SECOURS SPECIALISE

TRANSPORT MATIERES RADIOACTIVES

The Cher department s specialised emergency plan for the transport of radioactive materials

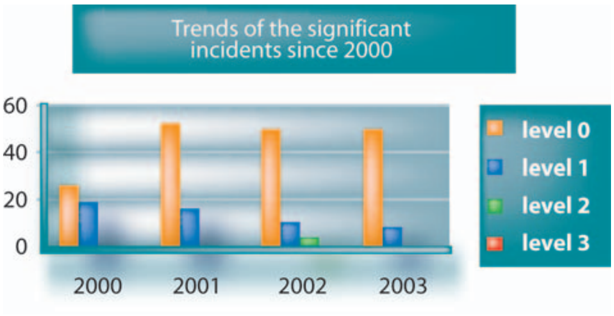
2003 emergency drill

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 2003, the emergency response provisions put in place by the ASN, the Eure-et-Loir prefecture and the other national organisations were tested during an emergency drill in the Eure-et-Loir department, with COGEMA La Hague acting as consignor and COGEMA Logistics as transporter. A further drill will be scheduled for 2004.

7 INFORMATION OF THE PUBLIC

The international event scale (INES) came into force at international level in 1991. It covers nuclear events occurring in all civil nuclear installations and during the transportation of radioactive materials to or from these installations. In France, the INES scale has been applied to basic nuclear installations since 1994.



Application of the INES scale to incidents and accidents in the transportation of radioactive materials was initiated by the High Council for Nuclear Safety and Information (CSSIN) in 1999 for a test period of one year, and this was confirmed by a decision of the ASN on 11 April 2001.

In 2003, 50 incidents were rated level 0, and 10 level 1.

The IAEA and the NEA published a revision of the INES User Manual, giving explanations on the classification of transport incidents. The system set up in France, where instructions for use are more detailed than in the manual, takes these developments into account. In March 2002, the IAEA asked that for an experimental period, the INES scale be applied to transportation, backed up by a specific guide, and the European Commission consulted the Member States on a protocol for application of the INES scale to transportation. International alignment on application of the INES scale to transport is consequently probable in the medium term.

INES :
Échelle internationale
des événements nucléaires
Manuel de l'utilisateur
Édition 2001

ACCIDENT
7 ACCIDENT MAJEUR
6 ACCIDENT GRAVE
5 ACCIDENT ENTRAÎNANT UN RISQUE HORS DU SITE
4 ACCIDENT N'ENTRAÎNANT PAS DE RISQUE IMPORTANT HORS DU SITE

INCIDENT
3 INCIDENT GRAVE
2 INCIDENT
1 ANOMALIE

ÉCART
0 EN DESSOUS DE L'ÉCHELLE AUCUNE IMPORTANCE DU POINT DE VUE DE LA SÛRETÉ

ÉTABLI CONJOINTEMENT PAR
L'AGENCE INTERNATIONALE
DE L'ÉNERGIE ATOMIQUE
et
L'AGENCE DE L'OCDE POUR L'ÉNERGIE NUCLÉAIRE

8 SUMMARY AND OUTLOOK

The ASN continues to reinforce the supervision it has exercised since 1997 over radioactive material transportation by:
- pursuing inspections on the premises of the designers, manufacturers, users, carriers and consignors of radioactive material packaging;
- reviewing internal transport regulations at nuclear sites;
- testing the emergency response provisions it would implement in the event of an accident involving radioactive material transportation;
- updating communication tools enabling information of the public as to the seriousness of an accident involving radioactive material transportation.

These actions have reinforced the safety culture of the transport operators.

The inspections conducted and the events which occurred in 2003 show that considerable progress is still needed in establishing the radiation protection programmes that have been mandatory since 2003 and in ensuring that packages are correctly secured, this being one of the main causes of the events declared to the ASN. The ASN will be continuing its work in these areas.

However, it is important not to overlook the substantive technical work underlying the issue of package approval certificates: 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.

ELECTRICITY GENERATING NUCLEAR POWER PLANTS

CHAPTER 11

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6 REACTORS OF THE FUTURE

7 SIGNIFICANT EVENTS ON EACH SITE

8 SUMMARY AND OUTLOOK

CHAPTER 11
ELECTRICITY GENERATING NUCLEAR POWER PLANTS

1 INTRODUCTION

This chapter is devoted to pressurised water reactors. These reactors, used to produce electricity, 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.

2 GENERAL DATA ON PRESSURISED WATER REACTORS (PWR)

In the main, the 19 French nuclear power plants are similar. They are all equipped with two to six reactors of the same type (pressurised water reactors), giving a total of 58 reactors, built by the same company, Framatome.

The following distinctions are generally made:
- among the thirty-four 900 MWe reactors:
  - the CP0 series, comprising the two Fessenheim reactors and four 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),
- among the twenty 1300 MWe reactors:
  - 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 and Penly.

Finally, the N4 series comprises four 1450 MWe reactors, two on the Chooz site and two on 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.

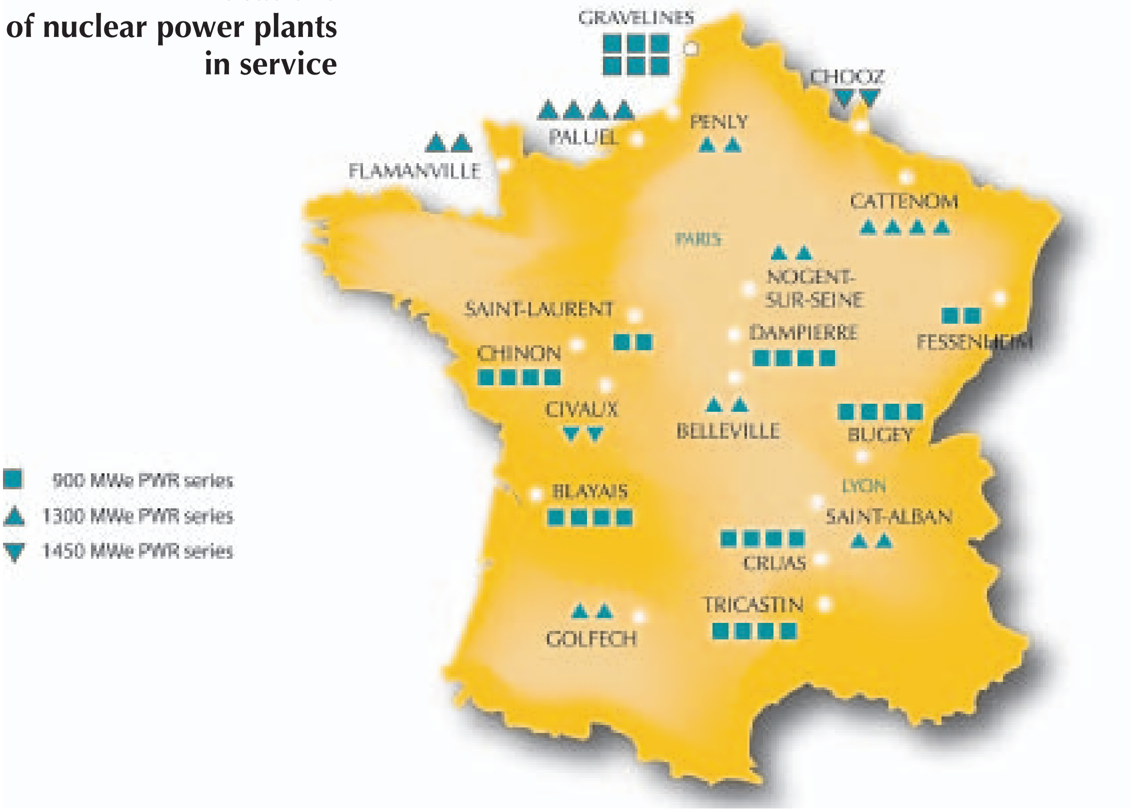
The CPY series differs from the Bugey and Fessenheim reactors in building design and the addition of an intermediate cooling system between that used for containment spraying in the event of an accident and that containing river water. It also provides for more flexible reactor control.

The design of the 1300 MWe reactor primary and secondary loops, core protection devices and plant buildings differs considerably from CPY series provisions. It will be noted that the power increase is matched by the addition of a fourth steam generator, so that the cooling capacity is greater than for the 900 MWe reactors equipped with three steam generators. Moreover, the reactor containment consists of a double concrete-walled structure, instead of the single wall 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 the more compact steam generators and of the primary pumps and in the computerised instrumentation and control system.

Locations of nuclear power plants in service



2 | 1

Description of a nuclear power plant

2 | 1 | 1

General presentation

All thermal power plants have a source of heat which they transform into mechanical and then electrical power. 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 produced vaporises water. The steam is then expanded in a turbine driving an alternator generating electric power. After pressure reduction, the steam then flows into a condenser where it cools on 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 and water intake and release structures and possibly an air-cooler.

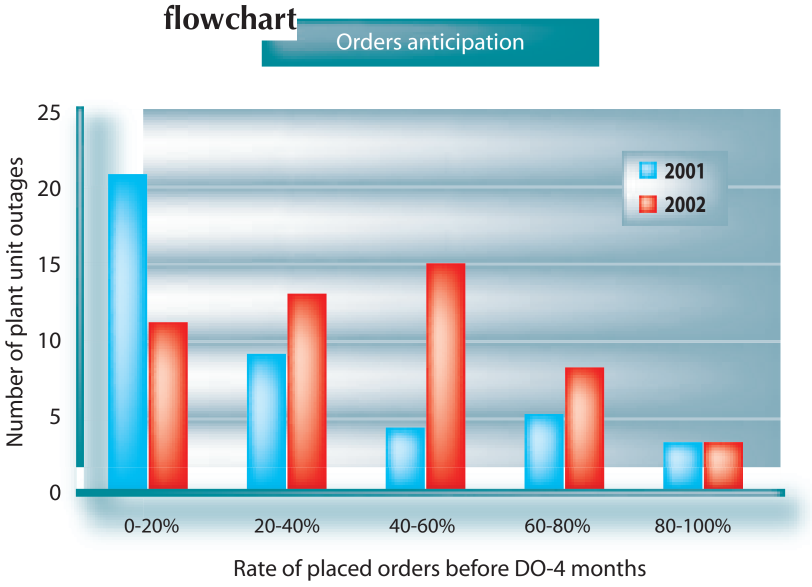
The nuclear island basically comprises the Nuclear Steam Supply System consisting of the primary system and devices and systems assuring reactor operation and safety: the chemical and volume control system, the safety injection system, the residual heat removal system, the containment spray system, the electrical instrumentation and control and reactor protection systems.

The Nuclear Steam Supply System is also equipped with circuits and systems assuring ancillary functions: primary effluent treatment, boron recycling, feedwater supply, ventilation, emergency power supply (diesel generators).

The conventional island comprises the turbine, the AC generator, the condenser, the utility departments and the electrical power supply for the installation. Some of this equipment contributes to reactor safety.

The secondary system belongs 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 recycle system
VVP	main steam system
LP Turbine	low-pressure turbine
HP Turbine	high-pressure turbine

2 | 1 | 2

Core, primary and secondary systems

The reactor core consists of rods containing uranium oxide pellets or mixed uranium and plutonium oxide pellets (MOX fuel), located in fuel assemblies, contained in a steel vessel. When fissioned, the uranium 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 at the top at a temperature of about 320 °C.

The chain reaction, and hence the reactor power, is controlled by control rods inserted in the core and by variation of the boric acid (neutron absorber) content in the primary system water. The control rods are used to start and shut down the reactor and to follow load variations. Their gravity dropping into the core trips the reactor. The boric acid concentration is adjusted according to the gradual depletion of fissile material in the fuel.

The primary system removes heat from the reactor core by circulating pressurised water in cooling loops (three for a 900 MWe reactor, four for a 1300 MWe or 1450 MWe reactor). Each loop, connected to the reactor vessel, comprises a steam generator and a circulating pump, known as a primary pump. On one of the loops, a pressuriser controls primary fluid pressure and volume variations. The pressurised primary water conveys the heat removed from the reactor core and transfers it to the secondary system water in the steam generators. The primary water is taken up again by the primary pumps which return it to the reactor core. The pressuriser enables the primary water pressure to be kept at 155 bar, to prevent boiling, since the water is heated to over 300 °C.

The primary system water transfers the heat produced by the reactor core to the secondary system water, without entering into contact with it, in the steam generators. The secondary system consists mainly of a closed loop through which, in turn, passes water in liquid form on one side and in steam form on the other. The steam produced in the steam generators undergoes partial expansion in a high pressure turbine, then passes through the moisture separator reheaters before entering the low pressure turbines for final expansion before being released 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.

2 | 1 | 3

Main auxiliary 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. When the chain reaction has been stopped, the reactor core continues to produce heat, known as after-power. This heat has to be removed, since otherwise it could damage, or even melt, the fuel, thereby releasing large quantities 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 normal primary pump seal leakoff,
- to regulate the boric acid concentration.

2 | 1 | 4

Safeguard systems

The purpose of the safeguard systems is to control incidents and accidents and mitigate their consequences.

The main safeguard systems are the safety injection system (RIS), the containment spray system (EAS) and the steam generator auxiliary feedwater system (ASG).

The RIS system injects borated water into the reactor core in the event of an accident in order to smother the nuclear reaction and remove the after-power. It comprises passive pressurised accumulators and pumps with varying flowrates and release pressures for different types of accident situations. These pumps extract water from the 2000 m^3 PTR tank. When the tank is empty, they are connected to the reactor building sumps, where the EAS spray water is collected, together with water from the primary system in the event of a primary pipe break.

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) and during reactor start-up and shutdown stages.

2 | 1 | 5

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 assures the cooling of certain nuclear equipment and operates in a closed loop system between the primary water and the pumped river or sea water,
- the essential service water system (SEC), which uses the heat sink (sea or river) to cool the RRI system.

2 | 1 | 6

Reactor containment building

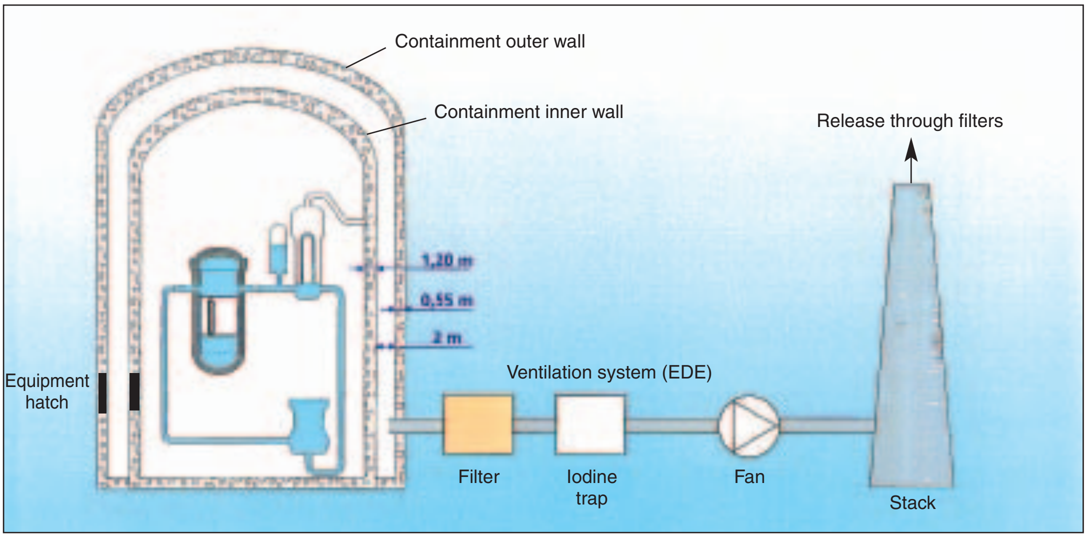
The PWR containment building has two functions:

- containment, and thereby protection of the public and the environment with respect to radioactive products which could be dispersed within the containment building under accident conditions. This building is consequently sized to withstand maximum pressure values in accident situations and to minimise leaks under these conditions,
- protection of the reactor against external hazards.

There are two types of PWR containments:

- the 900 MWe PWR containments, comprising a single 90 cm thick pre-stressed concrete wall. Its mechanical strength is such that it can withstand the reference accident pressure and its structural integrity is assured with respect to an external hazard. 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 assured by the inner wall and the ventilation system (EDE) which collects both inward and outward leaks in the annulus between the two walls. Resistance with respect to external hazards is mainly assured by the outer wall.

Block diagram of a 1300 MWe PWR containement building



2 | 1 | 7

Ancillary systems

Operation of the plant requires a certain number of ancillary functions, including:
- compressed air supply to the pneumatic valves,
- supply of electricity to the valves, pump motors and all electrical monitoring and instrumentation and control equipment. This electricity can be supplied from a number of sources: the plant's own production, an outside power line, emergency diesel generators, batteries, and so on.
- the instrumentation and control systems performing control, regulation and automatic reactor protection functions. Their design, originally based on relays and automated systems in the first generation reactors, gradually evolved with the construction of the plant population, first with the introduction of digital systems and then, on the most recent reactors, with a fully computerised instrumentation and control system.

These systems are subject to the same strict requirements as the important safety-related systems they support.

2 | 2

Operation of a nuclear power plant

2 | 2 | 1

EDF organisational structures

The EDF Energies Branch is organised in eight divisions, including the Nuclear Fuels Division (DCN), the Nuclear Generating Division (DPN) and the Nuclear Engineering Division (DIN).

Daily nuclear power plant operations, including safety, radiation protection and security, is the responsibility of the DPN (Nuclear Generating Division). 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. They interact with the various power plant departments, notably the site engineering departments.

The Operating Plant Support Centre (CAPE) is subdivided into 13 groups covering the various engineering trades and skills concerned, together with two support structures.

The IN (Nuclear Inspection) teams, on behalf of the DPN authorities, carry out verification assignments on the entire division. Safety assessments dealt with in this framework concern the regulatory requirements and objectives of the DPN authorities.

The contracting authority for plant modifications decided at national level is the UNIPE (national engineering unit for operating plants).

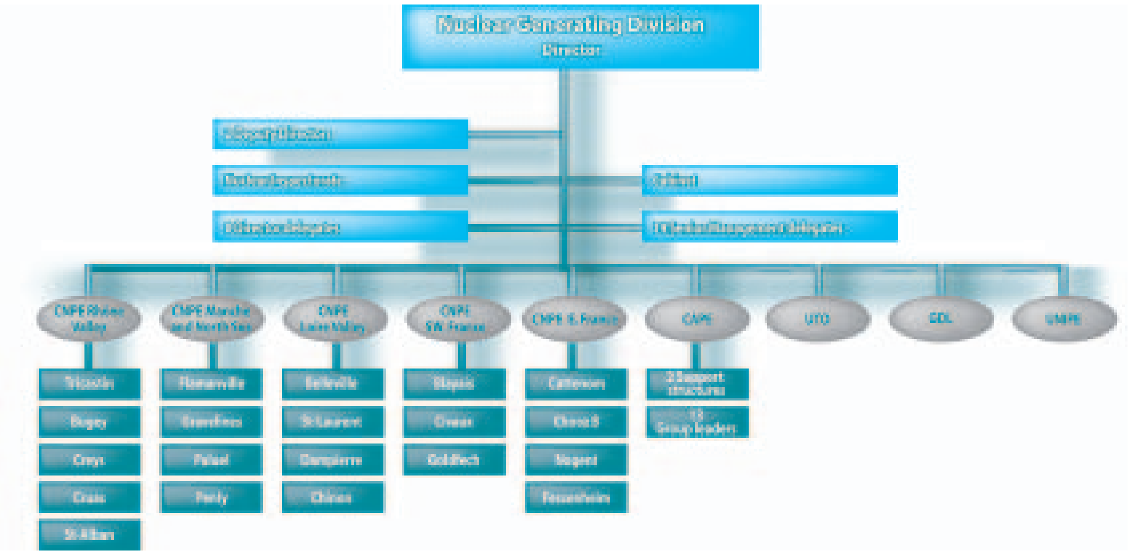
The UTO (Operational Technical Unit), in charge of generic maintenance for all plants, acts as a service company for all sites.

The GDL (Laboratories Group) is assigned the task of analysing and checking the behaviour of materials used for the construction of plant equipment.

The DPN head office departments and the nuclear power plants are also in contact with the other entities of the Energies Branch, i.e. the DIN (Nuclear Engineering Division) and the DCN (Nuclear Fuel Division).

The DIN engineering centres are responsible for equipment design and modification, together with specifications and the preparation of regulatory dossiers concerning this equipment. These activities notably concern the CNEN (National Centre for Nuclear Equipment) with regard to the N4 reactor series, the CIPN (Engineering Centre for Operating Plants) for the 900 and 1300 MWe nuclear islands and the CNEPE (National Centre for Electricity Production Equipment) for conventional islands for all plants. All dismantling and waste management activities are grouped at the CIDEN (Engineering Centre for Dismantling and related Environmental Issues). The SEPTEN (Design Department for Thermal and Nuclear Projects) carries out studies to define equipment specifications for operating plants and for the EPR (European Pressurized water Reactor) project.

Within the nuclear production centres, the various departments are organised on a trade basis, with a view to ensuring the three main functions of safety, production and maintenance. Multi-trade pro-



ject teams are formed to carry out specific activities, such as those performed during unit outages. There is an engineering department for production and maintenance activities. Site engineering is supplemented by a “New equipment” structure and “Assignments”, notably in the fields of safety, risk prevention and the management of human resources.

Within the framework of its supervisory activities at the national level, the Nuclear Safety Authority (ASN) deals mainly with the DPN. The ASN contacts head office department representatives for all matters related to major problems encountered at the plants and for generic issues, i.e. those concerning some or even all of the French nuclear reactors. For matters concerning the safety of a specific reactor, the Nuclear Safety Authority contacts the plant concerned. As regards equipment design and study documents, they are discussed in the first place with the DIN.

2 | 2 | 2

Fuel and fuel management

a) General principles

At the beginning of the operating cycle, the reactor core represents a very substantial energy reserve, which gradually diminishes during the cycle as the fissile nuclei disappear. The high initial reactivity is offset by the boron dissolved in the primary system water, since boron has neutron absorbing properties. Its concentration in the water is adjusted during the cycle according to fuel burnup.

The cycle ends when this concentration approaches zero. The cycle can, however, be extended if the temperature, and possibly the power level, are lowered to below their nominal values.

At the end of the cycle, the core is unloaded to renew part of the fuel.

b) PWR fuel

EDF uses two types of fuel in its PWRs:
- U-235 enriched uranium oxide (UO_2) fuel,
- mixed uranium and plutonium oxide (MOX) fuel.

UO_2 fuel

This fuel is primarily manufactured by FBFC, a subsidiary of Framatome and COGEMA (see chapter 12). However, with a view to diversifying its supplies EDF has, since 1980, been obtaining fuel from several foreign fuel manufacturers.

Initial U-235 uranium enrichment for UO2 fuel using natural uranium is limited to 4.2% (this limit is 4.1% for reprocessed uranium).

For fuel using natural uranium, the increased U-235 enrichment above 3.7% required the use of a consumable poison in order to offset the greater reactivity. This poison, which consists of gadolinium oxide, is then mixed with depleted or slightly enriched uranium oxide.

MOX fuel

MOX fuel is produced by the COGEMA MELOX plant at Marcoule. An initial plutonium content, limited by regulation to an average of 7.08% per fuel assembly, provides an energy equivalence with 3.25% U-235 enriched UO_2 fuel.

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.

c) Fuel management systems

Reactor fuel management is chiefly characterised by the following:
- the nature of the fuel used and its initial fissile content,
- the fuel burnup (expressed in GWd/t) characterising the quantity of energy extracted per ton of material,
- the number of new fuel assemblies loaded at each reactor refuelling outage,
- the length of the burnup cycle (generally given in months),
- the reactor operating mode, for characterising the stresses to which the fuel is subjected.

2 | 2 | 3

Operating documents

For nuclear power plant operation, plant staff consult various documents, on certain of which, concerning safety, the ASN focuses particular attention.

The first such documents are the general operating rules (RGE), which present the provisions implemented during reactor operation. They consequently supplement the safety analysis report, which deals mainly with provisions made at the reactor design stage. Decree 63-1228 of 11 December 1963, as modified, specifies notably that in support of its start-up licence application for a Basic Nuclear Installation, the operator shall issue the above two documents.

The RGE comprise several chapters, among which those having particular safety implications are carefully examined by the ASN.

Chapter III, entitled “Technical Operating Specifications” (STE), delimits the reactor’s normal operating range. The operating parameters (pressure, temperature, neutron flux, activity, flow, etc.) are permanently measured by sensors, thereby constituting plant operation indicators. In the event of set points being exceeded, the plant process relay control detects the phenomenon and triggers an alarm in the control room so that the operators are informed of the event, analyse the situation and implement the operating provisions notably imposed by the STE. This chapter also specifies the equipment required according to the reactor state and indicates actions to be undertaken in the event of malfunction or failure of this equipment.

Chapter VI concerns the procedures to be adopted in the event of an incident or accident. It contains the rules defining operating principles adopted 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 IX 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 correctly. In the event of an unsatisfactory result, the course of action to be followed is stipulated in the technical operating specifications. Such situations can oblige the operator to shut down the reactor to restore the failed function.

Finally, Chapter X 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. This chapter was added in 1997, at the request of the then DSIN, with a view to compiling a consistent set of current tests. It is gradually being included in the RGE for the different reactor series.

In addition, constant concern to ascertain that the installation is operating within its design basis limits leads EDF to undertake regular equipment inspections to check age-related alterations.

On the basis of manufacturer recommendations, EDF has defined periodic component inspection programmes (also known as preventive maintenance programmes), based on design estimates as to deterioration.

In certain cases, notably for pressure devices such as piping and valves, their implementation involves recourse to non-destructive test (NDT) methods (radiography, ultrasonic tests, eddy current tests, dye penetrant tests, etc.) entrusted to specially qualified staff. In some cases, it is deemed preferable to take "early warning" samples of equipment to enable more accurate destructive testing. This is notably the case when NDT methods are unable to detect faults considered probable.

The RGE and maintenance programmes are used to draft more detailed documents such as the component work sheets or operating procedures.

2 | 2 | 4

Plant unit outages

In the nuclear power plants operated in France, replacement of the spent fuel contained in the reactor core obliges EDF to programme periodic shutdowns in order to open the vessel. This is known as a unit outage. Depending on the current fuel management system, the operating period between two consecutive refuelling outages varies between about 12 months for the 900 MWe series and 18 months for the 1300 MWe series.

During these outages, access is momentarily possible to parts of the installation which are inaccessible during reactor operation, notably those located in the reactor building. This is, in particular, the case for the main primary system. Advantage is thus taken of these outages to inspect the installation and verify its condition by means of tests and checks. If necessary, maintenance operations can be carried out in order to ensure that the operating and safety conditions of the installation are as required for the following cycle. It is also during unit outages that most of the scheduled plant modifications are carried out.

An average unit outage lasts about 6 weeks. They can however extend over 4 to 5 months in the case of 10-yearly outage programmes or when extensive maintenance operations are scheduled (steam generator replacement, containment building repair work, etc.) or again, when a new technical problem comes to light. The scope of the inspections, which has considerable repercussions on the duration of the outage, is of particular interest to the ASN, since it is one of the best indications of the actual condition of the plant.

Welding job site

The operator is consequently obliged to schedule and prepare these operations in detail several months beforehand, with a view to optimising the many actions undertaken, booking competent outside workers, organising worksites under cramped conditions in cluttered environments, whilst constantly bearing in mind current labour regulations (radiation protection of workers, specified in situ working periods, etc.). During an outage, EDF has to manage and supervise the work of several hundred additional workers. The safety and availability of the reactor during the next cycle will depend on the quality of these operations.

Given what is at stake, the ASN closely follows the work carried out during unit outages. Restart of any reactor which has been shut down for more than two weeks requires ASN approval, given after examination of the results of the various operations carried out.

Finally, once the reactor has gone critical, the results of physical tests performed on the new reactor core to demonstrate its correct behaviour are communicated to the ASN and to the IRSN.

3 EQUIPMENT AND COMPONENT SAFETY

3 | 1

Construction supervision

The BCCN is directly responsible for supervision - as specified in the order of 26 February 1974 and basic safety rule II.3.8 (see chapter 4, § 1|1|4) - of the manufacturers EDF and Framatome-ANP. Supervision of construction takes place from design up to manufacture and then erection on the site of the main primary and secondary system components.

This supervision involves spot checks at two stages:
- during design: on the basis of the justification files provided by the contractor. These files describe the mechanical behaviour of the components according to the loads they experience in normal operation or would experience in the event of an accident. Analysis of the documents is supplemented by relevant inspections on this subject,
- during manufacture/erection: 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 these documents.

This inspection ends with the hydrostatic testing of the pressurised components.

For reactor construction, a general hydrostatic test is performed on the site. The BCCN then forwards the results of its inspection to the SPN (Standing Nuclear Section) of the Central Committee for Pressure Vessels. The test report required to allow temperature rise of the loaded core can then be issued by the Burgundy region DRIRE.

In terms of manufacturing, activity is today mainly linked to the production of spare parts for the nuclear power plant fleet (small routine maintenance parts or large components such as closure heads and steam generators).

Throughout the construction process and within the framework of the 1984 quality order, the constructors EDF and Framatome carry out surveillance functions with respect to manufacturers, suppliers and sub-contractors. This is implemented through assessment of their quality assurance systems, through technical assessment of their ability to implement technical processes which are both the best suited and in conformity with the state of the art, and through the carrying out of source level inspections. The BCCN checks the reality and efficiency of the surveillance carried out, the methods adopted to deal with deviations encountered and the ultimate regulatory compliance of the components produced. These checks take place for all manufacturing operations involved, from steel making to completion of non-destructive tests.

In 2003, the BCCN carried out 30 factory inspections.

3 | 2

Modification supervision

With a view to clarifying ASN and EDF relations with regard to examination of modifications important for safety, the ASN adopted in 2002 a new modification appraisal process. The first aspect of this new management process is aimed at adapting the depth of the analyses carried out to the safety implications at issue, by proceeding to a classification of modifications into three groups according to certain safety criteria. So, only the modifications belonging to groups 1 and 2, covering those having the most pronounced safety impact, are subject to prior ASN approval before their integration in a reactor or before their generalisation to other reactors of the same standardised plant series. Group 3 modifications require no prior approval.

The purpose of the second aspect of this examination process is to specify the contents and due dates of certain information documents required by the ASN.

This process is currently at the experimentation stage.

In 2003, the ASN classified the modifications to be made to the reactors of the N4 series and some of the modifications to be made to the 1300 MWe reactors during their second ten-yearly outage. Some of these modifications are the result of their periodic safety review.

3 | 3

Nuclear power plant aging

3 | 3 | 1

Nuclear power plant aging and safety

Nuclear power plants, like all industrial installations, are subject to aging. This can affect civil engineering structures (buildings, anchors, supports), mechanical equipment, process control equipment (electrical equipment, instrumentation and control systems, actuators, etc.) and modify the installation's safety. The role of the ASN is thus to ensure that the operator's general strategy takes account of all aging-related phenomena, in order to guarantee a good level of safety compatible with the regulations, throughout the plant's operating lifetime.

Aging determines equipment lifetime and two families of equipment are considered:

- non-replaceable equipment - the vessel and the containment building - which are consequently subjected to specific studies and supervision. For this equipment, the design-related and supervisory provisions are essential, even if for the containment buildings, and maybe one day for the vessels, a number of repair processes are conceivable and must be developed. Related ASN actions are described in paragraph 3|6|1 for vessels,
- replaceable equipment, which is all the remaining equipment. For these components, the operator considers that the notion of lifetime does not apply, since the equipment can be replaced. Aside from application of scheduled maintenance, the aging strategy in this case consists in anticipating and where necessary implementing repair and replacement operations.

3|3|2

Plant aging strategy

The ASN deems that a “defence-in-depth” approach would minimise the effects of aging. This approach is three-fold: design, surveillance and modification or replacement.

*** Providing against aging by design measures**

At the design stage, the various parts of the installation are designed for use under operating conditions which do not significantly impair their functions or their strength. A comprehensive set of constructive provisions, based in particular on the choice of materials and installation layout, aims to prevent aging phenomena.

In certain circumstances, however, phenomena resulting in equipment damage are unavoidable. In these cases, construction or operating measures must be taken to limit aging effects.

When such phenomena are identified at the design stage, the associated safety demonstrations must take into account the estimated characteristics of such equipment at end of life. In addition, in the case of large-scale phenomena, surveillance arrangements are made to give sufficiently early warning if there is a possibility that initial estimates may not remain valid throughout the lifetime of the installation. Reactor vessels, for example, are subjected to an irradiation monitoring programme, confirming the soundness of the regularly updated design basis embrittlement postulates.

ASN action begins at the design stage. So in the context of the EPR project (see § 6), it paid particular attention to ensuring that the operator explain how it intended to extend the life of certain components. Similarly, when operating reactors undergo unexpected deterioration, the operator has to re-examine equipment design, with a view to minimising or even eliminating the phenomena observed, such as, for instance, the stress corrosion of the alloy 600 (see § 3|6|2).

*** Aging surveillance: advance and remedial action**

In addition, other deterioration phenomena can be discovered in the course of plant operation. Periodic surveillance actions, preventive maintenance, larger scale provisions, such as the 10-yearly outage programmes or the conformity inspections carried out in the context of safety reviews (see § 3|4), or again the analysis of operating incidents, all provide opportunities for detection of these phenomena.

Generally speaking, understanding and assessing the kinetics involved, together with surveillance of deterioration phenomena, constitute a second element in the control of plant aging, mainly aimed at ensuring that plants remain within the bounds of the initial design basis data.

In the case of the main primary and secondary systems equipment, the order of 10 November 1999 requires that the operator implement programmes to monitor the main deterioration phenomena leading to a change in the properties of the materials. The order also stipulates that before each ten-yearly requalification (ten-yearly outage for the main primary circuit), the operator shall, on the basis of the results of this programme, notify the ASN of the reactor’s ability to operate for the coming ten years.

The ASN’s action on this second line of defence also of course concerns the remedial actions implemented with regard to nonconformities detected during operation. However, simply dealing with deterioration as it appears would denote an excessively passive attitude. So the ASN ensures that the operator forestalls such deterioration by:
- improving surveillance plans, adding inspections where necessary, such as the complementary investigation programmes (PIC), to be implemented during the second 10-yearly outages (see § 3|4|3),

– when new deterioration modes are evidenced, identifying reactor zones liable to undergo similar damage (for example areas particularly sensitive to multi-cycle thermal fatigue - see § 3|9|1 a),

– developing suitable surveillance methods for accurate detection of phenomena, before they become dangerous.

The ASN believes that plant safety tomorrow depends on the effectiveness of surveillance today.

*** Modifying or replacing equipment liable to be affected by aging**

The third line of defence in depth against aging consists of the possible repair, replacement or modification of the items concerned.

However, the availability of a substitute solution can only be considered acceptable if it has been prepared sufficiently in advance. This is essential for at least two reasons: the time needed to procure identical or equivalent components in the case of replacements, and the need to make adequate work site provisions. In particular, the operator must take account of and anticipate the risk of obsolescence of certain components and the possible loss of technical skills on the part of the personnel involved.

In this context, the ASN will in the coming years maintain its vigilance regarding anticipation of forthcoming maintenance operations. This anticipation involves both putting in place versatile tools (automatic tools for cutting and welding piping sections for instance) and control of the industrial capacity available. In a context where new work is restricted to the spares needed for correct operation of the nuclear plant fleet, the availability of components and of qualified repair and replacement personnel is heavily dependent on the operator's industrial maintenance policy, in partnership with its main contractors.

3 | 3 | 3

Aging and operating lifetime

In 2001, the ASN announced to EDF that it would state its position on the continued operation of reactors further to completion of their 3rd 10-yearly outage programmes (VD3) and that EDF should consequently define a work programme preparing this stage in reactor lifetime. The ASN provided EDF with guidelines in this respect, which would enable an ASN decision to be made as to the safety level of the reactors concerned and the capacity of EDF to ensure their operation beyond the VD3 deadline under satisfactory safety conditions.

In December 2003, the Advisory Committee began to examine the aging programme of work proposed by EDF and considered the methodology and organisation put in place to be on the whole satisfactory. However, given the date of the first VD3, the time to implement this programme of work is felt to be tight and will require EDF to commit adequate resources rapidly.

3 | 4

Safety reviews and 10-yearly outages

In France, the DGSNR carries out a complete "check-up" on each EDF nuclear power plant at 10-yearly intervals. The safety review is an opportunity for in-depth inspection of the installations to check that they all comply with the safety standards. It is also an opportunity to compare the level of safety of the installations with the more recent installations and to make the modifications felt to be necessary with a view to a constant increase in safety.

Fessenheim nuclear power plant

3 | 4 | 1

Safety reviews for the 900 MWe reactors

a) The VD2 safety review for the 900 MWe reactors

The 900 MWe reactor safety review carried out with a view to their second 10-yearly outage (VD2) started in 1987 for the Fessenheim and Bugey reactors (CP0 series) and in 1990 for the other 900 MWe reactors (CP1 and CP2 series). In 2003, modifications were made on six 900 MWe reactors as a result of this safety review during their second 10-yearly outage.

b) The VD3 safety review for the 900 MWe reactors

In 2003, following initial technical discussions and consultation of the Advisory committee, the DGSNR defined the safety review guidelines for the 34 900 MWe reactors, to be carried out with a view to their third ten-yearly outages.

The ASN relied on national and international experience feedback and on a comparison with the more recent reactor models, including the EPR project, to define the scope of the review.

These guidelines are specified in a letter of 9 October 2003, published on the DGSNR's web site (www.asn.gouv.fr), which initiates this safety review, determines the scope and orientations of the studies to be conducted by EDF, and the deadlines to be met so that the resulting modifications can be made to the 900 MWe reactors during their third ten-yearly outages starting in 2008.

The DGSNR also asked that the studies covering the risk, in accident situations of clogging of the sump filters in the reactor building be given priority and extended to cover all types of reactors (see § 3|9|6).

3 | 4 | 2

Safety reviews for the 1300 MWe reactors

The DGSNR confirmed in April 1999 the initial study programme for the 1300 MWe reactor safety review.

Review of the reference safety requirements will be carried out with respect to the N4 series reference requirements, in particular taking account of feedback from the 900 MWe series VD2 safety review.

In 2003, EDF presented the modifications to be implemented during the VD2. This batch of modifications will be examined using the process established by the DGSNR (see § 3|2).

The first 1300 MWe reactor to undergo its second 10-yearly outage will be Paluel 2 in 2005.

The conformity check, which includes points such as protection against hazards originating in the reactors' industrial environment, protection against internal missiles and the operability of the requisite equipment in incident or accident situations, is currently being completed on all sites of the 1300 MWe series. In 2003, the Paluel, Saint-Alban, Flamanville and Cattenom sites presented reviews of their conformity checks to the DGSNR and the IRSN.

3 | 4 | 3

10-yearly outages

The order of 10 November 1999 requires that the main primary circuit and each secondary circuit undergo requalification comprising a full inspection and hydrotesting, every ten years.

The full inspection enables verification of plant condition, in addition to the periodic examinations carried out during refuelling outages (see § 2|2|4), extending the checks to areas which are not regularly inspected.

This outage is also an opportunity for inspection of the reactor vessel, particularly the most irradiated area in the immediate vicinity of the reactor core, and its welds (see § 3|6|1).

Dampierre nuclear power plant

The hydrotest, which consists in subjecting the system to a hydraulic pressure equal to 1.2 times the design pressure, constitutes an overall pressure resistance test. This test does not take into account all the types of operating loads involved, but it enables identification of any serious defects in unsuspected areas. This was, in fact, the case in 1991 with detection of the vessel closure head adapter cracking phenomenon (see § 3|6|2) and in 1989 with the cracks in the 1300 MWe reactor pressuriser nozzles.

In 2003, the Blayais 1, Blayais 2, Gravelines 4, Dampierre 3, Saint-Laurent B2 and Chinon B1 reactors underwent their second 10-yearly outages, and the VD2 batch modifications were carried out. This opportunity was taken to replace the steam generators in Saint-Laurent B2.

3 | 5

In-service maintenance

3 | 5 | 1

Application of the ministerial order concerning main primary and main secondary system operation

In 2003, the work programmes carried out by EDF for implementation of the order of 10 November 1999 mainly concerned the following:

- the reference dossiers: in 2003, the ASN continued to investigate these dossiers, with additional work provided by EDF on several points, and carried out on-site inspections to evaluate the extent to which documentary systems had been set up (see § 3|5|2);
- maintenance work: in May 2003, the ASN took two decisions concerning dossier investigation and maintenance work respectively (see § 3|5|3);
- qualification procedures for non-destructive tests: the ASN is carrying out inspections to assess the EDF work programme designed to provide it with all qualified applications before the regulatory deadline of 29 November 2004 (see § 3|5|4).

3 | 5 | 2

The reference dossiers

Article 4 of the order of 10 November 1999 requires that operators draft reference dossiers for the reactor main primary and main secondary systems. These dossiers, based on the initial design and manufacturing files for the systems and taking account of experience feedback from operations, should justify the long-term integrity of these systems. The operator is required to update these dossiers by periodically incorporating operational experience feedback.

During the course of 2003, the ASN continued to investigate these dossiers, in particular on topics related to justification of operating conditions, the mechanical performance of the equipment and the prevention of the risks of fast fracture. The conclusions of this investigation will also enhance the data needed for examination of the in-service surveillance programmes.

Implementation of the regulatory requirements also led to each site drawing up a documentary system making it easy to locate any findings likely to concern maintaining equipment integrity (manufacturing files, incidents, operating conditions, maintenance work on the equipment, etc.). During inspections carried out in 2003, the ASN noted that the sites have begun to put the documentary systems in place, but this process is still incomplete, in particular for monitoring areas of the main secondary systems subjected to high cyclic loadings.

3 | 5 | 3

Revision of the main primary and secondary system maintenance programmes

DGSNR/SD5 ministerial decision 030191 was signed on 13 May 2003 to implement article 10 of the order of 10 November 1999. It defines the procedures for examining the dossiers concerning maintenance work on PWR main primary or secondary systems.

Not all maintenance work done on the main primary and main secondary systems has the same complexity or the same importance. The decision thus makes a distinction between light, medium and heavy maintenance work. The dossiers can be investigated either locally by the regional DRIRE concerned, or at a central level by the BCCN. In this latter case, EDF must designate a central contact who is responsible for designing the maintenance work. The classification will also determine the conditions for requalification of the work and guaranteeing its quality and the reactor's subsequent ability to operate.

DGSNR/SD5 decision 030191 does not deal with the principles of technical classification of maintenance work. It is up to the operator to define a classification for each maintenance task and to inform the ASN of the principles it uses to do this. However, minimum criteria are stipulated in DGSNR/SD5 decision 030192 taken by the ASN on 15 May 2003. The operator is required to apply these criteria until such time as it has issued requirements in the RSE-M code considered by the ASN to be in conformity with the order of 10 November 1999 and its implementing circular.

These criteria link the technical classification of maintenance work not only to the risk it poses for the guaranteed integrity of the equipment, but also to the checks carried out after maintenance to requalify the equipment. For example, a manual weld on a pipe requalified by two distinct volumetric examinations may be considered medium maintenance work, whereas with a single volumetric examination it would be considered heavy.

The technical classification rules are currently being codified in the RSE-M code. They were the subject of a code amendment form, examined by the ASN to ensure that it was in conformity with the principles of DGSNR/SD5 decision 030192.

Welding operation during steam generator replacement

3 | 5 | 4

Maintenance work on main primary and secondary systems

Article 8 of the order of 10 November 1999 specifies that "non-destructive testing processes used on operational equipment must be qualified prior to use by an entity, chosen by the operator", whose competence and independence must be proven.

The aim of this qualification procedure, resulting from discussions at international level, is to demonstrate that the examination method used is suitable for the detection of the degradations it is supposed to look for. 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.

A stipulation in the order of 10 November 1999 is that the responsibility for declaring qualification should be entrusted to a qualification commission separable from the ASN, but duly recognised as competent and independent of both the reactor operators and those directly involved in developing the processes. This commission was accredited by the COFRAC. It assesses the representativeness of the mock-ups used and any defects incorporated and then checks that the examination method effectively covers the performances required to satisfy the qualification result specifications.

Implementation of these new measures requires a period of transition. The order thus provides for the use up until 29 November 2004 of non-destructive test processes the qualification of which has not yet been confirmed.

At the request of the ASN, the operator in 2002 proposed a programme whereby all qualified applications would be available by the end of the transitional period. The inspections carried out by the ASN in 2003 to assess implementation of this programme highlighted inadequacies in deadline compliance by the entities concerned, leading the ASN to ask the operator to tighten up the organisation in place so that the regulatory timescale is met. After analysing the situation, the operator at the end of 2003 signalled its intention to request a waiver to the order of 10 November 1999 concerning part of the examinations used for in-service supervision.

3 | 5 | 5

Reliability Centred Maintenance

In 2003, the Nuclear Safety Authority examined the new maintenance method for active, primarily electromechanical, components (pumps, valves, etc.) set up by EDF in the mid-90s. This method, which was based on American practices known as “Reliability Centred Maintenance”, was adapted by EDF under the name of “optimisation de la maintenance par la fiabilité” (OMF). Its aim is to improve the efficiency, rationality and traceability of the basic preventive maintenance programmes, in terms of safety, availability and cost issues.

The OMF method employs a functional approach which determines what maintenance is to be performed according to the consequences of equipment failure, rather than simply according to its causes, as is the case with a conventional approach.

The ASN considers that employing this method entails no major safety drawbacks. The ASN did however ask EDF to forward a quantitative and detailed summary of its application and to provide clarifications, in particular regarding the conditions in which common mode failures are taken into account.

EDF has begun work to upgrade this method, called “OMF 2nd generation”, which is gradually being implemented by the NPPs. The ASN is preparing to examine this new method and the conditions in which it is used.

3 | 6

Main primary and secondary system condition

3 | 6 | 1

Reactor vessels

The vessel is one of the essential components of a pressurised water reactor. This molybdenum ferritic steel component is 14 metres high, 4 metres in diameter and 20 centimetres thick. It houses the reactor core and its instrumentation and in normal operation is completely filled with water, bringing its weight to 300 tonnes. It can withstand a pressure of 155 bar at a temperature of 300 °C.

Regular and precise monitoring of the reactor vessel is essential for the following two reasons:
- replacement of the vessel 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 opposite the fuel. This embrittlement makes the vessel particularly sensitive to pressurised thermal shocks or to sudden pressure surges when cold. The presence of a crack in such an embrittled area would be unacceptable.

To monitor the condition of the reactors in service, the following steps were taken at start-up of the first EDF reactors:
- a programme to monitor the effects of irradiation (PSI): capsules containing test specimens made of the same metal as the reactor vessel were placed inside the reactor, near the core. 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 aging, 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 allows detection of any defects located under the vessel's inner stainless steel lining.

In the first few years, this check was restricted to the weld zones on the various shells making up the vessel. It was gradually extended to the entire area opposite the core. A number of sub-coating defects were then detected on certain reactor vessels, chiefly:
- Tricastin-1 in 1999 (about fifteen defects, the deepest of which was 1.2 cm),
- Fessenheim-1 in 1999 (one defect 0.6 cm deep),
- Fessenheim-2 in 2000 (five defects less than 1 cm deep).

At the present time, all vessels have undergone a least one 100% core area inspection. The defects detected so far have all been considered non-harmful in terms of the 30-year lifespan, either owing to their small size, or because they are not located in "hot spots", where the neutron flux is highest, or because the initial mechanical properties of the reactor vessel's basic metal were good. Appropriate in-service monitoring, good surveillance of vessel embrittlement and a number of precautionary reactor control measures enabled the ASN to authorise continued operation of these reactors.

In addition, the study of incident and accident scenarios leading to cold fast pressure build-ups was presented to the Advisory Committee for nuclear reactors in June 2001.

EDF, on this occasion, announced its intention to modify overpressure protection provisions for situations where the reactor is shut down and the fuel is in the vessel. The pressuriser relief valves, today only used when the reactor is operating, will be used for this purpose.

This modification will be installed on the 900 MWe series reactors during their third 10-yearly outages, which is compatible with vessel embrittlement kinetics. For the 1300 MWe and 1450 MWe series reactors, taking vessel aging kinetics into account, it has been shown that no decision on the carrying out of such modification would be necessary before these reactors were nearing their third 10-yearly outage.

The revision by EDF of the "In-service behaviour of the 900 MWe vessels" dossier reached the ASN at the end of 2002. It is currently being analysed and should lead to presentation of the dossier to the Standing Nuclear Section of the Central Committee for Pressure Vessels in 2004.

3 | 6 | 2

The nickel based alloy zones and the special case of the reactor vessel closure heads

In a pressurised water reactor, several parts are 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.

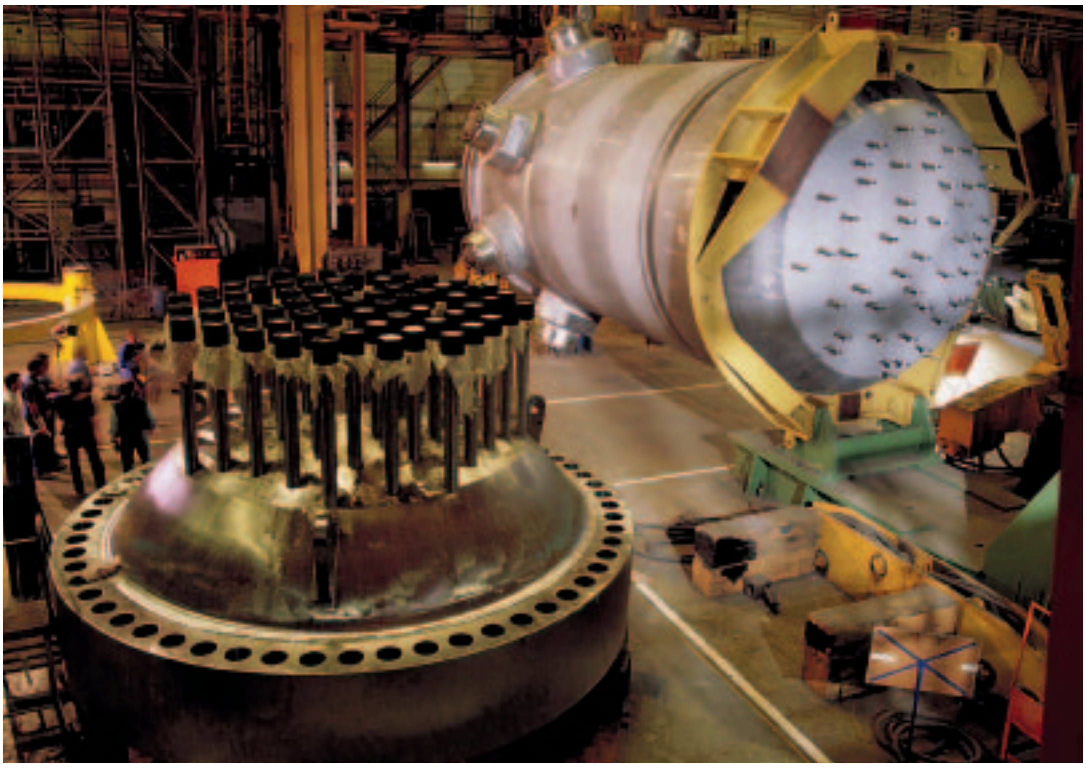
Inconel 600 nickel-based alloy is sensitive to stress corrosion, leading to the appearance of cracks. In certain cases, cracking can be quick, for example on the 1300 MWe reactor pressuriser instrumentation nozzles in the late 1980s, or on the heat-treated steam generator tubes in Nogent 1 in the early 1990s.

To deal with the more severely affected areas, such as the steam generators and vessel closure heads, replacement programmes are under way. Several old steam generators, in which the tube bundle was made of 600 alloy, have been replaced since the early 1990s (see § 3|6|3) and an extensive vessel closure head replacement programme is in progress (see below).

The importance of monitoring 600 alloy zones was confirmed by the fact that in the United States, many incidences of deterioration of vessel head adapters and vessel bottom head penetrations have been observed since 2000. In the spring of 2000, considerable damage was discovered on the vessel head of the Davis Besse plant: a cavity of about 200 mm in diameter had gradually been created by corrosion owing to the presence of boric acid. This aggregate of boric acid crystals was created by leakage from a control rod drive mechanism and then fed by water sweating through a crack on a vessel head adapter. In 2003, leaks on two vessel bottom head penetrations were discovered in South Texas 1.

In France, and in addition to the steam generator and vessel head replacement programmes mentioned earlier, several 600 alloy areas of the NPP are subject to particular supervision following DGSNR/BCCN decision 010067 of 5 March 2001. These areas are: the steam generators partition stub/partition plate, the vessel bottom head penetrations, the M supports and blend radius repairs and the underclad cracking (DSR) on the vessel nozzles. For each of these areas, the in-service supervision programme defined by the operator must meet inspection target and frequency requirements. In certain cases, new developments and new qualifications may be required for these checks.

Reactor vessel heads



Vessel and vessel closure head in the Framatome - ANP plant in Chalon-sur-Saône

The closure head closes the reactor vessel and ensures that pressure is maintained during operation. It is removed at each outage for fuel assembly loading and loading. This component is made of molybdenum ferritic steel, lined on the inside with two layers of stainless steel. It comprises two parts welded together: a spherical dome forming the upper head and a flange for assembly with the vessel. The spherical dome is perforated with 65 holes (900 MWe series) or 77 holes (1300 MWe and N4 series) in which are shrink-fitted vessel head adapters enabling passage of the control rod drive shafts. These adapters were until 1991 made of alloy 600.

In 1991, in the course of the Bugey-3 hydrotest, a leak was observed on a vessel closure head penetration. This leak was caused by stress corrosion cracking.

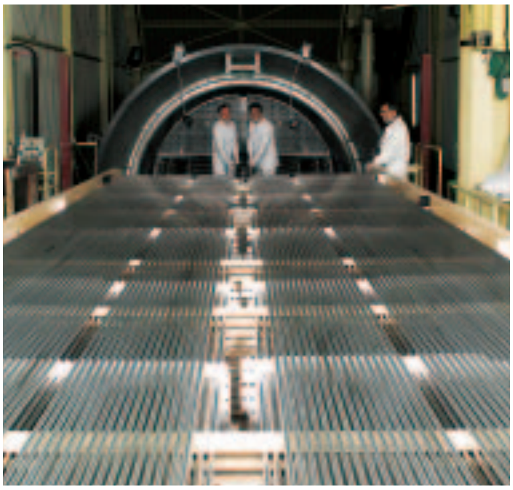
At the request of the ASN, the operator began a process of inspections to identify the population of closure heads concerned by this defect. As closure head adapter leakage is unacceptable, the ASN asked the operator to remove from service adapters with cracks which - owing to their size - are likely to lead to in-service leakage. EDF examined the possibility of repairing the adapters and detecting leaks. Faced with the problem of repairing or replacing the cracked adapters, EDF decided to replace the closure heads affected by cracking and then gradually all the closure heads with 600 alloy adapters. The replacement closure head adapters are made of 690 alloy, which is far less susceptible to stress corrosion.

Of the 54 closure heads, 12 are still to be replaced. Those not yet replaced are subject to a programme of checks, the frequency of which depends on the presence and size of the defects; when these defects reach a certain size, the closure head must be replaced.

3 | 6 | 3

Steam generator tube maintenance

The steam generators are the exchangers ensuring heat transfer between the primary system water and the secondary system water providing steam for the turbine driving the alternator. They are equipped with thousands of small-diameter, thin-wall (about 1 mm) tubes subjected to extremely harsh thermal and mechanical conditions. Consequently, these tubes degrade in service, mainly due to stress corrosion cracking of the tube inner or outer skin. The manufacturing material used until 1988 (alloy 600) is particularly sensitive to this problem. Since then alloy 690 has been used. Other deterioration, such as wear, deformation and vibration continue to affect the tubes, regardless of the material used to make them.



Tube installation in a steam generator

A steam generator tube break would result in significant leakage of radioactive water from the primary to the secondary system, which could reach 150 m^3/h and possibly give rise to radioactive release to the environment. The last accident of this type occurred in the South Korean Ulchin nuclear power plant in April 2002, bringing to 13 the number of “steam generator tube break” accidents which have occurred worldwide since 1970. With a view to guarding against this type of accident, which has never occurred in France, EDF permanently monitors any leaks between the primary and secondary systems during reactor operation and, during refuelling outages, checks the condition of the steam generator tubes, following a programme tailored to the different types of defect liable to occur.

Under application of the 10 November 1999 order, EDF in 2003 revised the inspection programme for the steam generator tube bundle implemented during refuelling outages, in order to take account of experience feedback for the last three years. In DGSNR decision 030472 of 1 December 2003, the ASN made a number of observations and required additions to these programmes:

- improved inspection methods, in order to detect circumferential stress corrosion cracks affecting the 600 alloy tubes;
- setting up of a programme of surveillance and preventive treatment of tubes in which for certain steam generator models there is a vibration risk;
- boosting of inspection performance on those steam generators for which EDF has decided to perform maintenance every two outages instead of every outage.

These new inspection programmes, supplemented by the ASN's requirements, will come into force on 1 March 2004.

In the early 1990s, EDF also initiated a programme to replace certain steam generators in which the bundle was made of 600 alloy. In 2003, the 3 steam generators at Saint-Laurent B2 were thus replaced, bringing to 12 the number of reactors in which the steam generators have been replaced.

3 | 6 | 4

Hydrotest leaks and steam generator replacement

The order of 10 November 1999 requires that every 10 years, the main primary and secondary systems undergo complete requalification. This requalification comprises a full inspection of the equipment and examination of the safety arrangements made by the operator, along with a hydrotest performed under the supervision of the regional DRIRE concerned.

The full inspection is an opportunity to check the condition of the parts of the reactor that are not usually checked. The hydrotest of the main primary and secondary systems takes place in the presence of a duly authorised DRIRE representative and consists in ensuring that the primary or secondary system can withstand a test pressure at least equal to 1.2 times the design pressure of the system concerned, without major defects or significant leakage occurring. This minimum test pressure is 206 bar for the main primary system and, for the main secondary systems varies according to the reactor plant series, from 89.8 bar for the 900 MWe series, to 106.2 bar for the 1300 MWe series, and finally 108 bar for the 1450 MWe series.

Arrival of a replacement steam generator at Saint-Laurent

In 2003, the steam generator tube bundles in the Le Blayais 1 and 2 and Chinon 1 reactors, revealed cracks during the hydrotest performed during the second ten-yearly outage of these reactors. Remedial measures tailored to each situation were stipulated by the ASN in the requalification reports. As applicable, they involve additional checks and operating restrictions.

Following the same problems encountered in 2002 on the steam generators of Dampierre 2, the ASN in early 2003 asked EDF to revise its replacement policy for the older steam generators. EDF in mid-2003 forwarded the conclusions it had drawn from the problems encountered and its revised steam generator replacement policy. This new policy provides for replacement of the steam generators of 10 reactors, at a rate of one replacement per year. The ASN is preparing its position concerning this programme and will present it in the second half of 2004 to the Standing Nuclear Section of the Central Committee for Pressure Vessels.

3 | 6 | 5

Chemical cleaning of steam generators

Autoclave used for experiments to qualify the chemical cleaning process

On the occasion of the second ten-yearly outage of Chinon B1, EDF carried out chemical cleaning of the secondary part of the 3 reactor steam generators. The aim of this operation was to eliminate particles caused by corrosion of the systems connected to the turbine generator and impurities dissolved in the main secondary system water, which build up primarily in the outer part of the steam generator tube bundle. These particle deposits are the cause of tube bundle corrosion and a drop in steam generator efficiency. From the regulatory viewpoint, this operation was subject to the order of 10 November 1999 which regulates in-service monitoring of the main primary system and the main secondary systems.

The Standing Nuclear Section of the Central Committee for Pressure Vessels was consulted with regard to performance of this operation, given the working conditions, with the core unloaded and the main secondary system still pressurised.

The checks performed on the steam generators after chemical cleaning revealed a copper residue on the lower part of the tubes. This residue could disrupt the eddy current testing performed at each refuelling outage. At the request of the ASN, EDF preventively plugged about 50 tubes and, before the next reactor refuelling outage, will be required to propose a solution to eliminate these residues or adapt the eddy current inspection process.

Problems with the cleaning operation in particular led to exposure of the maintenance staff and plant operators to irritant chemical products, resulting in evacuation and temporary closure of certain areas.

The actual efficiency of steam generator rinsing was also only a fraction of that expected, which led to pollution and closure of part of the liquid effluent storage tanks. Poor anticipation of the pollution of these tanks led to accidental, unauthorised release of chemical reagents into the natural environment.

Tube installation in a steam generator

3 | 6 | 6

Prevention of steam generator water overflow

On 23 January 2003 the ASN signed a decision concerning the behaviour of PWR main secondary systems in the event of a steam generator tube break (RTGV).

RTGV is an accident that has already happened on 13 reactors around the world, but never in France. It leads to leakage of primary system water into the secondary system as a result of the pressure difference between the two, and filling of the secondary system of the damaged steam generator. If not stopped in time, this filling loads the atmosphere venting valves or the secondary system steam piping valves. In this case, the primary system contaminated fluid is released directly into the atmosphere.

The action taken by the operators to prevent this situation, consists in identifying the steam generator concerned, isolating it both from the feedwater side and the steam release side, then ensuring depressurisation and cooling of the reactor in order to achieve equilibrium between the pressure in the primary and secondary systems, thereby stopping the leak.

Depending on how the accident is managed by the operators, the damaged steam generator may fill with water and overflow into the steam release pipe. Water overflow into the steam pipe is likely to generate pressure waves and agitation. In these circumstances, it is hard to guarantee the mechanical strength of the atmospheric venting line.

There is also a risk of loading the steam line protection valves with water, in other words, operating conditions for which they are not designed.

In a decision of 23 January 2003, the ASN therefore asked EDF to define palliative solutions by 23 January 2004, to prevent water overflowing into the steam line of the damaged steam generator and to forward to it a programme for implementing the solutions defined.

3 | 7

Rod cluster control assembly maintenance strategy

The rod cluster control assemblies are used to start and stop the reactor and follow the load variations required by the turbine generator set. Their gravity dropping into the core trips the reactor.

With the primary pumps in service, operation in hydraulic flow can lead to vibration-induced perforation of the assembly cladding at the level of intermittent guidance in the upper internals and the fuel assemblies. This perforation leads to pollution of the primary fluid by the silver contained in the neutron absorbing material in the control assemblies.

With the reactor in service, the operation of the control assemblies in neutron flux conditions can lead to swelling of the neutron absorbing material, leading to swelling of the cladding, with eventual cracking and integrity loss. This cladding swelling must be limited to ensure correct operation of the control assemblies at reactor trip.

To minimise these cladding deterioration phenomena, a new control cluster design is gradually being installed on the nuclear fleet. These new assemblies are given anti-wearing surface treatment and are equipped with a smaller diameter absorbent material rod to delay the onset of these deterioration phenomena.

Since 1996, EDF has set up a maintenance strategy to ensure that there is no cladding perforation and that the control assemblies are functioning correctly.

Experience feedback from this strategy is periodically validated by the ASN. Incorporation of this feedback entails periodic revision of the supervision programme and preventive replacement of the control assemblies throughout the nuclear fleet.

The maintenance strategy for 2003 stipulated protective coating of the control assemblies with cracked cladding. The ASN asked EDF temporarily to suspend this protective coating process pending justification of the absence of any risk of pollution of the primary fluid. Although this justification has been provided for the first generation assemblies, that concerning the new generation of assemblies is expected for early 2004.

3 | 8

Conformity deviations being dealt with

A conformity deviation is any hardware or equipment deviation from the applicable reference framework (RGE, RDS, design, etc.).

Further to discussions entered into since 1999, EDF set up in July 2001 a pro-active approach to detection and treatment of deviations affecting the nuclear fleet population. This process mainly concerns generic deviations or those involving critical safety issues. It is aimed at mastering the handling of deviations and informing the ASN accordingly.

This process identifies four stages:

- **the emergence stage**, which leads EDF to inform the ASN of a potential deviation for which characterisation within a given time lapse will be initiated,
- **the characterisation stage.** The objectives of this stage, leading to conclusions as to the noxiousness of the deviation identified, are as follows:
  - assess the impact of the deviation on the functions to be performed and on plant safety,
  - assess the extent of the deviation (equipment concerned, reactors concerned),
  - compile the data required for a possible safety significant event report,
  - conclude on the maintaining of the installation “as is”, identification of compensatory measures, necessity of restoring compliance along with deadline targets or bringing installation to a safe condition (unacceptable safety hazards involved),
- **the treatment strategy elaboration stage**: upon conclusion of this stage, the ASN is presented with the reworking objectives or commitments,
- **the implementation stage** of the reworking actions.

After examination of the dossier provided by the operator upon conclusion of the characterisation stage, the ASN states its position regarding the plant reworking schedule proposed.

The table below summarises characterised deviations still being dealt with and which will not be developed further in paragraphs 3|9, 3|10 and 3|11.

Deviations	Handling process	Reactors concerned
Seismic and pressure resistance of the ripple shims on the essential service water systems	Characterisation completed: the EDF dossier does not contain any reworking other than on the Nogent site. The ASN asked for additional demonstrations.	Belleville, Cattenom, Chinon, Nogent, Chooz B, Civaux
Seismic resistance nonconformities on spent fuel racks (INES 1)	EDF commitment to completing reworking by June 2004.	Saint-Laurent B, Dampierre, Chinon, P4 series
No translation blocking of the thermostatic valve actuator stems on the LHP and LHQ diesels (INES 1)	EDF announced reworking of this equipment no later than the next outage of the reactors affected by the anomaly.	1300 MWe series
Seismic resistance anomaly on the IPS systems: incorrect positioning of the anchor pins in the civil engineering work of the piping supports (INES 1)	Implementation of a modification and reinforcement of the pins on 6 reactors with an outage in 2003. EDF will by the end of 2003 propose a schedule for early implementation of this programme with respect to the initial VD2 schedule for the other reactors.	CPY series
RRA pump lubrication conformity deviation: use of grease not qualified for accident conditions	EDF commitment to reworking all affected equipment by the end of 2006.	All plant series

3 | 9

Auxiliary and safeguard systems

3 | 9 | 1

Thermal fatigue

a) Multi-cycle thermal fatigue in mixing zones

The incident which occurred on 12 May 1998 in the RRA circuit of the Civaux 1 reactor drew attention for the first time to a multi-cycle thermal fatigue phenomenon in mixing zones of fluids with a high temperature differential. This phenomenon had not been taken into account in the design of the plants.

Following this incident, EDF implemented a programme of supervision of the RRA circuits on all the reactors. The defective sections were replaced and the RRA circuits in the N4 series reactors were modified in order to limit thermal fatigue loads.

In order to improve knowledge of this thermal fatigue phenomenon, the RRA sections removed were analysed, giving an inventory of the damage caused by thermal fatigue. EDF also set up an R&D programme following which the fundamental knowledge obtained should enable a monitoring policy to be applied to nozzles prone to fatigue.

EDF also identified all the mixing zones prone to multi-cycle thermal fatigue located on the other reactor systems. The results of this survey were presented to the Standing Nuclear Section on 18 April 2003. The ASN also asked the operator to look for solutions designed to minimise the thermal fatigue induced risk of fracture in mixing zones. These steps should be taken pending a long-term solution to controlling this risk, in order to guarantee a high level of safety. Finally, the ASN asked that the mixing zones prone to fatigue undergo appropriate checks.

b) The "Farley – Tihange" phenomenon

The so-called "Farley-Tihange" phenomenon concerns the thermal fatigue which gave rise to the cracking observed on Dampierre 2 primary system piping in 1992, and then on Dampierre 1 in 1996. This phenomenon, which is likely to affect all the 900 MWe reactors, is due to cold water leakage from the RIS system. Its potential consequences on installation safety require EDF to check the integrity of the zones exposed to this thermal fatigue phenomenon during reactor refuelling outages.

The ASN initially required EDF to provide compensatory measures with a view to limiting thermal fatigue hazards on lines liable to be affected. These measures mainly comprise valve surveillance operations. EDF was subsequently led to propose a system modification, with a view to eliminating the thermal fatigue phenomena concerned.

In view of the impact of this modification on reactor control and operation, its start-up was authorised by the ASN on an experimental basis on the Dampierre 2 and Fessenheim 1 reactors as of the summer of 2001, and then extended to all reactors in December 2003.

3 | 9 | 2

Nozzles sensitive to vibratory fatigue

For several years, small-diameter nozzles of safety-related piping are observed to crack due to a vibratory fatigue phenomenon. In 2000, the ASN asked EDF to devise a durable solution to the risk of vibratory fatigue cracking of these nozzles.

EDF accordingly established an action plan, presented to the Advisory Committee for Nuclear Reactors in April 2001 and June 2002. This action plan comprises two stages, the first dealing with proved cracks and the second with all main safety-related systems, with a view to preventing this type of damage. First modifications resulting from this action plan concern either elimination of nozzles deemed unnecessary or improvement of nozzle resistance to vibratory fatigue. These modifications were all implemented for the first time between 2002 and 2003 in accordance with EDF's commitments, and will be implemented on all reactors between 2004 and 2007, after checking that the specified goal has been achieved. At the request of the ASN, EDF in 2002 undertook to modify the conditions in which the second phase of this plan would be carried out, on the basis of the opinion of the Advisory Committee for reactors, and then in 2003 made a commitment to a schedule for achievement. In 2003, EDF also revised the supervision programme which allows detection of cracking on these nozzles pending the modification. The ASN aims to monitor this matter permanently in the coming years, without waiting for the deadlines put forward by EDF.

Instrumentation for measuring susceptible nozzles

3 | 9 | 3

Presence of gas and risk of boiler effect in the RIS and EAS recirculation piping

In the event of a leak in the primary system, the recirculation system recovers the water collected in the reactor building sumps. In February 2000, an insufficient water level was detected on the Chinon site at the suction of the reactor building sump valves. The potential consequences of this type of nonconformity would be, on the one hand, dewatering of the pumps when switched to recirculation due to the presence of gas in the piping and, on the other hand, jamming of the EAS and RIS system valves, due to a pressure build-up in the mechanical components (boiler effect). These two phenomena result in loss of the recirculation function. Considering the safety hazards involved, EDF proposed a modification whereby the PTR tank would be used for RIS and EAS pipe venting and filling.

This modification was completed on the 900 MWe reactors in 2002. Its deployment to the 1300 MWe reactors continued in 2003 and all reactors should be modified by 2006.

As regards the P'4 series, the reactors are equipped at the design stage with a device enabling sump water makeup. However, for reasons related to piping sizing, these water makeup devices do not suffice to solve the boiler effect problem on the RIS and EAS system valves. In 2002, the ASN approved installation of a system eliminating this risk. Installation on the 12 reactors concerned was completed during the outages in 2003.

RIS safety injection pump

Furthermore, with a view to complying with the ASN requirement for identification of the origin of the presence of gas in the piping, experiments began in 2002 on a 900 MWe reactor. The results obtained and the experience feedback from the periodic tests performed on all the reactors led EDF in July 2003 to propose compensatory measures to guarantee the level of water present in the recirculation piping. During the last quarter of 2003, EDF submitted to the ASN its final conclusions on the causes of the problem, its harmfulness with regard to installation safety and the methods of dealing with the problem for the various plant series. After examining them, the ASN will rule on any changes to be made to the modifications already defined.

3 | 9 | 4

RIS accumulator drainage speed in the 900 MWe reactors

In the framework of routine RIS tank drainage test procedures for the CP0 and CPY series reactors during the 10-yearly outages, difficulties have been encountered since 2000 in connection with the specified procedure and a faster drainage speed than provided for at the design stage was evidenced. In the event of a large primary leak, the loss via the break of a large quantity of the water injected, could lead to inadequate fuel cooling. This generic incident was rated at level 1 on the INES scale in 2001.

In 2003, EDF continued tests on the Chinon B1, Gravelines 4, Blayais 1, Blayais 2 and Dampierre 3 reactors. These tests confirmed the generic nature of the anomaly.

EDF in March 2003 submitted a reassessment of the minimum strength criterion of the RIS accumulators release lines on the CPY series. The reassessment justification file is currently being examined.

At the end of 2002, EDF sent the ASN the schedule for application to the CP0 plant series of a modification consisting in increasing the tank water volume, in addition to the palliative measures initially implemented.

3 | 9 | 5

Accident condition qualification deviations

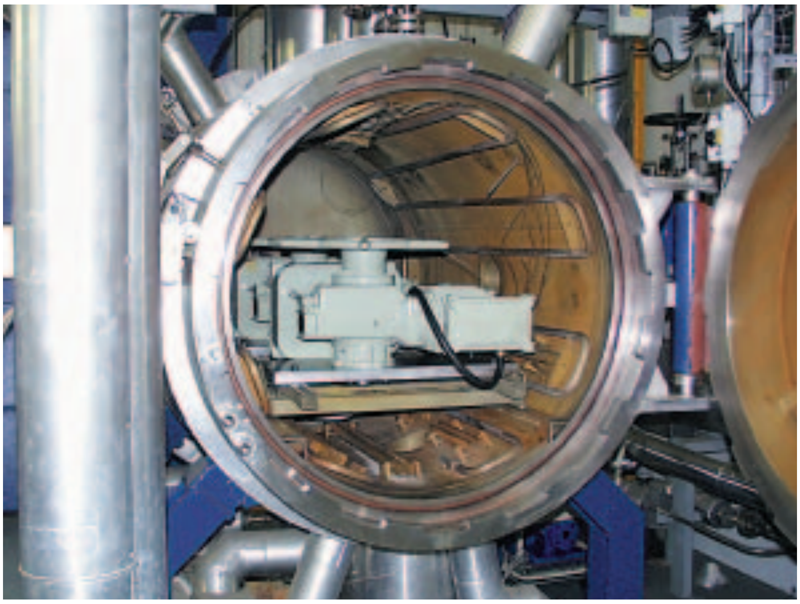
Equipment needed to bring the reactor to a safe condition and keep it there in the event of an accident undergoes qualification testing under accident conditions. These tests are performed on a sample of this equipment and aim to demonstrate its correct operation under the stresses and loads induced by an accident (temperature, pressure, humidity, irradiation, earthquake, etc.). Depending on the role of the equipment, the severity of the qualification test programmes varies. For example, equipment located within the containment and required to function during or just after an accident and under seismic loadings, falls into category “K1”.

Servo-motors qualified for accident conditions

To check the conformity of certain servo-motors with their original qualified “K1” reference model, EDF conducted tests in July 2000 on servo-motors sampled from the manufacturer. During these tests, corrosion due to the post-accident environmental conditions simulated for the tests caused rotor jamming in the stator after a period of time shorter than the qualification specification

According to EDF, this deviation from the qualification requirements can be explained by changes in manufacturing methods between the model which underwent initial qualification testing in 1983-1984 and the equipment sampled in 2000. The stator protective varnishing procedures are notably in dispute.

In view of the actuator manufacturing conditions, the presence of this type of anomaly on all pressurised water reactors cannot be ruled out. The valves equipped with these actuators are mainly containment shut-off valves, but can also belong to safeguard systems. The safety hazard involved is the



Servo-motor in the qualification test rig

non-operability of these valves under accident or post-accident conditions, with a potential impact on the reactor containment or cooling functions.

In a decision dated 31 October 2003, the ASN asked EDF to ensure conformity of the servo-motors considered as having priority no later than 31 December 2006. The reworking process will start in January 2004. The ASN also asked EDF to submit a reworking schedule for the other K1 servo-motors affected, by the first quarter of 2004.

Pump and valve viton seals

In the course of checks carried out to guarantee maintained qualification of equipment with respect to accident conditions, EDF discovered that Viton seals had been installed on pumps and valves qualified to withstand accident conditions, mainly in safeguard, chemical and volume control, venting and residual heat removal systems. These Viton seals had been assembled in place of those made of EPDM, which is the material initially qualified for use on this equipment. But Viton is not a qualified material.

In 2003, the ASN announced its position on the strategy for dealing with these deviations proposed by EDF, that is:
- reworking of the affected pumps is in progress and will be completed in 2004;
- the ASN agreed to the reworking schedule for the priority valves, which should be completed at the end of 2004, and is analysing the reworking calendar for the other equipment;
- measures to identify “other equipment qualified to withstand accident conditions” and potentially affected by this nonconformity are under way. Investigations are in progress.

Solenoid valves qualified to withstand accident conditions

In the framework of a series of checks on the “manufacturing compliance of new qualified equipment”, EDF at the end of 2001 carried out inspections on Asco-Joucomatic V301-O-5 type “K1” qualified solenoid valves. Various manufacturing deviations calling into question the qualification of this equipment with respect to accident conditions were evidenced during these inspections carried out on new equipment.

The deviations identified are of several types: presence of paper in the coil compartment, presence of machining residue, seal assembly deviations, lubrication inadequacies. These deviations can jeopardise the correct operation of this equipment under accident conditions.

The ASN accepted the strategy for dealing with the problem proposed by EDF, based on a schedule for reworking the priority equipment running until December 2006. The ASN asked EDF to submit a schedule for reworking the other ASCO-Joucomatic V301-0-5 solenoid valves by the first quarter of 2004.

Valve remote control assembly nonconformities

In November 2000, EDF detected on the Cattenom site assembly nonconformities on the remote control cardan joints of safety-related valves belonging to different safeguard systems (safety injection system, containment spray system) and auxiliary systems (chemical and volume control system, nuclear island vent and drain system, primary effluent treatment system). Additional investigations carried out in 2001 on several reactors provided further indications as to the extent and consequences of the defects:

- only the 900 MWe (except for the Fessenheim and Bugey sites) and 1300 MWe reactors present assembly deviations,
- under normal operating conditions, these nonconformities have no safety impact,
- in the event of an earthquake, disconnection of the remote control cardan joints concerned cannot be excluded, which could result in the inoperability of the associated valves.

Considering the deviations observed, liable to jeopardise operation of safety-related valves required after an earthquake, the ASN's decision of 30 January 2003 asked EDF to rework all valve remote control assemblies by no later than 31 August 2004. The reworking is in progress.

Manufacturing nonconformities in the vessel water level measurement capillaries

At the end of 1996, EDF checked the capillaries used to measure the water level in the reactor vessel, this being a status parameter required for operation using the state-oriented approach (APE). Assessments and tests revealed abnormal production of hydrogen caused by radiolysis of water and by corrosion of the carburised zones in association with the presence of acid traces linked to incorrect manufacturing.

According to the analysis submitted by EDF in the first half of 2003, this anomaly has no consequences on the accident and/or post-accident operating strategy. This dossier is currently being examined by the ASN.

3 | 9 | 6

The recirculation sump filters clogging risk

In the event of a pipe break accident inside the reactor building, the safety injection (RIS) and containment spray (EAS) systems are automatically started. 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 device.

Given the flow of water in the reactor building, the debris generated by the pipe break (particles of insulation material, concrete or paint) are likely to reach the sump filters. Creation of a porous medium on these screens creates a risk of sump clogging, while entry of a foreign body into the systems can lead to malfunctioning 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.

In June 2003, initial results from the experimental research programme run on the subject by the IRSN were presented to the Advisory Committee for reactors. On the basis of its opinion, the ASN asked EDF in October to examine the phenomenon of sump filter clogging in an accident situation and to submit its position before the end of 2003 regarding the risk of failure of the recirculation 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. Physical modifications to the installations are being examined in order to remedy the anomaly. At the same time and pending implementation of the modifications, the operator is also analysing various measures to limit the impact of the anomaly in an accident situation.

In 2004, the ASN will examine the technical data forwarded by EDF and the measures proposed to remedy the anomaly. In the light of its potential impact on installation safety, this event was rated at level 2 on the INES scale.

3 | 10

Condition of civil works

3 | 10 | 1

Nuclear auxiliary building stacks

The nuclear auxiliary building ventilation system (DVN) maintains ambient conditions to ensure correct equipment operation and personnel access. The evacuated air passes through an active carbon filter which traps the iodine and is then released through the DVN stack at an altitude allowing sufficient dilution of the effluent.

On the Chooz B and Civaux reactors, the strength of these stacks has, according to EDF, been demonstrated for the maximum historically probable earthquake (SMHV) in the vicinity of each plant, as well as for the strongest winds used in the design calculations. However, for the earthquake used in the design of the reactors, of an intensity higher than the SMHV, the resistance of these stacks cannot be guaranteed.

On the Penly, Cattenom, Golfech and Nogent reactors, resistance of the stacks to the design basis earthquake is guaranteed. However, for the strongest winds used in the reactor design calculations, it is not.

In 2003, these anomalies led to declaration of a level 1 incident on the INES scale.

Collapse of a stack could on the one hand disrupt the release of gaseous effluents and on the other damage the equipment connected to the main steam evacuation piping and strike the roof of the fuel storage building.

EDF made a commitment to rework the N4 series reactors within two years and the Cattenom, Golfech, Nogent reactors within one year. For the DVN stacks of the Belleville reactors, which are of the same design, reinforcement work has already been carried out.

The ASN also asked EDF to propose a programme for reinforcing the DVN stacks on the Penly reactors, which are of the same design as those on the Chooz B and Civaux reactors, and to justify the schedule for reinforcement work based on the actual state of deterioration of the stacks.

The ASN also asked EDF to revise its maintenance doctrine for these structures by the end of 2003.

3 | 1 0 | 2

Nonconformities in PTR and ASG tank anchoring

Following the discovery in 2000 of a design anomaly rated level 1 on the INES scale, compromising the high-intensity earthquake resistance of the ASG and PTR tanks for the Bugey and Fessenheim reactors, the Nuclear Safety Authority asked EDF in 2000 to conduct additional investigations on all the other reactors. The results of these investigations identified discrepancies similar to those observed in Fessenheim and Bugey on five other sites. Resistance to a very high intensity earthquake cannot be guaranteed for the ASG and PTR tanks in Chinon, Blayais and Tricastin. For the Dampierre and Saint-Laurent sites, the design anomaly only concerns the ASG tanks.

The ASN analysis of the documents presented by EDF showed that the resistance to the reactor design basis earthquake (SDD) cannot be guaranteed for:

- the ASG tanks on the Chinon, Tricastin, Dampierre, Blayais, Saint-Laurent and Gravelines 3, 5 and 6 reactors;
- the PTR tanks on the Chinon, Saint-Laurent, Cruas, Gravelines, Tricastin, Blayais and Dampierre reactors.

However, resistance to the maximum historically probable earthquake for the vicinity of the site is guaranteed, except for the PTR tanks in Chinon, which were quickly reinforced.

In 2003, the ASN asked EDF to restore or to guarantee, through additional engineering studies, the resistance to the design basis earthquake of the PTR and ASG tanks concerned.

3 | 1 0 | 3

Mechanical equipment supports

a) Mechanical equipment anchoring

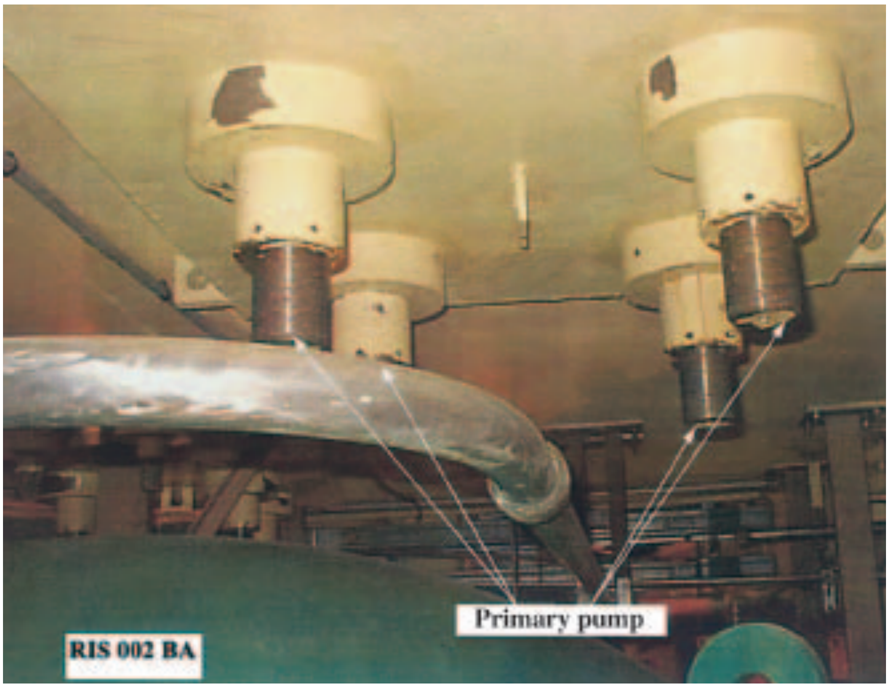
The supports under large items – steam generators and primary pumps – as well as certain primary, secondary and ancillary system components, are secured to the civil works by steel rods passing through the concrete slab, called tie-rods. These tie-rods are pre stressed, in other words they are tensioned at erection. The role of pre-stressing is to exert a high compressive load at the interface between the civil works and the support plate. This force prevents slippage or separation of the support under shear or tensile forces applied in both normal or accident situations, in particular in the event of an earthquake or pipe brake. Inadequate pre stressing or rupture of the tie-rods can lead to situations in which the supports no longer perform their function, which could compromise the performance of the equipment in an accident situation.

Main primary system (CPP) prestressed tie-rods

In 2003, EDF continued its systematic replacement of main primary system, large component tie-rods, to which it had committed itself in June 2001, on the basis of a schedule accepted by the ASN.

Other tie-rods

In June 2003, EDF committed itself to a treatment strategy for pre stressed tie-rods which had so far undergone neither inspection nor reworking. This strategy consists in replacement of the tie-rods in which there is a risk of fracture resulting from stress corrosion. The tie-rods for which there is a risk of insufficient pre stressing are then pre stressed again to ensure sufficient margin with respect to their accident situation loading.



Primary pump support leg (seen from under the pump floor)

b) The anti-seismic tie-rods retaining the vessel closure head equipment

The anti-seismic tie-rods retaining the vessel closure head equipment are intended to ensure firm, zero-play clamping of the anti-seismic ring (for the 900 MWe reactors) or the anti-missile slab (for the 1300 MWe and 1450 MWe reactors), in order to limit, in the case of an earthquake, the movements of the control rod drive mechanism (CRDM). These tie-rods are adjusted at reactor commissioning and are not covered by any preventive maintenance programme.

Adjustment anomalies were discovered on these tie-rods in 1999. They concern potentially all reactors. The risks associated with this type of anomaly could be loss of one or more tie-rods in the event of an earthquake. If the upper part is not firmly secured, the CRDM could be subjected to considerable bending forces by an earthquake, possibly leading to deformation or damage. The potential consequences of this would be the jamming of a number of control clusters and the appearance of primary breaks in the CRDM housings or casings.

In 2003, EDF continued to check the correct adjustment of the tie-rods.

The ASN asked EDF to speed up the engineering studies in order to produce a maintenance strategy such as to guarantee durable adjustment.

3 | 10 | 4

Fessenheim and Bugey reactor seismic design review

The overall verification programme on the seismic design provisions for the Fessenheim and Bugey reactors initiated in 2001 continued in 2003. This programme notably comprises an analysis of the seismic behaviour of a selection of safety-related equipment, based on in situ inspections, consultation of databases stipulating the seismic resistance of various types of equipment, analysis of seismic qualification dossiers and simplified calculations.

EDF selected nearly 700 safety-related systems and components which were inspected by experts with regard to their seismic behaviour at the Fessenheim plant, in October 2001 and during reactor shutdown in June 2002. EDF demonstrated the earthquake resistance of 90% of the equipment. For those items for which earthquake resistance could not be justified, corrective action is under way.

For the Bugey plant, EDF has already justified the earthquake resistance of half the equipment.

3 | 10 | 5

The primary system large component snubbers

Snubbers (DAB) are installed on the large components - steam generators, primary pumps, pressuriser - of reactor main primary systems (CPP). These devices, which partially ensure wall and floor mounting of the above components, must comply with a two-fold requirement:
- under normal operating conditions or during normal operation thermal transients, they must not hinder motion of the piping or component concerned,
- under accident conditions - whether earthquake or loss of primary coolant - they must block the piping or component and hold it blocked throughout the transient.

DAB blocking during a normal operating transient can exert severe forces on the CPP beyond design basis provisions. Under accident conditions, the failure of a DAB to block when required, resulting in equipment or piping deformation, could also exert forces on the CPP beyond design basis provisions.

After examination of the operating feedback on the previous maintenance programme, the ASN considered that DAB compliance with operating requirements had not been demonstrated and that the scheduled programme of further maintenance actions was unacceptable. EDF therefore had to increase the checks on these items during the course of 2003.

In 2003, EDF proposed a rework schedule for these items and a new maintenance strategy, currently being examined by the ASN.

3 | 10 | 6

1300 MWe series handling crane accessories

On 25 June 2002, EDF reported to the Nuclear Safety Authority an incident concerning the seismic resistance failure of several accessories equipping the reactor handling crane of the Flamanville, Nogent, Cattenom, Belleville, Penly, Golfech plants and Paluel-3 and 4 reactors. These handling cranes are used for plant construction, for the positioning of large components in the reactor building and during reactor maintenance outages for the handling of heavy equipment. There are two different types of crane used on the 1300 MWe reactors; the Vevey designed cranes and the CFEM designed cranes.

The resistance of various items (the walkway located on the crane and the rotation system access platforms) on the cranes in the Paluel 3 and 4 reactors and at Flamanville, Belleville, Golfech, Penly, Nogent and Cattenom, designed by Vevey, cannot be guaranteed for the reactor design basis earthquake. On 9 July 2002, this anomaly led EDF to declare an incident rated 1 on the INES scale.

The identified risk in the event of an earthquake is the free fall of the walkway on the reactor scram and reactivity control system equipment. However, the studies conducted by EDF concluded that the walkway can withstand the maximum historically probable earthquake (SMHV) for of each plant.

These components will nonetheless need to be strengthened to guarantee their resistance to the reactor design basis earthquake, which is of higher intensity than the SMHV.

In addition, the revolving cranes of the Paluel 2 and Saint-Alban 1 reactors, designed by CFEM, must also be strengthened to ensure that they can withstand the reactor design basis earthquake. The cranes of the Paluel 1 and Saint-Alban 2 reactors, of the same design, were already strengthened in 2002.

The schedule proposed by EDF for the strengthening work was considered by the ASN to be unsatisfactory. The ASN thus set earlier dates in a decision of 22 April 2003.

The Vevey designed cranes will therefore be strengthened at the next shutdown of the affected reactors and in any case before the end of October 2004, except for the Penly 1 and Golfech 1 reactors, located in areas of very little seismic activity, which will have to be dealt with by the end of June 2005. The cranes for the Paluel 2 and Saint-Alban 1 reactors, designed by CFEM, will all be reinforced before the end of October 2004.

3 | 1 0 | 7

Cruas NPP reactor building internal paintwork

The design of the metal liner of the 900 MWe reactor containment involves protection from corrosion by a thin coat of decontaminable paint. This paint is subject to qualification requirements, and its good performance in both accident and post-accident situations must on the one hand guarantee operability of the recirculation function after a reference incident, and on the other enable the containment to continue to ensure the integrity of the third containment barrier.

The paint used inside Cruas NPP reactor buildings 1, 2 and 3 is of a different composition from that of the other 900 MWe series reactors. It is polyurethane instead of epoxy based. The results of the accident condition resistance tests are non-conforming. EDF has agreed to replace this polyurethane type paint with a qualified paint by March 2005, on the zones located above the RIS and EAS sumps, representing one quarter of the total surface area. The modification work on Cruas 3 was done in 2003.

The ASN is examining the conclusions of this dossier, and in particular is assessing whether reworking one quarter of the total inside painted area of the Cruas 1, 2 and 3 reactor buildings is sufficient.

An inventory of epoxy type paint qualifications is in progress, because the accident condition resistance tests required according to the periodic maintenance programme were not always carried out.

3 | 1 1

Electrical and instrumentation and control systems

During the course of 2002, a number of incidents involving electrical panels were reported to the ASN.

At the request of the ASN, the Flamanville 2 incident of 21 January 2002 was analysed in detail by EDF. After this analysis, the operator took a series of measures to prevent similar incidents from happening again. On the one hand, the type of inverter which caused the incident was checked and its maintenance procedures modified in order to limit the prejudicial consequences of human error. On the other, the organisation in place in the reactor control room was changed in order to reduce the risks of operator error during an incident. At a national level, EDF asked all nuclear sites to learn from the Flamanville incident and inserted the event scenario in the operator training curriculum.

During the course of 2003, the ASN carried out a programme of electrical panel operation and maintenance inspections in the nuclear power plants. Initial results show that this area is on the whole satisfactory, despite disparities between the sites. The inspectors observed and required correction of a number of problems with site organisation and with application of the measures required by EDF head office services.

3 | 12

Protection against hazards

3 | 12 | 1

Seismic protection

In May 2001, the DGSNR adopted a new Basic Safety Rule (No. 2001-01) concerning determination of seismic hazards for ground level Basic Nuclear Installations.

One year later, EDF presented the Nuclear Safety Authority with the ground response spectra associated with Safe Shutdown Earthquakes (SMS) and Maximum Historically Probable Earthquakes (SMHV), reassessed in the light of this new Basic Safety Rule. Certain spectra reveal overshooting for high frequencies as compared with the reactor design basis spectra used.

These spectra will be used for seismic reassessment in the framework of the 1300 MWe reactor series safety review.

As regards the 900 MWe reactor series, for which the safety review is terminated, overshooting is also observed. Although these reassessed spectra are part of the safety reference system which will be examined in the framework of the safety review associated with the third 10-yearly outage programme for the 900 MWe reactors, EDF intends to carry out complementary studies beforehand, with regard notably to verification of electrical building resistance.

3 | 12 | 2

Flood protection

Following the flooding of the Blayais site in December 1999, EDF undertook steps aimed at reassessment and protection of the sites against external flooding hazards. Flood risk characterisation for a particular site is based on the methodology examined in the framework of the Advisory Committee for Nuclear Reactors meeting on 20 December 2001 and involves separate technical dossiers for each site.

Reassessment of the flood risk covers:
- revision of the maximum design flood level (CMS)[1];
- additional contingencies which could lead to flooding of the sites, such as particularly heavy rain, water storage tank breaches, rising groundwater levels, etc.;
- reactor procedures, which take account of the work done to provide protection from the CMS and other contingencies.

An initial version of these technical dossiers is being analysed by the ASN.

At the request of the ASN, EDF made a commitment to deadlines for transmittal of the final versions of these technical dossiers, which are set at June 2004 for the sites most exposed to this risk and December 2004 for the others. The new versions of these technical dossiers will take account of all of the approaches adopted by the DGSNR and resulting from the 20 December 2001 meeting of the Advisory Committee for Nuclear Reactors.

To date, only the Belleville, Bugey, Tricastin and Chooz sites are required to raise the maximum design flood level, necessitating the study of protective systems.

EDF has also committed to a schedule for performance of the work made necessary by this reassessment. In particular the upgrading of the CMS protections should be completed by the end of 2006 and watertight press of the underground structures will be completed before 2008.

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[1] This level is the water level to be considered when designing the protections according to the site situation. The calculation scenarios are generally the thousand year flood plus 15% for riverside sites, and a tide coefficient of 120 combined with 120 km/h winds for coastal sites.

The events of 2 and 3 December 2003

The Cruas nuclear power plant takes its cooling water from the Rhone river. In the night of 1 to 2 December, intake of water containing large amounts of mud and vegetable matter impaired the efficiency of the cooling systems. The degradation of the heat sink is covered by the normal reactor operating procedures: it requires reactor shutdown, in NSSS temperature and pressure conditions guaranteeing that the safety functions are available. This state is referred to as the safe shutdown state.

Loss of the heat sink is covered by the accident procedures, application of which requires that the on-site emergency plan (PUI) be triggered.

The rapid deterioration of the exchange capacity of the cooling systems led the Cruas plant operator to trigger the radiological PUI as a preventive measure, fearing loss of the heat sink. The ASN activated its emergency centre on the morning of 2 December 2003.

The Tricastin plant, located further downstream than Cruas, takes its cooling water from the Rhone bypass canal at Donzère. Large-scale pumping of water charged with vegetable matter and mud triggered safety shutdown of the cooling water pumping system required for electricity production and consequently automatic shutdown of reactors 3 and 4 on 2 and 3 December 2003 respectively.

Fearing a deterioration of the situation, the Tricastin plant triggered its own PUI in the night of 2 to 3 December 2003.

The high flowrate of the Rhone and its tributaries also presented a threat of flooding for the nuclear installations other than electricity production units.

The Gaffière, which is close to the Tricastin hot unit (BCOT), reached its warning level and the operator was obliged to cease all activities on 2 December 2003 and take all physical and organisational measures necessary to prevent water entering the premises.

The Marcoule site, which houses several nuclear installations, was threatened with submersion of all access roads and the various operators took the necessary measures to guarantee the safety of their installations in the event of prolonged isolation of the site.

As of late afternoon on 3 December 2003, the status of the nuclear installations, the weather forecast and the flowrate of the Rhone river were considered to be satisfactory and enabled a number of alerts to be lifted. EDF was able gradually to restart its reactors.

EDF head office services maintained a supervisory team in action in order to monitor the changing situation in the Rhone valley and in the Loire (Belleville, Dampierre, Saint-Laurent and Chinon) and Garonne (Golfech) valleys. The maximum flood levels were to be reached on these rivers in the next few days.

In accordance with their procedures, the operators of the nuclear power plants on the Loire took preventive protection measures, in particular with regard to site access problems (submersion of access roads and flooding of car parks), and the build-up of detritus in the hydroelectric dam upstream of the Golfech plant was released in collaboration with the Golfech plant operator.

The ASN rated the events on the Cruas site at level 1 on the INES scale, and those on Tricastin at level 0.

The Belleville plant during the flooding of 2 and 3 December 2003

3 | 12 | 3

Risks linked to extreme weather conditions

Generally speaking, national and international experience feedback reveals problems related to climatic hazards, the scale, frequency or type of which can raise questions concerning the initial design of the installations.

The partial flooding of the Blayais site in December 1999 was accompanied by violent winds which further aggravated the situation (loss of offsite power supplies, etc.).

Certain phenomena beyond current standards, whether or not related to climate change, therefore led EDF and the ASN to exercise exceptional vigilance with respect to these aspects. The risks linked to violent winds, snow, tornadoes, drying up of the cold source, frazil, maximum cold source water temperatures, maximum air temperatures, lightning and forest fires will be analysed as part of the reassessment of the 900 MWe series for the third ten-yearly outages. The purpose will be to evaluate the ability of the plants to withstand these risks.

3 | 12 | 4

Risks of internal explosion

Based on the conclusions of the inspections carried out in 2002 on this topic, the incidents and the anomalies detected on the sites, the ASN informed EDF of its requirements concerning how to deal with this risk of internal explosion.

These requirements concern physical prevention and protection measures, as well as the actual operation of the facilities, in particular the response to an anomaly on systems for which there is a risk of explosion.

The ASN asked EDF to ensure that the existing means for protection against internal explosions be analysed during the periodic safety review of the 900 MWe series for the third ten-yearly outage and that a similar process be conducted on the other plant series.

3 | 12 | 5

Fire protection

On the topic of fire hazards, the Nuclear Safety Authority carries out a large number of inspections every year.

The approach to fire hazards at nuclear power plants is based on several lines of defence.

a) Prevention

Prevention consists mainly:
- in ensuring that the nature and quantity of combustible material present on the premises remains in compliance with the design basis of the fire sectorisation elements (fire doors, etc.),
- in requiring a fire permit for all work liable to start a fire (welding, grinding, etc.).

It should be noted that the order of 31 December 1999, which specifically applies to basic nuclear installations, in particular regulates the fire protection aspect, the “prevention” section of which already applies to the operators.

In order to improve this line of defence, EDF responded to the many reports established by the Nuclear Safety Authority on this subject in recent years, by drawing up new operating requirements, which came into force on the sites on 1 January 2003.

Despite these new directives given by EDF head office, the Nuclear Safety Authority found that on the EDF nuclear power plants, there is still room for improvement in the “fire” culture. For example, this year on the Cattenom site, a VLL waste fire broke out because large quantities of this waste had been incorrectly stored in inappropriate premises, in contact with a radiator.

b) Installation design

Limiting the consequences of a fire outbreak is mainly based on the fire sectorisation principle (i.e. dividing the installation into sectors designed to contain the fire within a given perimeter) ensuring the geographical separation of the redundant equipment performing a safety function.

In this connection, the Nuclear Safety Authority continues to be vigilant regarding progress on the fire action plan elaborated by EDF to obtain 900 MWe and 1300 MWe reactor compliance, the completion date for which was set at 2006 by a decision of 12 September 2000.

Going beyond this work scheduled for late 2006, the ASN also asked EDF, as part of the third ten-yearly safety review for the 900 MWe reactors, to further improve fire protection in these reactors, by identifying and dealing with any remaining weaknesses:

- through use of the results of a fire probabilistic safety study, complementing the deterministic approach used hitherto;
- through a reassessment of the margins that exist between qualification of the fire-break elements in place and the duration of the foreseeable fires in the premises.

In addition, the 31 December 1999 order sets environmental protection requirements (retention of fire fighting water, containment of toxic fumes, etc.). In response to these new requirements, EDF produced risk analyses and proposals for modernising its installations, in particular concerning those which do not house equipment important for reactor safety (and therefore not covered by the fire action plan) but in which a fire would be likely to have direct environmental consequences (for example, the radioactive waste processing premises).

These studies are currently being analysed by the ASN and its technical support body.

c) Fire-fighting

Every year, there are about thirty outbreaks of fire on EDF nuclear power plants, which represents, on average, one outbreak of fire per reactor every two years. Operating feedback shows that the situations so far encountered were brought under control by the EDF fire-fighting teams, backed by outside emergency services.

However, deeming notably on the basis of ASN inspections and operating feedback from several events that the organisation of fire-fighting on nuclear power plant sites and the degree of competence of the EDF fire-fighters had to progress, the ASN had requested EDF in May 2001 (by a letter made public) to proceed to an overall review of its policy in this respect.

In reply, on 1 July 2003, EDF implemented a new fire-fighting training and organisational doctrine.

The effectiveness of the operator’s action plan is currently being assessed by the Nuclear Safety Authority through an increased number of fire drills performed during unannounced inspections.

During these inspections, the Nuclear Safety Authority observed labour tensions within the NPPs concerning the operating teams’ view of their fire-fighting duties, and at their request received representatives from the CFDT and CGT unions to discuss this subject.

Effects of the summer 2003 heatwave and drought on nuclear power plant operations

Safety aspect

The exceptional weather conditions observed during the summer of 2003 reduced the flowrate of the watercourses constituting the cold source of the reactor cooling systems and raised their temperature.

The high temperatures of the cold source reduced the efficiency of the cooling systems in certain premises and reduced the power evacuation capacity during reactor outages.

In order to optimise management of the cold source cooling capacity, the sites increased monitoring of the efficiency of the devices exchanging heat with the cold source and adopted special measures to adapt the power to be evacuated by these systems (as was the case in Belleville and Chooz).

For premises in which temperature criteria have to be met, the sites installed additional air cooling systems (fogging, additional air conditioning, etc.), as the existing systems did not have sufficient cooling capacity.

In particular, the temperatures recorded in the reactor buildings on the Fessenheim site led the operator to set up a system for cooling the outside of the containment, for which effectiveness tests where performed at the beginning of the heat wave.

Owing to the gradual temperature rise inside the reactor buildings on the Dampierre and Chooz sites and the ineffectiveness of the sprinkler system used on the Fessenheim site, the three sites asked the ASN for authorisation to use the air mixing system inside the reactor buildings. This authorisation was granted.

Finally, the period of drought observed in 2003 led in the Loire Valley to restrictions on low-water make-up in the Loire. Creation of a threshold on the Chinon site was envisaged, to guarantee operation of the cooling pumps in the event of a drop in the Loire flowrate. This finally proved not to be necessary.

Environmental aspect

Nuclear power plants generate thermal releases into watercourses or the sea, either directly for those plants operating in an “open circuit”, or after passage through cooling towers, enabling some of the calories to be released into the atmosphere. Thermal releases from the plants raise the temperature between upstream and downstream of the release by values ranging from a few tenths of a degree to several degrees.

These releases are regulated.

The climatic conditions observed during the summer of 2003 raised the temperature of certain watercourses by about 5 °C above the average historical values observed over the past 25 years. For these reasons, the operators reduced power or halted production from several of their reactors, on the Le Blayais, Golfech, Tricastin and Bugey sites.

However, electricity demand was high, precisely because of the heat wave, with increased use of air-conditioning for example, at a time when electricity production facilities other than nuclear reactors were also experiencing operating difficulties (also related to the heatwave and drought): availability of dams, thermal and atmospheric releases from oil-fired plants. This situation involved the risk that the electricity supply resources would be insufficient, leading to significant load-shedding.

In July 2003, the DGSNR considered that the requests submitted by the operators of the Golfech, Tricastin and Bugey NPPs, for thermal releases in excess of those authorised by the plants’ release licences, were non-significant modifications and therefore approved them.

For those operator requests considered as significant, the Ministers for the Environment, Health and Industry issued an order on 12 August 2003, authorising electricity production facilities located on the Rhone, Moselle, Garonne and Seine rivers to continue operating with thermal releases higher than the limits authorised in the release authorisation orders for these installations, while limiting the temperature rise in these watercourses to between 1 and 3 °C depending on the type of facility and the river.

The thermal releases surveillance committee set up to evaluate the effects of this decision will issue its opinion in 2004.

As part of its analysis of the impact of the summer 2003 heatwave and drought on nuclear reactor operations, the ASN sent EDF a number of questions which will require detailed analysis and for which answers and justifications will be required before summer 2004, with respect to safety and the environment.

Ministerial order of 12 August 2003 concerning the exceptional water release conditions for nuclear power plants

The Minister for Ecology and Sustainable Development, the Minister for Health, the Family and the Handicapped and the Minister Delegate for Industry,

Having regard to the Environment Code;

Having regard to the Public Health Code;

Having regard to law 2000-108 of 10 February 2000 as amended, concerning the modernisation and development of the public electricity service;

Having regard to decree 63-1228 of 11 December 1963 as amended, concerning nuclear installations;

Having regard to decree 95-540 of 4 May 1995 as amended, concerning liquid and gaseous effluent releases and water intake by basic nuclear installations;

Considering that the climatic conditions currently faced by France and Europe as a whole are exceptional circumstances;

Considering the threat to the safety of property and persons, the continuity of public services and the economic activity of the country that could result from an imbalance between electricity supply and consumption demand;

Considering the higher interest involved in maintaining operation of the riverside or coastal electricity production plants on the metropolitan national territory to guarantee the country's electricity supply,

Order as follows:

Article 1

Notwithstanding any contrary provisions in their current administrative licences, issued under application of the above-mentioned decree of 4 May 1995, the thermal electricity production facilities covered by the above-mentioned decree of 11 December 1963 discharging water into the Garonne, Rhone, Seine and Moselle river basins may continue to do so until such time as the difference between the water temperature measured upstream and downstream after mixing each of these installations, reaches the following values:

1 °C for installations fully equipped with cooling towers, this limit being raised to 1.5 °C for those located on the Seine and Moselle rivers;

3 °C for the other plants.

Article 2

Use of these measures by the electricity producers, insofar as they constitute a waiver to the currently applicable limits, will be reduced whenever possible and limited only to the electricity production necessary for meeting national consumption and for complying with international agreements and undertakings by these producers to the European Commission.

Article 3

Throughout the period in which this order shall be in force, the electricity producers shall closely monitor the environmental impact of any measures they are required to take, in particular on river fauna, and their impact on human health, particularly concerning bathing and water sports downstream.

Article 4

Throughout the period in which this order shall be in force, the electricity producers shall keep the Director General for Nuclear Safety and Radiation Protection, the Director for the Prevention of Pollution and Risks and the Director for Water, and the Prefects with responsibility for river basin coordination, informed on a daily basis of the effective temperatures recorded after mixing downstream of each of the plants concerned, along with any repercussions observed on fish life.

Article 5

This order shall be published in the *Official Gazette of the French Republic*. It shall take effect once notified to the electricity producers, for a period ending on 30 September 2003.

Done in Paris, on 12 August 2003.

The Minister delegate for Industry,
Nicole Fontaine

The Minister for Ecology and Sustainable Development,
Roselyne Bachelot-Narquin

The Minister for Health, the Family
and the Handicapped,
Jean-François Mattei

4 NUCLEAR POWER PLANT OPERATION

4 | 1

Safety role of human and organisation factors

A substantial proportion of nuclear safety actions concern the equipment and how to improve its reliability and progress continues to be made in these areas. However, the correct functioning of the installations, to a very large extent, depends on the quality of the work done by the personnel. It is therefore essential to look closely at the "human factor", given that this is a broad field encompassing individual and collective behaviour as well as organisation and management.

Nuclear Safety Authority action is based on the following general principles:

- the responsibility of the operator: within the framework of general safety objectives, it is the role of the operator to define organisational provisions and to then adapt them whenever necessary and to ensure adequate training for its staff. The ASN where appropriate analyses and approves certain provisions but prescribes no standardised organisational arrangements for nuclear operators. Similarly, it falls to the operators to train their staff and assess their ability to fulfil their tasks,
- surveillance: inspections carried out in nuclear operator departments often provide opportunities to take a closer look at the running of these organisations. Topics like "safety management", "training", "human factors", "reactor control" or "service companies", for instance, enable assessment of the degree to which human and organisational issues are taken into account in nuclear installations,

• operating feedback: incident analysis should enable the operator to improve group work efficiency. The spontaneous bringing to light of particulars should be aimed at safety improvement and not at identification of culprits,

• 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.

4 | 1 | 1

Training at EDF

With regard to training, EDF has since the end of 1996 been implementing new policies based mainly on training decentralisation to the sites and introduction of the notion of competence.

In November 2001, EDF defined its policy for setting up assessment of course work for the more sensitive professions. At the end of 2003, all national training courses linked to a sensitive activity comprise a formal arrangement for assessing what has been learned. With regard to the local courses, there is still considerable disparity between the sites.

As of 2001, the DPN decided to review its training system in depth and have it move towards a skills development process:
- by developing a skills management process on each site;
- by deploying a simulator on each site;
- by entrusting training to the professional training service (SFP), with the sites focusing on skills management.

With this in mind, and to facilitate shift personnel training, a programme aimed at equipping each site with a full-scale simulator is currently being implemented. At present, in addition to the four regional training centres equipped with a simulator (Le Bugey, Paluel, Chinon, Gurcy-le-Châtel), four simulators are installed at the Gravelines, Chooz, Cattenom and Fessenheim sites. Two new simulators were installed in 2003 on the Belleville and Le Blayais sites. The other sites will be equipped with simulators in early 2005. The simulators on the Paluel, Cattenom and Gravelines sites will be renovated in 2005 in order to incorporate the technical modifications made on the sites.

At the same time as the “local skills development system” is being deployed, steps are being taken to professionalize the skills management duties of the managers.

In a context of tightening requirements (safety, environment, budget savings, etc.) and high staff turnover (departures for retirement), the DPN in 2003 implemented a human resources policy giving it a multi-year picture of jobs and skills so that it has the resources needed to attain the performance targets.

4 | 1 | 2

EDF nuclear fleet management

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

A broader reflection 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.

Cost control concerns are now more clearly apparent in the operator's dialogue with the Nuclear Safety Authority. Technical discussions with EDF have clearly become tougher with regard to these aspects of economic feasibility, the justification for certain requirements or certain deadlines, and in the handling of very short term subjects during unit outages.

Operator internationalisation entailed major organisational changes at EDF in 2002. At the request of the ASN, the implementation of this new organisation was the opportunity for a redefinition of the nuclear operator's responsibilities between the EDF chairman, the Energy Branch management, the management of the nuclear engineering and nuclear production divisions and the management of the nuclear power plants.

At the beginning of 2003, EDF informed the ASN of its aim to develop cost-benefit type approaches, which would be able to take account of both technical-economic constraints and safety goals in the engineering decisions, and to demonstrate the pertinence of the choices made. This approach would be implemented for each dossier, in order to help to choose a solution to a safety problem and to set priorities for modifications within a constant budget envelope.

Faced with the various issues associated with this approach, the ASN identified the main areas for work that would require investment in the coming years. The first area for work is that of developing supervision and monitoring tools for early identification of possible drifting: examination of the economic situation, spending trends, staff management and changes in the operator's organisation will require closer attention.

The second area of work is to set up a more open and responsible dialogue with the operator concerning the economic issues. The ASN is thus willing to examine a cost-benefit type argument, in which the operator would demonstrate that some of the improvements requested by the ASN do not represent an optimum allocation of the available budget and would thus propose devoting these resources to other actions with greater safety benefits.

The third area of work is to set up 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 arrival of an interconnected electricity market.

4 | 1 | 3

Surveillance of service companies and quality of subcontracted operations

Most nuclear reactor maintenance work is subcontracted by EDF to outside firms. This work is mainly seasonal, as it is highly dependent on the schedule of plant outages and concerns some 20,000 people every year.

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

The main areas of supervision by the Nuclear Safety Authority are therefore the following.

a) Choice and surveillance of service companies

In order to comply with the requirements of the ministerial order of 10 August 1984, EDF has a service company selection system based on assessment of their technical know-how and their quality organisation. In addition to this pre-qualification approach, and given its responsibility for its installation, EDF also has to carry out or ensure surveillance of its service companies and use operating feedback for continuous validation of their qualification.

This service company qualification system supervision led in 2003 to Nuclear Safety Authority inspections in the NPPs, but also in EDF head office departments responsible for this process.

In particular, adaptation of the existing system to the recent EDF policy of making more widespread use of “integrated services” (contract placed with a service company whereby a single purchase order covers maintenance involving different professions and includes coordination of the professions and work-sites delegated to the contractor) was looked at with respect to management of the second level subcontracting that this implies.

Finally, concerning field surveillance of service companies, the Nuclear Safety Authority feels that in the light of its work-site inspections, EDF still has to make significant progress on this aspect of subcontractor management.

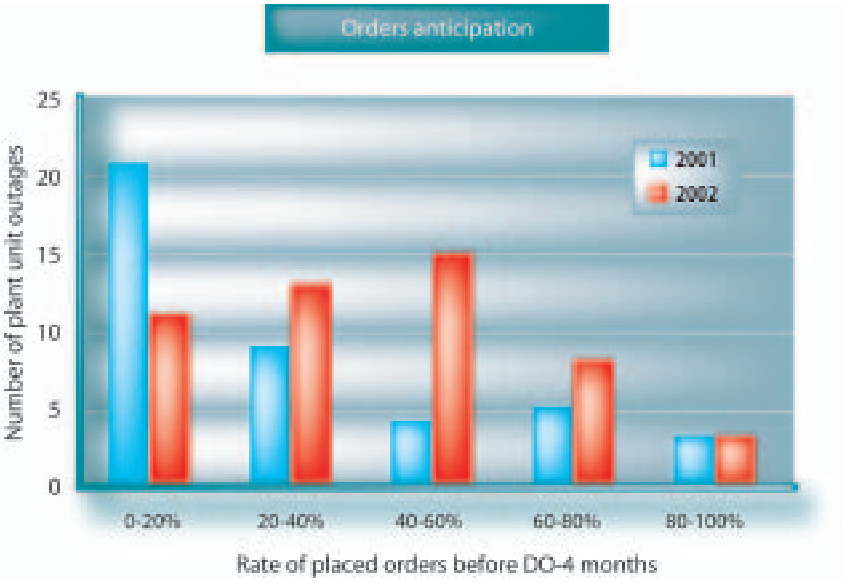
b) The conditions of maintenance operations

As regards maintenance preparation, the Nuclear Safety Authority observed a clear improvement in early preparation of orders and thus in the visibility of the service companies’ upcoming work load: in 2002 for the unit outages, half of the sites placed at least 40% of their orders more than four months before the beginning of the outages (as compared with 20% in 2001).

c) Radiation protection and working conditions

As regards worker radiation protection, the Nuclear Safety Authority places emphasis on checking equal treatment by EDF for all nuclear workers, regardless of whether they are employed by the service companies or by the operator.

Even if supervision of working conditions to protect individuals is the responsibility of the labour inspectorate, the Nuclear Safety Authority for its part considers that degraded working conditions are also prejudicial to the quality of the maintenance work done and thus to safety. The labour and BINI inspectors are thus required to communicate with each other on this subject of joint interest



(analysis of accidents at work, observance of working time limits, etc.). It is worth underlining that in many cases, with regard to the EDF installations, the BNI inspector and labour inspector functions are held by one and the same person.

d) The service company market

The operator's decision to outsource part of the maintenance of its reactors should not create a situation of dependency causing it to lose control of the scheduling or quality of the maintenance work done (defaulting by a company in a monopoly situation for a specific activity, inadequate service company resources to handle the volume of work, and so on).

Although EDF set up a structure for supervising its service company market and for monitoring the available resources, the Nuclear Safety Authority wished to have its own separate view of this field and in 2003 initiated a specific audit, the results of which are expected in 2004.

4 | 2

Fuel and fuel management

4 | 2 | 1

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 management with a view to maximising efficiency.

Implementation of the GARANCE and GEMMES fuel management, respectively on the 900 MWe reactors in 1994 and on the 1300 MWe reactors in 1996, enabled EDF to gradually increase the uranium fuel burnup fraction to an average of 52 GWd/t per assembly. This value corresponds to the current regulation limit.

Presented to the Nuclear Safety Authority in 1997, the CYCLADES fuel management system is characterised by:
- extension of cycles from 12 months to 18 months,
- use of 4.2% U-235 enriched UO2 fuel,
- inclusion of fuel rods comprising burnable poison on U-235 enriched bases (this poison counteracts the greater core reactivity at the beginning of a cycle).

After examination of the accident studies in the Fessenheim and Bugey reactor safety reports, the DGSNR authorised initial loading of CYCLADES fuel into Fessenheim 2 in October 2000.

At the present time, all the Fessenheim and Bugey reactors have adopted the CYCLADES fuel management.

MOX parity: towards increased MOX fuel burnup

EDF is looking to optimise the use of MOX fuel and relax the operating constraints on the 900 MWe reactors loaded with this fuel. These constraints are in particular the result of MOX fuel assembly management, which is different from that of UO2 assemblies in terms of number of burnup cycles and burnup fraction achieved. The current limitation on MOX fuel is formulated in terms of initial plutonium content and number of in-pile burnup cycles. It is the equivalent of an average maximum burnup of about 42 GWd/t.

With this in mind, in June 2001, EDF presented the DGSNR with its feasibility file for future MOX fuel management. Known as "MOX parity", this fuel management entails an increase in the burnup fraction of the MOX fuel assemblies, as a result of the greater number of burnup cycles for these

Fuel management – Situation as at 31 December 2003

Fuel management system	Characteristics	Duty cycle	Reactors concerned
Standard 900 MWe (GARANCE)	4-batch, UO_2 fuel	12 months	Gravelines 5 and 6 Chinon B2 Blayais 3 and 4 Cruas 1 to 4
Hybrid MOX (GARANCE MOX)	4-batch, 3.7% U-235 enriched UO_2 + 3-batch, MOX	12 months	Blayais 1 and 2 Chinon B1, B3 and B4 Dampierre 1 to 4 Gravelines 1 to 4 St-Laurent B1 and B2 Tricastin 1 to 4
900 MWe extended duty cycles (CYCLADES)	3- batch, 4.2% U-235 enriched UO_2	18 months	Fessenheim 2 Bugey 2 to 5
1300 MWe extended duty cycles (GEMMES)	3-batch, 4% U-235 enriched UO_2	18 months	Belleville 1 and 2 Cattenom 1 to 4 Flamanville 1 and 2 Golfech 1 and 2 Nogent 1 and 2 Paluel 1 to 4 Penly 1 and 2 St-Alban 1 and 2
Standard 1450 MWe	4-batch, 3.4% U-235 enriched UO_2	12 months	Chooz B1 and B2 Civaux 1 and 2

fuel assemblies and modification of their initial plutonium content. This latter change is necessary to counteract a further isotopic deterioration of the plutonium resulting from reprocessing heavily irradiated fuels and to guarantee future energy equivalence between MOX fuel and 3.7% U-235 enriched UO2 fuel.

EDF is considering 2005 for initial implementation of “MOX parity” management.

After examining the feasibility file in 2002, investigation of “MOX Parity” management is continuing with examination of the safety file. Initially, this examination aims to check the conformity of the safety studies with the approved reference framework and subsequently to check the validity of the results presented in the safety studies. The Nuclear Safety Authority will issue an opinion on these two points in the first half of 2004.

The future GALICE and ALCADE management systems

As of 2006, EDF envisages replacing the existing GEMMES management, operational on the 20 reactors of the 1300 MWe series, with GALICE management. Fuel assembly enrichment would rise from 4 to 4.5% UO2, with maximum fuel burnup then being 62 GWd/t, and the average cycle remaining at 18 months.

In the same way as for “MOX Parity” management, EDF forwarded the GALICE management feasibility file to the ASN in December 2002 and the ASN should issue an opinion by the end of 2003.

ALCADE management is envisaged as of 2007 for the 4 reactors of the N4 series. In order to lengthen the cycles for these reactors (which would go up from 11 to 18 months), fuel enrichment would be raised to 4.2% and fuel burnup to 54 GWd/t. The feasibility file was transmitted to the ASN in December 2003.

Adaptation of regulations

Since 2001, the Nuclear Safety Authority has been working on drafting a ministerial order concerning nuclear fuel and its utilisation in nuclear reactors. The draft order was forwarded in 2002 for comments to EDF, to the Institute for Radiation Protection and Nuclear Safety and to the various fuel assembly designers and manufacturers. The Nuclear Safety Authority took account of all comments received during the course of 2003 and produced a new version of its draft order for presentation to the Advisory Committee for Nuclear Reactors in 2004.

4 | 2 | 2

Rules and methods used to demonstrate safety

The safety demonstration for the new in-pile fuel management practices generally relies on new rules and new methods for the study of design basis accidents (accidents used at the installation design stage to design the reactor protection and safeguard systems).

a) Method for studying the risk of interaction between fuel pellet and clad (IPG)

In November 2000, EDF presented the ASN with changes to the rules and the method for studying the risk of fuel rod burst in the event of power transients. To include the IPG risk in safety studies at present entails special power reactor control constraints: the reactors of the 1450 MWe series therefore have to run at stabilised power as of the beginning of the second burnup cycle.

These rules and methods were the subject of an ASN position in February 2002. They should be applied to demonstrate the safety of “MOX parity” fuel management and to relax the 1450 MWe reactor technical operating specifications.

b) Method for studying a steam line break accident (RTV)

In 2000, EDF presented the ASN with a new method for studying an RTV accident based on the use of different thermohydraulic software from that used to study the LOCA. This method is designed to be implemented as part of the “MOX parity” management safety demonstration. Examination of this method gave rise to initial remarks in July 2002 from the ASN, which is currently continuing its examination.

c) Rules for studying complementary accidents

The complementary accident category covers the study of design basis accidents aggravated by major failures in redundant equipment required to guarantee installation control in an accident situation. These studies allow identification of control operator actions which will ensure that safety objectives are met.

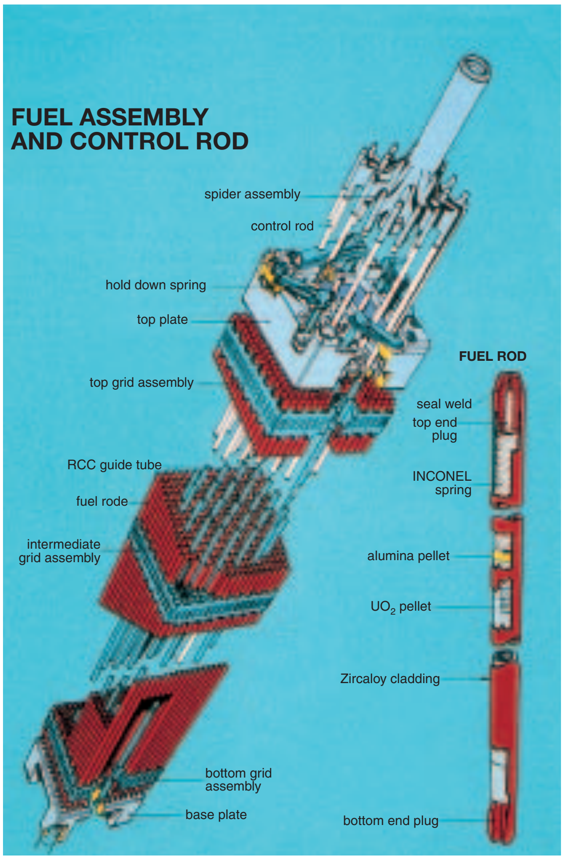


Diagram: fuel assembly and control rod cluster

The rules proposed by EDF are based on the use of probabilistic safety assessments (PSA) for identification of the potentially hazardous sequences. A study of these sequences is then conducted using a deterministic approach.

The ASN defined its position with regard to these rules in July 2002, further to the examination undertaken by the Advisory Committee for Nuclear Reactors in the framework of the 1300 MWe reactor safety review.

d) Rules for studying design basis accidents combined with loss of offsite power

In 2001, EDF forwarded the rules it intended to use for assessment of margins with respect to this type of accident.

The ASN defined its position with regard to these rules in July 2002, further to the examination undertaken by the Advisory Committee for Nuclear Reactors in the framework of the 1300 MWe reactor safety review.

e) Method for verification of non-reopening of the pellet-clad gap

The scheduled increase in fuel burnup fractions led EDF to present to the ASN a new method for verification of the non-reopening of the pellet-clad gap. The ASN defined its position on this new method in July 2002.

f) The realistic deterministic method (MDR) and the hot rod statistical method (MSCC)

In the framework of the CYCLADES fuel management safety demonstration, EDF used a new method for studying large break loss of coolant accidents. This method, known as the “realistic deterministic” method, is based on assessment of the fuel rod clad temperature during the accident transient, using thermal hydraulic software enabling physical modelling of this transient. To date, the ASN has limited acceptability of this method to the study of large break loss of coolant accidents on 3-loop PWRs. The doctrine and principles underlying development of the MDR method are the subject of requests for additional data from EDF.

A second method, known as the hot rod statistical method, which is complementary to the MDR, enables determination of the thermal response of the hot test rod. It thus provides maximum temperature and clad oxidation values, which are then compared with the safety criteria. It can be applied either using directly the uncoupled hot assembly module (MACD), or using a mathematical function or response area.

In July 2002, the ASN decided in favour of this method, but only in the case of direct use of the MACD. In 2003, EDF sent the ASN a file concerning application of MDR to 4-loop PWRs. The ASN will examine it at the same time as the GALICE fuel management.

4 | 2 | 3

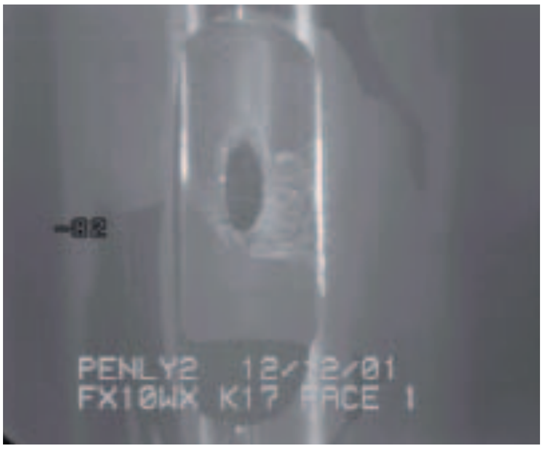
Fretting defects on 1300 MWe reactor fuel

Since 2001, several reactors of the 1300 MWe standardised series have been affected by fretting problems. Fretting is a vibration phenomenon affecting fuel assembly rods in the grid cells and causing friction, clad wear and finally clad failure.

a) Origin and kinetics

Current working assumptions regarding determination of the origin of the phenomenon notably concern particularly marked hydraulic phenomena for the 1300 MWe standardised series, combined with the effects of a gradual irradiation-induced slackening of the force holding the rod in its cell.

A primary defect first appears at bottom grid assembly level. This can then give rise to a secondary defect, due to fuel clad hydridation (chemical reaction at high temperature between clad zirconium and the primary water). These defects are accompanied by release of various radioelements, which can be measured isotope by isotope.



Fuel rod perforation due to vibratory wear at bottom grid assembly level

b) Consequences

These fretting defects have worker radiation protection consequences, since they may result in the dissemination of radioelements in the primary system, notably alpha-emitting particles which are extremely penalising for the radiation protection of primary system outage maintenance staff. Special provisions are consequently made to prevent contamination and limit doses to maintenance teams concerned.

The radioactive particles disseminated in the primary system also complicate waste and effluent management, notably with regard to discrimination and tracing of waste containing alpha-emitters and compliance with ANDRA activity criteria requirements.

c) Situation of the 1300 MWe plant series with regard to fretting

The two reactors most severely affected by this phenomenon were Cattenom 3 during its 8th irradiation cycle, which was completed in 2001, and Nogent 2 during its 11th cycle, which ended in late 2002. On Cattenom 3, 26 assemblies which had undergone 3 irradiation cycles and 2 which had undergone 2 cycles were found to be leaking. The problems encountered by EDF following the 8th cycle in Cattenom 3 were taken into account by Nogent 2 as this reactor's outage was brought forward by 5 months to limit the increase in the level of activity measured in the primary fluid. 22 assemblies which had undergone 3 irradiation cycles and 1 assembly which had undergone 2, were nonetheless found to be leaking when the reactor was defuelled.

This situation led the Nuclear Safety Authority, in a decision dated 14 January 2003, to require that EDF follow stricter radio-chemical specifications prior to the 12th irradiation cycle of the reactor. The purpose of this decision was to ensure early detection of possible clad failures and restrict dissemination of radioactive material in the primary system in the event of a substantial break.

The activity levels currently measured in the Cattenom 3 primary systems would seem to show that the assemblies are not leaking. Those in Nogent 2 indicate possible fretting. They are monitored on a weekly basis.

Fretting also appeared to a lesser extent on a dozen other reactors of the 1300 MWe series since 2001. This situation led EDF to declare a generic significant incident to the ASN on 9 January 2003, which was rated at level 1 on the INES scale.

Considering that the generic nature of the defect on the 1300 MWe series was proven, the ASN in a decision dated 10 July 2003, required EDF to apply to all the 1300 MWe reactors stricter radio-chemical specifications of the same type as those already applicable to Cattenom 1, Cattenom 3, Cattenom 4 and Nogent 2.

d) Fuel assembly reinforcement

In order to counteract fretting problems, the fuel manufacturer FRAGEMA (EDF's main fuel supplier) proposed a modification to its latest generation of fuel assemblies, aimed at reinforcing them in the stress concentration areas. The AFA3GLr fuel assembly is thus equipped with an additional bottom grid aimed at improving rod stability in its grid cell. After initial authorisation to load this type of assembly in the core of Cattenom 3 at the end of 2002, the ASN in 2003 authorised eight of the 1300 MWe reactors most prone to fretting, to irradiate a load of AFA 3GLr fuel.

In February 2003, the ASN also authorised EDF to irradiate an initial load of Westinghouse designed RFA 1300 fuel assemblies. These assemblies comprise a reinforced base structure to better withstand the effects of fretting (see § 4|2|4).

4 | 2 | 4

Fuel assembly modifications

EDF is carrying out several experimental programmes aimed at improving both fuel safety and performance levels. The improvements being 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.

The PENTIX programme

The PENTIX programme, proposed by EDF in 1998, consists in qualifying an M5 alloy rod cladding in a standard fuel assembly structure (AFA 3GL). The M5 alloy is a cladding material characterised by greater corrosion resistance and which should lead to a significant increase in fuel burnup.

The first irradiation cycle with a core made up entirely of PENTIX AFA 3GL assemblies had to be cut short by 5 months at the end of 2002 owing to a significant rise in the level of activity in the Nogent 2 reactor primary fluid.

After this cycle, the ASN requested EDF to carry out in-depth examination of the non-leaktight fuel rods. These examinations revealed 39 clad failures on 23 fuel assemblies, among which 22 were 3rd cycle assemblies and 1 was a 1st cycle assembling. The clad failures of the 3rd cycle assemblies were attributed to fretting (see § 4|2|3), whereas the two clad failures discovered on the 1st cycle assembly were attributed to manufacturing defects and damage from a loose part.

Given that even though there was nothing to implicate the M5 alloy directly in the occurrence of fretting on Nogent 2, neither was there any way of ruling out any effect of the cladding material, the ASN in February 2003 informed EDF that no requests for irradiation of a fuel reload with M5 cladding would be accepted, other than as part of the continued PENTIX programmes on Nogent 2.

The ASN also asked EDF to initiate a research programme to ensure a clearer understanding of the phenomenon observed on Nogent 2. The first conclusions of this research highlighted the fact that the lesser elongation under irradiation of the M5 clad rods encouraged the appearance of fretting at the base of the fuel assemblies.

In the light of these new data, EDF in July 2003 asked the ASN for authorisation to irradiate a reload of PENTIX AFA 3GLr AA fuel in the Nogent 2 core at its next refuelling outage scheduled for mid-2004. In relation to the PENTIX AFA 3GL fuel currently being irradiated, the PENTIX AFA 3GLr AA fuel is characterised by the addition of a reinforcing grid at the base of the assembly (see § 4|2|3) and by lowering of the fuel rods to offset the lesser elongation under irradiation mentioned earlier. This subject is currently being examined by the ASN.

Before the clad failures in Nogent 2, the ASN had also informed EDF that the impact of the M5 alloy on the fuel cycle had to be clearly assessed and that its in reactor behaviour required further investigations with regard to LOCA accidents and the pellet-clad interaction phenomenon.

RFA 1300 and RFA 900 fuel

In 2003, EDF continued the efforts already in progress to diversify its nuclear fuel supplies. EDF therefore requested generic authorisation to use the Westinghouse designed RFA 900 fuel in the CPY series reactors at the end of 2002. This request followed the request for general use of the RFA 1300 assemblies of the same design on the 1300 MWe plant series.

These assemblies use technologies holding down the rods in the skeleton which are different from those used by Framatome and in particular employ a protection grid against loose parts and fretting at the base of the RFA 1300 assembly.

Considering that international feedback on use of these assemblies was not representative enough of the operating conditions of the EDF reactors, the ASN only authorised irradiation of a single fuel load of each of these two designs. These loads are currently being irradiated in Gravelines 6 (RFA 900) and Belleville 1 (RFA 1300).

The other experimental programmes

The ASN authorised EDF to load the Paluel 1 core with 4 Westinghouse designed APA 1300 fuel assemblies. These assemblies differ in their 4.95% uranium 235 enrichment and in the use of a particular cladding material designed to withstand high burnup rates. EDF's request concerned 3 cycles, but given the design of this fuel, the Nuclear Safety Authority felt that the hydraulic compatibility of these assemblies had not been proven and that further data were required to check the end-of-life axial retention of the APA 1300 assemblies. The ASN therefore only authorised irradiation of these assemblies for one cycle.

4 | 2 | 5

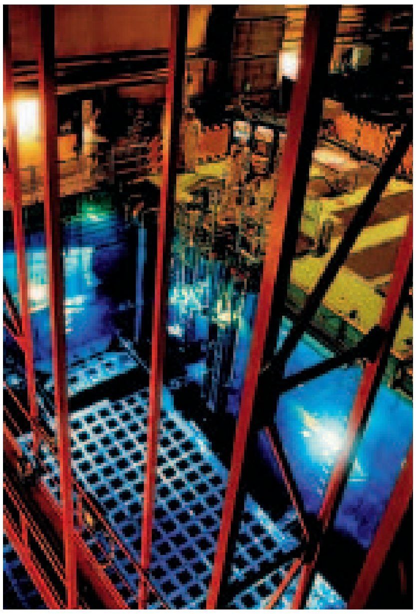
Fuel handling operations

On 2 April 2001, during nuclear fuel reloading into the Dampierre 4 reactor, a shift in the sequence of operations resulted in the mispositioning of a large number of fuel assemblies in the reactor core. This offset had, in fact, resulted in the constitution of a small cluster of new assemblies in the reactor vessel, which nevertheless remained subcritical. The incident was rated at level 2 on the INES scale.

The analysis of this incident by EDF and the inspection carried out by the ASN enabled identification of several malfunctions as regards organisation and control of the refuelling operations concerned and ergonomic inadequacies in the fuel handling equipment.

The studies required from EDF by the ASN showed that errors of this type could trigger initiation of a nuclear reaction in a 900 MWe reactor series vessel. These studies also showed that existing instrumentation was ill-adapted to prevention of criticality hazards during refuelling. The inadequacies with respect to the prevention of the criticality risk concerned the entire nuclear plant population.

In 2001, EDF took immediate corrective measures to ensure organisational improvements and better supervision of refuelling operations, together with operator training with respect to criticality hazards in the framework of operating activities and implementation of new fuel management systems.



Spend fuel pool at the Saint-Laurent nuclear power plant

At the request of the ASN, EDF at the same time undertook a generic criticality risk reassessment for the different fuel management systems currently planned. This survey also deals with improvement of the ergonomics of fuel handling equipment, the increase in criticality margins and reinforcement of detection and reactor control equipment in the event of a criticality accident.

In 2003, throughout the nuclear plant population, EDF implemented specific operating procedures (RPC) which specify the operating principles and associated constraints to be taken into account during refuelling operations. The increase in criticality margin is thus obtained throughout the nuclear plant population by general use in the RPCs of a reloading system less sensitive to errors and by increasing the reactor cavity boron concentration indicated in the 900 MWe reactor series technical operating specifications.

In addition, since 2002, EDF has been running a study programme aimed at the durability and clarification of the reference requirements provided to ensure the safety of fuel handling operations. These studies mainly consist in identification of anomalies due to handling activities which could lead to incident and accident situations and in rendering improbable a criticality accident by provision of independent and reliable lines of defence.

EDF has at the same time undertaken studies to develop additional appropriate detection resources for the prevention of criticality hazards, together with additional provisions to bring under control a postulated criticality situation during refuelling.

At the end of this study programme, scheduled for 2004, the ASN will issue its opinion on the reliability and exhaustiveness of the studies and the means deployed to prevent criticality hazard during refuelling fuel handling operations.

Since 2002, fuel handling has been an inspection priority for the ASN.

4 | 3

General operating rules (RGE) and reactor operation

4 | 3 | 1

RGE changes

a) Technical operating specifications (STE)

In 2003, the DGSNR examined and approved STE PTD EC 98 and PTD VD2 2002 applicable to the reactors of the 1450 MWe and 900 MWe CP0 plant series respectively. Furthermore, with regard to the 900 MWe CPY plant series reactors, the DGSNR approved an STE amendment for the PTD batch 93-2000. This was in order to take account of STE changes resulting from operating feedback from the CPY type reactors. Similar changes to the STE applicable to the 1300 MWe series reactors were examined by the DGSNR. This examination led it to issue a number of requirements prior to implementation on the sites of these STE amendments.

b) Waivers with respect to STEs

When an operator considers 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 Nuclear Safety Authority for a waiver, on a case by case basis. The Nuclear Safety Authority examines the request and decides whether it is acceptable, imposing compensatory measures for non-compliance with STE requirements whenever appropriate.

However, the DGSNR attaches importance to the precedence of the STEs and remains vigilant regarding limitation of the number of waivers. To this end, the Nuclear Safety Authority has, since 1993, undertaken continuous action aimed at obtaining from EDF:
- a review of the grounds on which the waiver application is submitted in order to identify those which justify STE adaptations,
- anticipation by head office departments of the site's needs, notably those related to nationally imposed modifications and to periodic testing.

The number of waivers examined in 2003 was 75, as against 100 in 2002.

The two most frequent reasons for waiver requests in 2003 were:
- unavailability of the auxiliary offsite power source, due notably to maintenance work on the 400 kV and 225 kV metal-clad substation housings;
- unavailability of the power measurement neutron system, during periodic recording of the saturation curve (counting rate dependent on the high voltage applied to the detector).

c) Periodic tests

In 2003, the ASN continued to examine the RGE periodic test programmes. This mainly involved:
- examination of the "PTD batch 93-2000" periodic test programmes for the reactors of the CPY series;
- approval of the "PTD EC 98" periodic test programmes for the 1450 MWe reactors.

Furthermore, following a metrology inspection of EDF head office departments, the ASN recalled that it is necessary to take account of measuring uncertainties when drafting periodic test rules and asked EDF to propose a schedule for revising the test rules, taking this problem into account.

4 | 3 | 2

Incident and accident operation

a) State-oriented approach (APE)

Changes in incident and accident operation principles

Until 1989, reactor operating procedures for incident and accident situations were based on an event-oriented approach, which consisted in pre-defining, on the basis of conventionally selected initiating events, the operating actions required to maintain safety functions (sub-criticality, cooling, containment). Starting from a single initial diagnosis, the operators thus implement a corresponding predetermined operating strategy.

The Three Mile Island (TMI) accident on 29 March 1979 revealed the limits of this approach. The event-oriented procedures proved unable to manage situations involving combinations of human or equipment failures in addition to the initiating event. EDF consequently decided to gradually replace the event-oriented approach by the new state-oriented approach (APE) whereby plant operation is adapted to actual NSSS condition, as defined on the basis of six reactor state parameters, which cover the three safety functions men-

Control room

tioned above. The objective of the APE operating procedures is then to restore the degraded function or functions by following an action plan defining priorities.

Implementation of APE procedures on the French nuclear power plant population

Implementation of APE procedures on French plants is not yet entirely completed.

In 1989, the ASN authorised APE operation for the 1300 MWe/P'4 series of reactors, subsequently extended in 1996 to cover the 1300 MWe/P4 series, followed by the N4 reactor series as of initial start-up. In 2001, the ASN approved a further development of the APE procedures for the 1300 MWe reactor series. It is known as "stabilised" APE, adopted in 2001 and 2002 at the Paluel, Cattenom, Nogent, Penly and Belleville sites.

In 1998, the ASN authorised adoption of the APE procedures for the CPY series of reactors. The first application of these procedures to this series, on the Tricastin 1 and 2 reactors, was subject to prior authorisation, in view of the issues at stake. During the course of 2000, only Tricastin 3 and 4 were authorised to switch to APE operation as the problems encountered with simplifying measurement of the vessel water level and the saturation temperature margin of the primary system water under accident conditions (see below) delayed the transition to APE operation on the other reactors of the CPY type. Inspections carried out by the ASN in 2001 on the Tricastin, Cruas and Dampierre sites, concerning the ability of the staff to implement this type of operation in an accident situation, demonstrated that the problems encountered in handling this instrumentation had been overcome. In 2003, APE procedures had been extended to all the CPY series reactors, apart from Saint-Laurent 1 and 2, where APE procedures will be adopted during 2004.

As regards the 900 MWe/CP0 series, the ASN in 1999 and 2000 authorised adoption of the APE procedures for the Fessenheim and Bugey reactors. In 2003, the DGSNR examined and approved the incident and accident situation operating rules for these 2 sites, with the technical and documentary state associated with the second ten-yearly outage (referred to as PTD VD2 CP0).

Measurement of the vessel water level and the saturation margin

In the initial PWR design, assessment of the primary system water content was based on a water level indicator in the pressuriser. The TMI accident proved this indicator to be an inadequate means of monitoring certain incident or accident situations. It was thus considered necessary, in the context of APE operating procedures, to provide the operator with vessel water level indications, supplied by an appropriate device. Similarly, and in order to ensure satisfactory cooling of the fuel rods by the primary system in an accident situation, it is important for the operator to be aware of the difference between the temperature of the water in the primary system and the temperature leading to boiling (saturation temperature). The instrumentation comprises a water temperature measurement which is compared with the primary system saturation temperature, which is solely pressure-dependent.

Difficulties on the sites related to the complexity of the periodic tests led EDF to implement the following two procedures:
- an industrialisation procedure, consisting in simplifying the periodic tests for the device. EDF had to check that the reduced functional precision requirements for the device were compatible with safe reactor operation in incident or accident situations,
- an appropriation procedure, aimed at ensuring complete control of the periodic tests both by EDF staff when they perform the work and the specialists concerned from service companies.

The difficulties encountered on the 900 MWe reactor series with regard to the vessel water level measurement precision were overcome in 2001 and 2002, by better appropriation of the periodic tests and requalification of this instrumentation by EDF staff.

As regards the saturation margin, in 2001, the ASN requested EDF to justify the greater release levels which could result from test simplification in the event of a steam generator tube double-ended break. EDF demonstrated that the theoretical liquid release increase is not due to periodic test industrialisation but to the new calculation methodology for uncertainties and to more conservative postulates, leading to acceptance of the new test methodology.

b) 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, the reactor is said to be entering a severe accident situation.

In this eventuality, albeit highly unlikely, various steps are taken to enable the operators – supported by the crisis management teams – to operate the reactor in order to control the various reactor safety functions, in particular containment of radioactive materials, and to minimise the consequences of the accident.

Severe accidents not taken into account at the initial PWR design stage are associated with no regulatory schedule such as safety reviews. Assessment of these accidents and appraisal of the level of requirements necessary for currently operating reactors are based on no clearly defined reference system. In view of available knowledge in this respect at the present time, the ASN considers that such a reference system should now be defined. It should define the approach and objectives regarding prevention and mitigation of the risks associated with severe accidents, the studies required to demonstrate compliance with the defined objectives and the practical provisions adopted and their design basis.

In 2002, EDF forwarded to the ASN a draft “severe accident” reference requirements. This draft is currently being examined and will be submitted to the Expert group for Nuclear Reactors in 2004.

4 | 3 | 3

Primary system vacuumisation

During reactor restart stages, filling the primary system with borated water entails thorough degassing of all piping. A first method used, known as “dynamic venting”, consists in circulating the fluid in order to remove any remaining air pockets, thus enabling thorough venting of the system.

RRA pump on the N4 plant series

One of the main drawbacks of this method lies in the considerable loads generated by repeated startups of the primary pump.

One of the techniques used to limit the number of these dynamic venting processes consists in filling the primary system under a pressure of about 200 mbar abs. Apart from lessening the mechanical load involved, this primary system venting process has the added advantage of requiring less time for system filling, thereby improving reactor availability and reducing the overall dose rate received by maintenance staff.

However, this operation requires that the primary system water level be lowered to mid-loop operation level, which is the minimum primary system water level compatible with core cooling by the RRA system (residual heat removal system). These conditions raise specific cavitation risks, notably with regard to the RRA system flow control valves. Cavitation induces harmful vibrations, which can cause cracking in certain sensitive nozzles and can even, in certain cases, damage the RRA pumps.

This is in fact the phenomenon which gave rise to two incidents at the Dampierre 4 reactor in October 1999, which resulted in an ASN decision to prohibit vacuumisation of the 900 MWe reactor primary systems, despite the fact that this practice had been in general use on these reactors since 1987. In 2002, the ASN authorised resumption of vacuumisation operations on the CPY series reactors, on the basis of control procedures defined to minimise the risk of cavitation and piping vibrations. As regards the CP0 series, more sensitive to vibration problems, an additional test was required for each of the six reactors, in order to clarify the level of risk associated with this operation. During the course of 2003, four reactors were tested. In October, the ASN approved resumption of vacuumisation operations for two of them. For the others, this authorisation is dependent on incorporation of a modification designed to strengthen piping resistance to vibration fatigue.

The design of the 1300 MWe reactors does not allow primary system vacuumisation. To date, only one reactor on the Cattenom site has been equipped with a device to allow experimental vacuumisation. In September 2003, EDF notified the ASN of its intention to incorporate this device on all reactors of this plant series and to make vacuumisation at restart general practice. EDF therefore scheduled various tests designed to demonstrate the harmlessness of this operation and to ensure that the device was reliable before it was put into general use. The ASN gave authorisation for testing on the Cattenom site in October. The results of this test are being analysed.

For the N4 reactor series, primary system vacuumisation was designed-in and authorised from the outset. However, discovery of cracking in the RRA system piping in the Civaux 1 reactor in 1998 led the ASN to prohibit the lowering of the primary system water level to mid-loop operation level, thus preventing vacuumisation. In 2003, the ASN authorised EDF to carry out four tests of transition to mid-loop operation level, associated with vacuumisation of the primary system. The results of these tests are currently being examined by the ASN, with a view to reaching a decision regarding EDF's request that the ban on transition to mid-loop operation be lifted.

4 | 4

Incidents

4 | 4 | 1

Summary of incidents in 2003

2003 saw the consolidation of new rules, initiated in 2002, aimed at introducing follow-up on deviations related to radiation protection and environmental releases, in addition to provisions for dealing with safety significant incidents:
– in order to comply with the requirements of the ministerial order of 31 December 1999, EDF supplemented its incident reporting system to integrate "environment" incidents not reported in another context (for example: overstepping of release temperature limits, release of non-radioactive products),

- in accordance with the DGSNR request of 17 June 2002, EDF has since this date applied the criteria defined by the ASN for the reporting of radiation protection incidents.
- a summary produced with the operator during the first half of 2003 led to slight modification of the declaration criteria as of January 2004.

In application of these rules, EDF in 2003 reported 671 significant events rated on the INES scale, of which 503 concerned safety, 166 radiation protection and 2 release into the environment.

The release events, when they do not compromise safety and are not a nuclear risk, are not rated on the INES scale. 58 environmental protection events were declared (including 2 rated at level 0 on the INES scale), which is a significant rise in relation to 2002. 14 events concerned releases of chlorofluorocarbons (CFC) into the atmosphere, significantly up on 2002, 17 events concerned release temperature overshoots, most of which were linked to the summer heatwave.

Application over a complete year of the radiation protection incident declaration criteria led to a rise in the number of these declarations: 166 radiation protection incidents declared in 2003. In 2002, following implementation in July of the radiation protection declaration criteria, 96 radiation protection incidents were declared.

On 10 September 2003, the Bugey site declared a significant rise in the number of contamination detections by site exit gate C3, all of which were attributable to the outage work on reactor 2. Of the 16 detections by the C3 gate, the site identified 12 external body or clothing contaminations and 4 internal contaminations, 2 of which required medical follow-up. The incident, rated 0 on the INES scale, gave rise to an extensive analysis of the deviations from safety and radiation protection rules and to appropriate corrective action.

Furthermore, at the end of December 2003, the Nuclear Safety Authority rated at level 2 an anomaly concerning the reactor water recirculation circuits in the event of an accident situation (see § 3|9|6).

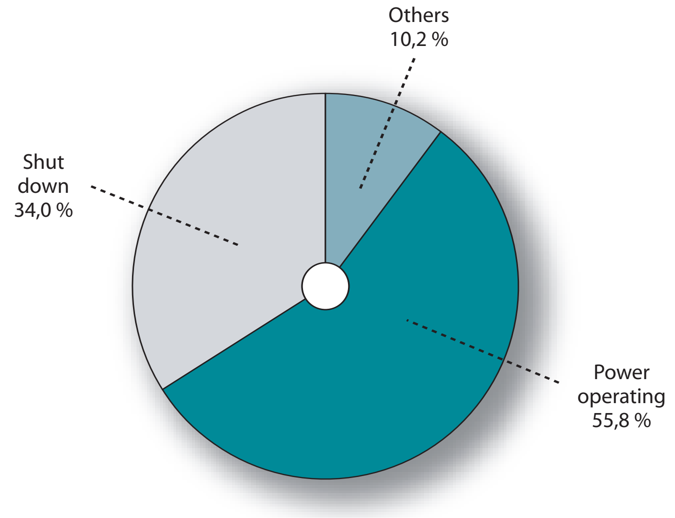
4 | 4 | 2

Statistical analysis of the incidents in 2003

The analysis was carried out from 1 December 2002 to 30 November 2003.

a) Breakdown of incidents on EDF reactors in 2003 according to the reactor state at the time

a – Breakdown of incidents on EDF reactors in 2003, according to the reactor state



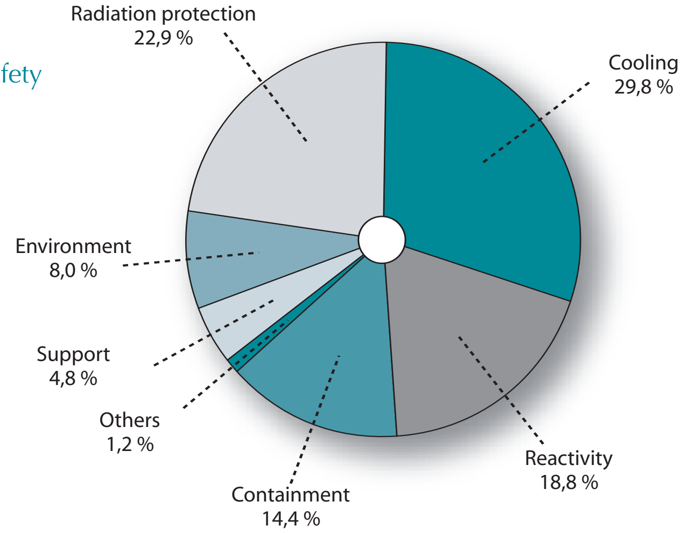
The diagram above shows that the number of incidents which occurred while the reactor was running is higher than that with the reactor shut down. The percentage of incidents with reactor running has risen with respect to 2002. This not very significant result over one year will have to be analysed in the light of progress made on the EDF "refuelling only" outage strategy.

The occurrence of certain incidents is independent of the reactor state at the time. These are grouped under the heading "Others". These are, for example, incidents related to contamination detected on the site exit gates or non-compliance with ministerial orders authorising effluent release.

b) Breakdown of incidents on EDF reactors in 2003 according to the safety function affected

Reactor safety is based on three safety functions: reactivity control, containment of radioactive substances and reactor cooling. The illustration below shows a breakdown of incidents according to the safety function affected. Certain incidents do not directly concern one of the three safety functions, but affect support systems, such as electrical power supplies or anchoring devices: they are included under the heading "support functions". In addition, this diagram shows the percentage of incidents related to radiation and environmental protection, respectively 22.9% and 8% of the incidents in 2003, up in relation to 2002.

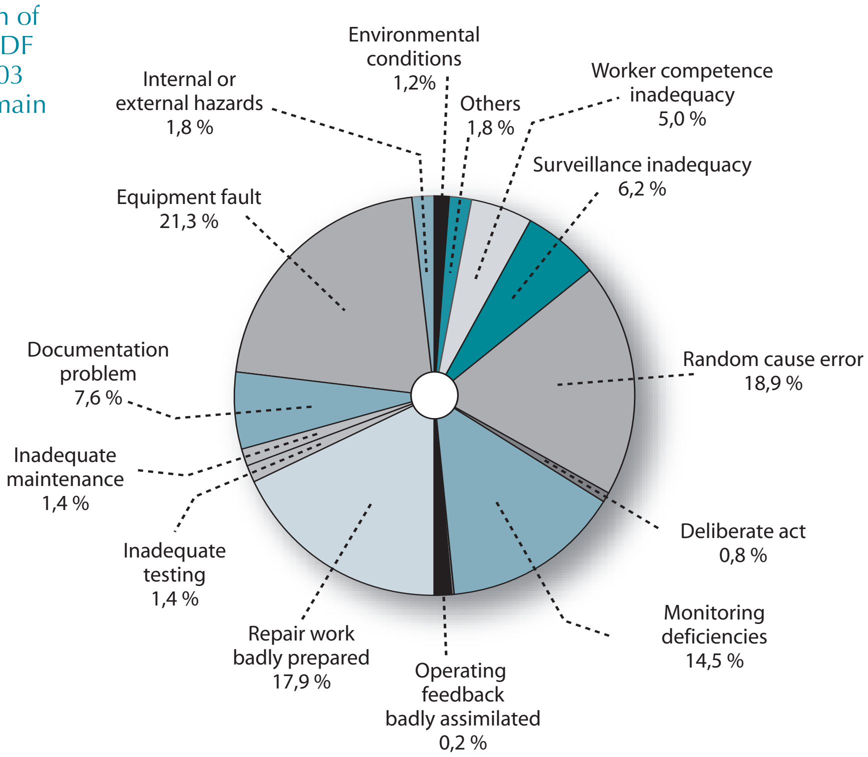
b – Breakdown of incidents on EDF reactors in 2003 according to the safety function affected



c) Breakdown of incidents on EDF reactors in 2003 according to main origin

The breakdown of incidents according to origin is appreciably the same as in previous years. A little less than a quarter of the incidents are due to equipment faults and about 60% are related to organisational and human causes.

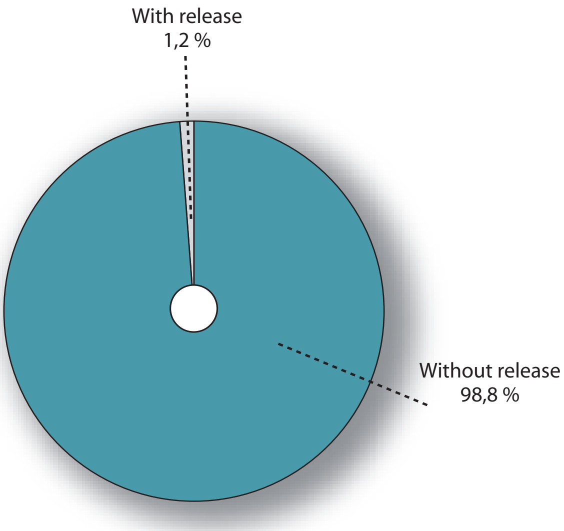
c – Breakdown of incidents on EDF reactors in 2003 according to main origin



d) Breakdown of incidents on EDF reactors in 2003 according to resulting accidental release

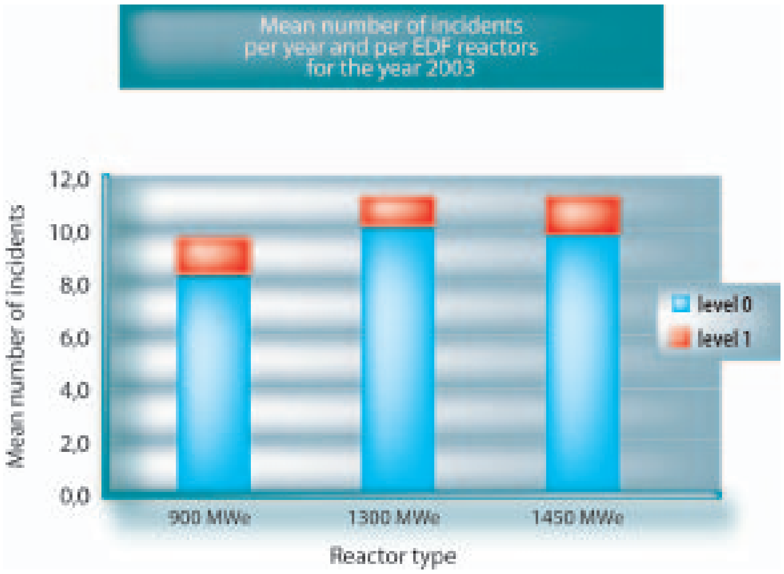
The number of incidents involving accidental release fell slightly from 1.8% in 2002 to 1.2% in 2003.

d – Breakdown of incidents on EDF reactors in 2003 according to resulting accidental release



4 | 4 | 3

Classification of incidents on the INES scale



In 2003, the proportion of incidents rated at level 1 on the INES scale is about 15%, or 104 incidents. One incident was rated at level 2.

5 RADIATION PROTECTION AND ENVIRONMENTAL PROTECTION

5 | 1

Radiological protection for nuclear power plant workers

In a nuclear power plant, ionising radiation sources have various origins:
- the fuel itself, especially spent fuel,
- equipment activated by the neutron flux, especially components close to the reactor core, such as the vessel and its closure head,
- particles resulting from reactor primary system corrosion and conveyed by the primary fluid. These particles become radioactive when they pass through the reactor core. They can then settle on systems conveying the primary fluid.

For this reason, during reactor operation and maintenance processes (fuel handling, equipment inspections or repairs, system alignment, waste management) workers involved can be exposed to ionising radiation.

A person's exposure level is quantified by a dose equivalent, expressed in sieverts (Sv). The sum of the individual dose equivalents, known as collective dose and expressed in man.sieverts, is used as an indicator of the dose level received by all workers.

In 2003, regarding worker protection, the transposition into French law of European directive 96/29/Euratom led to the publication of decree 2003-296 of 31 March 2003. This decree in particular specifies a reduction in the annual external and internal exposure limits from 50 to 20 mSv. For a period of two years from the date this decree comes into force, this limit is set at 35 mSv.

Furthermore, under application of the regulations concerning protection against ionising radiation, exposure of individuals must be kept at as low a level as is reasonably achievable, given current technology and economic and social factors. For this reason, EDF takes precautions in this respect, for its own and outside workers. The bar charts below give an indication of the results of this policy (known as "ALARA"). It results in a regular lowering of both individual and collective dose rates.

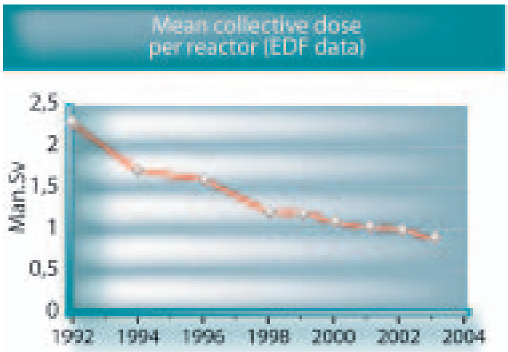
These results come at a time when EDF has initiated proactive steps in particular to increase the starting of the teams in charge of radiation protection, in dose forecasting and analysis of practices and in monitoring of persons and installations. In these areas, progress is not yet always visible.

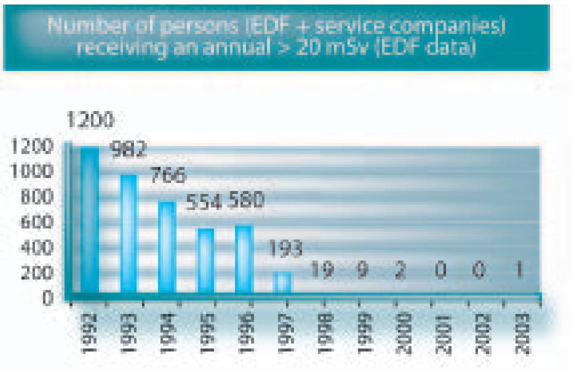
The ASN is responsible for supervising application of the regulations regarding protection of individuals against ionising radiation. Management of radiation protection and application of the ALARA approach at EDF were therefore the subject of priority inspection in 2003, both on site and in the head office departments.

Furthermore, the Expert group for Nuclear Reactors held a session in 2003 covering EDF methods to ensure radiation protection on the sites. The main lessons learned from the period 1999-2002 are that EDF has taken wide-ranging steps to bring radiation protection up to the same level as safety. At the same time, dose results improved with respect to both individual and collective doses. EDF will have to continue its efforts to ensure that national radiation protection doctrine is better implemented in the power plants.

In 2003, the ASN continued to of check EDF's inclusion of radiation protection provisions in maintenance work, within the framework of application of the ministerial order of 10 November 1999, which requires that the operator report on the dosimetric impact of the maintenance operations it intends to carry out.

In this context, the EDF head office departments or the sites draw up dosimetry targets for performance of certain operations. If, when preparing such an operation on a given reactor, the results of the dosimetric forecast diverge significantly from the corresponding target, the ASN requests additional explanations concerning the extent to which the ALARA approach was adopted for this operation. Then, as applicable, analysis of these explanations may have to precede effective implementation on the site.


Mean collective dose per reactor (EDF data)


Number of persons (EDF + service companies) receiving an annual > 20 mSv (EDF data)

EDF also intends to reinforce its own provisions by defining at the design stage of these maintenance operations dosimetry reduction and risk prevention procedures tailored to the operating conditions concerned. In the event of divergence, the ASN is informed of the operator's remedial action.

Between 1 July 2002 and 1 July 2003, 166 radiation protection related incidents were identified. These declarations were primarily made for incidents connected with incorrect signalling in controlled zones and failure to abide by the technical conditions for access to the zones.

Following the experience feedback thus acquired, the ASN modified the definition of event declaration criteria and introduced a new criterion concerning radiological cleanness. These criteria, which are common to all operators, enable the ASN to be better informed of the abnormal situations encountered on the nuclear reactors in this field, with adaptation of supervisory actions if necessary.

In addition, in response to a general request submitted by the ASN, EDF improved its procedures for access to red zones and is examining installation of automatic locking systems for access to the reactor pit (experience feedback from the irradiation incident in Tricastin, in March 1999, and that of Cruas, with less serious consequences, on 15 October 2001).

5 | 2

Containment of radioactive materials and radiological cleanness

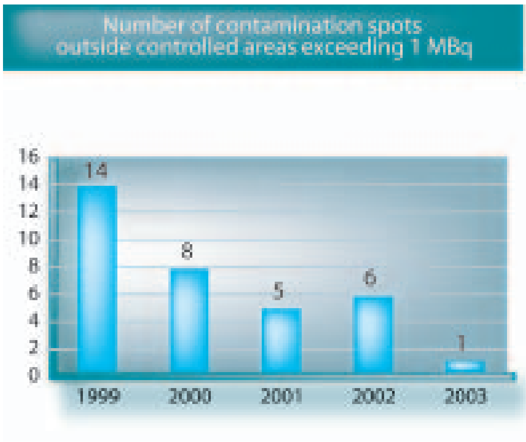
Radioactive corrosion products are present on systems conveying the primary fluid. In the course of maintenance operations on these systems (especially during refuelling outages), there is a risk of dispersion of the contamination in the immediate vicinity of the work site. This dispersion must consequently be controlled in order to prevent contamination of the rooms concerned, or even of workers and their equipment, with the risk of personnel and equipment movements spreading this contamination outside the controlled zone or even outside the site.

Since a number of cases of contamination dispersion have been detected in recent years, particularly in 1998, with the discovery of the spent fuel package contamination problem, EDF decided to implement a radiological cleanness action plan for both installations and people. This action plan, developed by the head office departments, initially specified reinforcement of the effectiveness of the main lines of defence, in particular by supplementing the staff contamination checks on leaving controlled areas (C1 and C2 check gates) with site exit check gates (C3) installed at all plants since 2001, and then adoption of a more comprehensive approach aimed at promoting practices guaranteeing the non-dispersal of radioactive materials.

In 2003, EDF continued implementing an action plan aimed at:
- reinforcing the measures (organisational, technical, etc.) with a view to limiting the dispersion of radioactive contamination to the immediate vicinity of the source and improving the level of cleanness in the controlled zone;
- reinforcing control of dissemination outside the controlled zone (changes to cloakrooms, improved detection, and so on).

These actions gave rise to the drafting of reference systems recalling the regulatory requirements and EDF internal requirements. Other actions such as drafting of guides of good practice (for example: guide for the use of personal protection equipment, equipment operating procedures, code of good practices on certain maintenance work sites, etc) were taken.

In 2003, an inspection of the Nuclear Production Division concerned EDF's radiological cleanness project. This followed on from that already carried out in 2002, which led to a number of comments by the ASN, in particular with regard to project management. This inspection revealed that these comments had been well taken into account by EDF and enabled the radiological cleanness indicators for all EDF nuclear power plants to be reviewed.



These indicators show a drop in the number of contamination hot spots outside the controlled zone: only one spot higher than 1 MBq was detected in 2003 and was declared as a significant event. As regards clothing contamination of more than 1 MBq, relative stagnation of the results is observed.

5 | 3

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 (see § 5|4) or the operating licences for installations classified on environmental protection grounds located on plant sites.

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

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, in the event of proven difficulties, article 48 of the order of 31 December 1999 provides for extra time allowances, without however exceeding 15 February 2006.

On several points, notably due to technical and economic difficulties, EDF was unable to comply with all the requirements of the order of 15 February 2002. However, the operator has provided a compliancy progress review for its installations, together with an assessment of the work to be carried out and a tentative schedule. These documents are being analysed by the Nuclear Safety Authority and for each site the Director General for Nuclear Safety and Radiation Protection set a schedule for conformity of those installations for which the analysis is completed.

5 | 3 | 1

Prevention of water pollution

EDF has developed specific studies on several technical subjects aimed at preventing accidental water pollution by products dangerous for the environment or by fire-fighting water. Extensive work is scheduled to ensure compliance in this respect, notably with regard to water retention structures and product unloading areas.

The sump and drain channels of the nuclear auxiliary buildings and effluent treatment buildings conveying radioactive fluids show tightness defects. In decisions of 20 December 2002 and of 27 June 2003, the DGSNR required that the CPY series nuclear power plant sumps be brought into compliance with the order before 15 February 2005, and that the drain channels of the CPY series nuclear power plants and the drain channels and sumps of the 1300 MWe and N4 series conform to article 17 of the order of 31 December 1999 by 15 February 2006.

For radioactive effluent storage tanks, EDF also asked for a waiver to article 14 of the order, asking that the calculations for a retention volume containing several tanks only take account of the largest of these tanks, as the order also requires that half the total volume of the tanks in the common retention capacity should be retained by it. This waiver was not granted by the DGSNR and the additional proposals submitted by EDF are currently being examined by the ASN.

Finally, and depending on risk analysis results, the ministerial order also requires the construction of retention capacities in zones considered particularly prone to pollution problems. At the ASN's request, and for each site, EDF produces studies presenting the technical and economic feasibility of such structures. These studies are currently being analysed by the Nuclear Safety Authority.

5 | 3 | 2

Lightning

In a decision dated 15 October 2002, the DGSNR asked EDF that the "lightning" protection studies, which determine compliance with the ministerial order of 31 December 1999, be sent to the ASN before 31 December 2003, and that the conformity work be performed by 31 December 2004 for all the nuclear reactors.

The "lightning" studies were indeed transmitted by 31 December 2003. They show that very few sites are not in conformity with the regulations and these nonconformities are currently being analysed by the ASN.

5 | 3 | 3

Noise

Article 48.II.2 of the ministerial order of 31 December 1999 requires, for 15 February 2004, a verification of compliance with prescribed limits together with a spectral analysis aimed at characterising noise with a specific tonality. EDF has complied with these requirements for all sites and sent the results to the Nuclear Safety Authority in the first half of 2003. In order to obtain data to validate the emergence values obtained by EDF, the DGSNR asked an outside contractor to conduct a series of measurements in the regulated emergence zones around the Golfech plant. The conclusions showed that EDF's emergence values encompassed those obtained by the outside contractor.

Some sites do not comply with the maximum emergence values specified by the orders. These deviations are primarily due to the air coolers and turbine buildings. EDF will in 2004 transmit a technical-economic study of the means to bring nonconforming sites into conformity. According to EDF's analysis, these sites are Belleville, Le Bugey, Chinon, Civaux, Dampierre, Golfech, Nogent, Penly and Saint-Laurent.

5 | 4

Release

5|4|1

Release licence revision

Under application of decree 95-540 of 4 May 1995 concerning gaseous and liquid effluent release and water intake by basic nuclear installations, the ASN continued in 2003 its examination of the applications for renewal of the water intake and non-radioactive liquid effluent release licences for EDF power plants. These licences, issued at prefect level under the previous regulations in this respect, comprise a stipulated validity time limit. At the request of the DGSNR, the dossiers presented by EDF now cover water intake and all radioactive and non-radioactive liquid and gaseous release. Their examination gives rise to public inquiries.

The renewals currently being examined were presented by EDF as soon as the previous licences reached their expiration dates. For the other nuclear power plants, intake and release licence expiration dates extend until 2021. So the Nuclear Safety Authority opted for their early renewal with a view to standardising requirements for the different sites. The ASN objective is that most of the existing authorisations be revised during the next few years. In particular, for sites where the authorisation deadline was imminent, the ASN fixed deadlines for the deposit of operator application dossiers by a decision of 4 July 2001. This concerns the Le Blayais, Cattenom and Nogent sites. With regard to the other nuclear power plants, Electricité de France undertook to provide all dossiers involved by 31 December 2006.

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 release concerned. These requirements notably specify the quantities, concentrations and surveillance provisions for pollutants liable to be contained in release into the environment. In this context, the ASN decided to modify the terms and conditions regulating release according to the following principles:
- are included in the authorisation orders the new requirements defined in the ministerial order of 26 November 1999 (see Chapter 3 § 2|2|1), notably with regard to the specification of radioactive release limits in terms of emission rates (expressed in becquerels per second), for each release point,
- with regard to radioactive release, since the actual release from nuclear power plants diminishes regularly and is well below current limit values, the ASN intends to reduce these limit values. It has stipulated new limit values, for each 900 and 1300 MWe series, based on operating feedback concerning real release, whilst taking into account various fluctuations due to normal reactor operation. The release limits have thus been divided by a factor varying from 2 to nearly 40, depending on parameters. Moreover, individual limits are now set for the iodines and carbon 14;
- with regard to non-radioactive substances, the ASN decided to better regulate releases, in order to correct shortcomings in prior prescribed requirements.

The latter two principles were applied for the first time when the water intake and effluent release licence for the Saint-Laurent-des-Eaux nuclear power plant was renewed in 1999. They were also applied to Flamanville, Paluel, Belleville and Saint-Alban in 2000. In addition, the stipulations of the order of 26 November 1999 now apply to the Chinon and Le Blayais sites, for which the orders were renewed in 2003.

Assessment of cumulated impacts

In order to better respond to concerns of the national authorities and the general public, EDF must continue and refine the studies undertaken concerning cumulated release impacts (radioactive, chemical, thermal) on rivers receiving release from several nuclear power plants in order to be in a position to assess the consequences. Initiated in 2000, these studies concerning the hydrographic basins of the Loire (five nuclear power plants) and of the Rhone (five nuclear power plants together with other fuel cycle installations) continued in 2003. For the Loire valley, these studies are completed. Their results will be presented to the river authority in 2004. For the Rhone, the studies are still in progress.

Rainwater sampling

The orders for Cruas and Gravelines were signed on 7 November 2003.

In 2003, examination of the Cattenom plant file continued with the public inquiry phase. Examination of the Nogent plant file also started.

5 | 4 | 2

Specific release problems at certain sites

Power plants with cooling systems now equipped with stainless steel condensers, replacing the brass condensers initially installed, are currently confronted with an amoebae proliferation phenomenon, in some cases pathogenic. Six plants are currently concerned: Chooz, Civaux, Dampierre, Golfech, Nogent and Bugey.

Except for Civaux which deals with amoebae using ultraviolet radiation, the other five sites use monochloramine treatment.

Since 2000 for the Dampierre plant and 2001 for the other sites using monochloramine treatment, releases related to this treatment must comply with conditions stipulated in ministerial orders signed by the Ministers for Health, the Environment and Industry. However, the environmental follow-up procedures evidenced the presence in the release of nitrogen-containing compounds, nitrates and nitrites, not covered by the licences. EDF thus in 2002 submitted order modification dossiers.

In 2003, the Administration accepted the dossiers submitted by Bugey, Chooz, Dampierre, Golfech and Nogent-sur-Seine. Public enquiries were also held in 2003.

For Civaux, in view of the sensitivity of the receiving medium (the Vienne), the DGSNR objected to chemical treatment. During the summer of 1999, EDF then installed an experimental treatment system using ultraviolet rays.

It has also been demonstrated that cooling systems create media favouring the development of legionnaire's disease bacteria, due to the water temperature involved. The systems for which the water is cooled by direct contact with the air, as is the case for nuclear reactor air cooler systems, could consequently present a risk of atmospheric dissemination of these bacteria. EDF made an inventory of the systems liable to be concerned as well as work situations and air inlets in aerosol release zones which could be hazardous. EDF also undertook studies and measurements to characterise the risk presented by these bacteria in the systems. This work is regularly presented to the health authorities (DGS/CSHPF) and to the DGSNR.

In the metals release field, non-compliance with several requirements of the order of 8 August 2000 concerning water intake and effluent release was evidenced on the Belleville site during its first year of implementation. Further to formal notice from the Nuclear Safety Authority on 21 December 2001, the operator in July 2002 filed a request for modification of the order in question.

In the light of the deficiencies of the dossier presented, the Director General for Nuclear Safety and Radiation Protection, by a decision of 16 September 2002, allowed the operator two months to supplement the dossier in question and initiate a study programme aimed at seeking solutions other than those in the dossier presented and more particularly those avoiding copper and zinc release.

In 2003, the dossier was felt to be acceptable by the Administration.

Further to an unannounced inspection on the topic “releases and water intake” the Nuclear Safety Authority inspectors noted that certain provisions of the release order of 2 February 1999 authorising Electricité de France to continue to take water and release liquid and gaseous effluent for operation of the Saint-Laurent-des-Eaux NPP site were not followed. The discrepancies lay in failure to abide by the liquid effluent sodium, sulphates, total phosphorus and chlorides concentration values prior to release. Consequently, the ASN gave the operator two months formal notice to comply with the release limit values set for the parameters in question or, failing which, to submit a duly justified request for modification of the release authorisation, in particular with regard to the environmental impact.

The thermal releases related to the summer 2003 heatwave are presented in § 3|12|3 of this chapter (extreme weather conditions).

5 | 4 | 3

Radioactive release values

Every month the operator communicates its release 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.

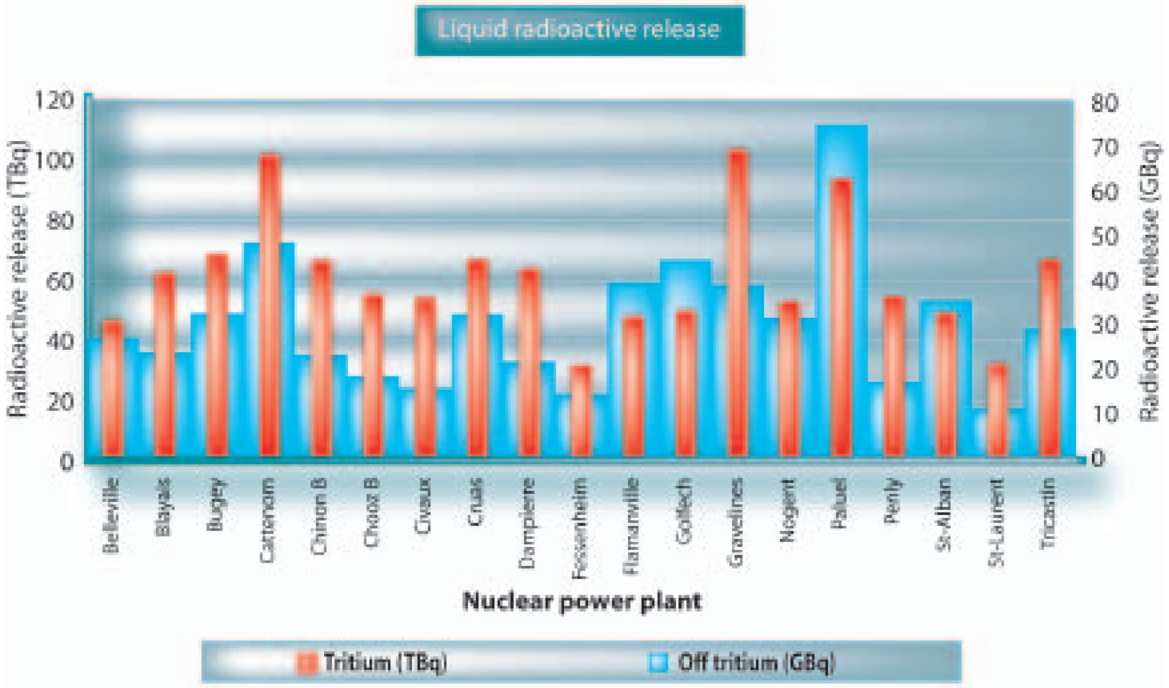
The 2003 results are presented in the following graphs. The “Liquid radioactive release” graph presents the 2003 liquid releases of tritium and liquid releases other than tritium (carbon 14, iodine 131, nickel 63 and other beta and gamma emitting radionuclides). The “Gaseous radioactive release” graph presents the 2003 releases of gases (carbon 14, tritium and rare gases) and halogens and aerosols (iodines and other beta and gamma emitting radionuclides).

The calculated radiological impact of the releases at the values required by EDF’s release and water intake licence dossiers on the most exposed reference group remains well below the allowable limits.

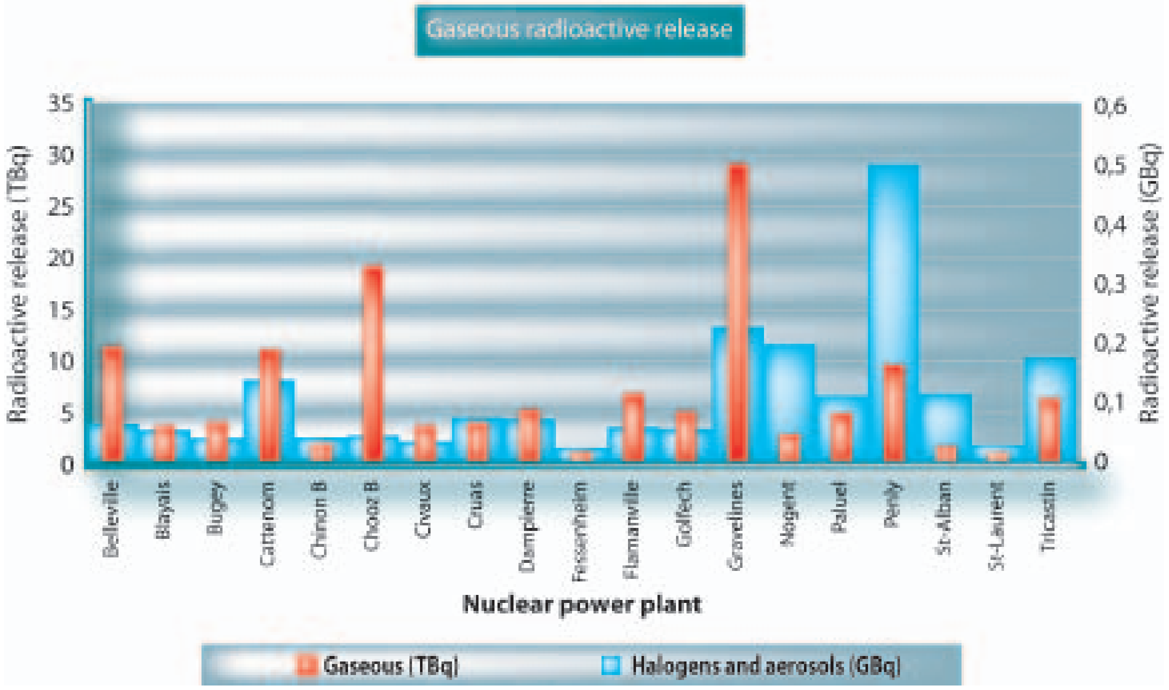
The effective annual dose delivered to the reference group mentioned in EDF’s release and water intake licensing applications is estimated at between a few microsieverts and a few tens of microsieverts per year.

For example, the effective annual dose corresponding to the values required by the release and water intake licensing dossier for the Paluel nuclear power plant is evaluated at 93 µSv/year. The dose corresponding to the actual 2003 releases from the Paluel site was estimated by EDF at 4.4 µSv.

Source : registres réglementaires



Source : registres réglementaires



5 | 5

Waste

On 10 November 2000, the ASN took a decision aimed at improving the storage conditions for nuclear power plant very low level waste (VLL, see chapter 15, § 1|1). Difficulties with the disposal channels had led to a build-up of certain types of waste on the sites. This decision imposed notably that, within a period of two years, provisions should be made for the interim storage on the sites of VLL waste with high calorific portential in better adapted, long-term installations. Pending availability of these installations, limits were also imposed on the provisional utilisation of the former interim storage areas.

EDF, in accordance with ASN requirements, requested authorisation to modify the BNI boundaries of the Belleville, Cruas, Golfech, Gravelines and Tricastin sites in order to include adapted long-term VLL waste interim storage structures. Time requirements for the regulatory examination of the ensuing authorisation applications prior to start-up, entailing a public inquiry and concluding with the issue of a decree, led the ASN to postpone utilisation of these installations. In the meantime, the provisional technical operating specifications imposed by the decision of 10 November 2000 for the existing storage installations continue to apply.

The draft decrees designed to modify the BNI boundaries of the Belleville, Cruas, Golfech and Tricastin sites were presented on 20 November 2003 to the Interministerial Commission for Basic Nuclear Installations (CIINB, see chapter 2, § 2|2|2) which gave a favourable opinion.

The draft decree designed to modify the BNI boundary of the Gravelines site will be presented to the CIINB in 2004.

For the other nuclear power plants, the storage areas are today in use.

Finally, the DGSNR asked the Advisory Committees for Nuclear Reactors and for Waste to undertake an assessment of EDF management of the waste produced by its nuclear installations. This assessment notably concerned measures taken with a view to improving waste management, from production to final disposal.

The waste surveys (see Chapter 15, § 1|3) play an important part in the assessment requested from the Advisory Committees, initially scheduled for the end of 2000. These surveys were imposed under the interministerial order of 31 December 1999 concerning general environmental provisions and were made available for all EDF nuclear power plants before the due date of 15 February 2001.

In the light of a preliminary examination of these waste surveys, the DGSNR has specified for all nuclear operators the main principles to be taken into account.

Moreover, the elements supplied by EDF at the end of 2001 enabled the Advisory Committees during the second half of 2002 to issue their conclusions and recommendations, which were incorporated into requirements from the DGSNR. In particular the situation of certain site interim storage areas requires additional safety analyses (see chapter 15, § 2|1|3), a subject which is currently being examined at EDF.

6 REACTORS OF THE FUTURE

The EPR is an evolutionary PWR project developed jointly by French and German manufacturers and utilities (Framatome, Siemens, EDF and a group of German utilities). From the safety viewpoint, this project considerably strengthens defence in depth provisions as compared with current reactors.

Examination of the project's main safety options has been proceeding since 1993, through a Franco-German cooperation agreement. The successive recommendations from the French and German experts were jointly approved by the Nuclear Safety Authorities of both countries up until the end of 1998, after which they were approved by the French Nuclear Safety Authority.

The review process gave rise in October 1997 to transmission to the French and German Nuclear Safety Authorities of the first detailed preliminary design for the EPR nuclear island, the "Basic Design Report", taking into account prior recommendations. Further to a project optimisation stage, implemented in 1998 by the designers, an updated version of the Basic Design Report was transmitted in February 1999. The final version of the "Technical Guidelines", constituting the recommendations for the main safety options for the EPR project, was validated in October 2000 by the Advisory Committee for Nuclear Reactors, assisted by German experts.

In 2003, the utilities continued their reactor project engineering work, in particular concerning the design and manufacturing options for the primary system large components, the design of certain systems, the radiological consequences of accidents, probabilistic safety studies and the RCC-M construction code.

In July 2003, the Standing Nuclear Section of the Central Committee for Pressure Vessels examined the design and construction options for the vessel nozzle support ring, and the Advisory Committee for Nuclear Reactors, assisted by German experts, examined the design of the fuel storage pit cooling system, the list of transients, incidents and accidents utilised in the design and the programme for taking account of human factors.

Furthermore, under the terms of the contract signed between the Finnish operator TVO and the Franco-German consortium AREVA-Siemens for the supply of an EPR, the ASN and the Finnish nuclear safety authority organised a number of meetings to deal with the safety requirements of the new reactors.

7 SIGNIFICANT EVENTS ON EACH SITE

This table presents the most significant events over the year 2003 on each nuclear power plant. All incidents and generic anomalies can be consulted on the ASN web site (www.asn.gouv.fr) under the "Actualité" heading. Additional information is obtainable from the DRIREs concerned.

BLAYAIS

Site :

Closure of examination of the water intake and liquid and gaseous effluent release licence renewal, with signing of a new order on 18 September 2003 (see § 5| 4| 1).

Decision of 17 January 2003 concerning reactor shutdown procedures in the event of oil pollution of the Gironde estuary.

Construction of a new simulator for operating teams training (see § 4| 1| 1) and a new room to accommodate the crisis teams in the event of an accident.

Reactor 1:

Second ten-yearly outage in particular comprising introduction of a large number of modifications as a result of the periodic safety review and a containment leaktightness test and hydrotest requalification of the main primary system, during which a large primary/secondary leak was detected (see § 3| 4 and § 3| 6| 4).

Outage disrupted by union action with no impact on the safety of the installation.

Reactor 2:

Second ten-yearly outage in particular comprising introduction of a large number of modifications as a result of the periodic safety review and a containment leaktightness test and hydrotest requalification of the main primary system, during which a large primary/secondary leak was detected (see § 3| 4 and § 3| 6| 4).

Reactor 4:
Significant extension of the length of the maintenance and refuelling outage in the summer following destruction of the alternator exciter as a result of an electrical short-circuit.

BELLEVILLE

Site :
Continued examination of the request for modification of the NPP's water intake and release order (see § 5|4|2).
CIINB examination of the draft decree to modify the plant's BNI boundary (see § 5|5).
Construction of a third fish ladder to help the large migratory species (salmon, eels, etc.) ascend the river.
Decision to raise the dyke around the site to take account of re-evaluation of the maximum design flood level (see § 3|12|2).
Pooling and joint preparation of both reactor outages.

BUGEY

Site :
National emergency exercise on 23 October, in particular comprising a test of the automatic telephone system alerting the population within a 2 km radius (see chapter 7).
Continued examination of the release licence application linked to monochloramine treatment of amoebae in the tertiary cooling circuit (see § 5|4|2).

Reactors 2 and 3:
Problems with liquid release temperatures during the heatwave of summer 2003 (see § 3|12|3).

Reactor 5:
Testing of a new method to measure the effectiveness of the control rod assemblies and experimentation of a chemical process for hydrogen removal from the main primary system during a scheduled outage.

CATTENOM

Site :
Continued examination of the release and water intake licence renewal application, in particular with a public inquiry from 25 August to 15 October (see § 5|4|1).
Fire in the liquid waste release treatment building on 9 April.
Problems with liquid release temperatures during the summer 2003 heatwave (see § 3|12|3).

Reactor 4:
Ten-yearly outage, in particular comprising hydrotesting of the main primary system (see § 3|4 and 3|6|4).

CHINON

Site :
Closure of examination of liquid and gaseous release and water intake licence renewal, with signing of a new order on 20 May 2003 (see § 4|4|1).
National emergency exercise on 9 October (see chapter 7).
Conformity reworking of the PTR tanks with respect to their seismic resistance (see § 3|10|2).

Reactor B1:
Ten-yearly outage in particular comprising a main primary system test during which an unusual primary/secondary leak was detected at the test pressure (see § 3|4 and 3|6|4), which led the Administration to issue reserves when signing the requalification report.
Chemical washing of the steam generators (see § 3|6|5).
Series of incidents between 21 July and 10 November during the ten-yearly outage and reactor restart, resulting from operational slackness and shortcomings in the safety culture.

Reactor B2:
Unscheduled shutdown after explosion of the current transformer.
Traces of boron detected on a thermocouple penetration in the vessel closure head during the scheduled outage.

CHOOZ

Site :
National emergency exercise on 12 June (see chapter 7). Approval of the new PUI (see chapter 7).
Continued examination of the application for authorisation to release nitrates/nitrites into the Meuse as part of the monochloramine treatment of amoebae in the tertiary cooling system, including a public inquiry in October, notification of the Belgian authorities and a recommendation from the Rhine-Meuse river authority (see § 5|4|2).
Continued examination of the commissioning dossiers for two reactors.

CIVAUX

Site :

IAEA OSART mission in May: the recommendations issued by the IAEA will be followed-up during a post-OSART inspection in 2004.

Emergency exercise, focused on civil defense, on 5 December (see chapter 7).

National emergency exercise on 11 December (see chapter 7).

Reactor 1:

Shutdown for partial inspection from 5 July to 22 August. The shutdown was delayed by 13 days, mainly owing to the heatwave, to inadequate preparation and to a union dispute affecting certain service companies.

Beginning of examination of the commissioning dossiers for two reactors.

CRUAS

Site :

Closure of examination of liquid and gaseous effluent release and water intake licence renewal, with signing of a new order on 7 November 2003 (see § 5| 4| 1).

CIINB examination of the draft decree modifying the BNI boundary of the plant, in order to incorporate a VLL storage area (see § 5| 5).

Implementation of a plan of action after the large number of reactor trips (8) between May and August.

Installation of additional cooling systems in several premises to ensure compliance with the maximum temperature levels specified by the STE (see § 2| 2| 3).

Reactors 1 and 4:

Replacement of 2 half-condensers. The replacement programme for all site condensers runs until 2005.

Reactor 2:

Problems experienced with the work to replace 4 control rod assembly mechanisms (see § 3| 8) during the reactor outage (adapter deformed by impacts and incorrect canopy weld). The reactor was connected to the grid more than 3 weeks late.

Reactor 3:

Problems encountered when painting the reactor building during the outage (paint removal and correct repainting of one quarter of the surface of the building). The containment of dust was inadequately managed, leading to dispersion throughout the reactor building. Hazard analyses and large-scale cleaning were undertaken prior to restart.

DAMPIERRE

Site :

Continued examination of the application for authorisation to release nitrates/nitrites into the Loire as part of the monochloramine treatment of amoebae in the tertiary cooling circuit, in particular with a public inquiry in October (see § 5| 4| 2).

Reactor 2:

Difficult restart after the ten-yearly outage in 2002 during which unusual primary/secondary leakage was observed (see § 3| 4).

Reactor 3:

Ten-yearly outage in particular comprising repair of the air cooler, which required application of 35 t of resins.

Reactor 4:

Unscheduled shutdown to replace the alternator rotor.

FESSENHEIM

Site :

Installation of an exterior cooling system on the reactor building containment (see § 3| 12| 3).

Reactor 2:

Hydrotesting of the main secondary system.

FLAMANVILLE

Site :

Switch to PTD batch 93-2001 and introduction of the 2001 and PAI modifications batch (see § 4| 3| 1).

Reactor 1:

Ten-yearly requalification of the main secondary system.

Repair of containment gusset leaktightness.

GOLFECH

Site :

CIINB examination of the draft decree modifying the plant's BNI boundary, in order to incorporate the VLL area and the combustion turbine, installations which contribute to continued improvement of site safety (see § 5| 5).

Public inquiry in October concerning the application for authorisation to release nitrates/nitrites into the Garonne as part of the monochloramine treatment of amoebae in the tertiary cooling system (see § 5| 4| 2).

Examination of the dossier for operation on the NPP of a unit for treatment of waste consisting of exchanger packings placed in the tertiary cooling system. Assent was given on 30 September.

Maintained production even though thermal releases were higher than the limits authorised by the release order (see § 3| 12| 3).

GRAVELINES

Site :

Closure of examination of renewal of the liquid and gaseous effluent release licence, with signing of a new order on 7 November 2003 (see § 5| 4| 1).

Examination of the application for modification of the BNI boundary, in particular with a four-week long public inquiry (see § 5| 5).

Problems with water intake monitoring owing to the presence of patches of oil in the North sea.

Installation of a new PUI and completion of PPI revision, with signing by the Nord and Pas-de-Calais prefects (see chapter 7).

Preventive distribution of stable iodine within the PPI perimeter from September 2002 to February 2003.

Reactor 1:

Requalification of the main secondary system.

Reactor 4:

Ten-yearly outage (see § 3| 4).

Reactor 5 :

Transition to state-oriented approach (see § 4| 3| 2).

Requalification of main secondary system.

Reactor 6:

Transition to state-oriented approach (see § 4| 3| 2).

Requalification of the main secondary system.

NOGENT

Site :

Continued examination of the application for authorisation to release nitrates/nitrites into the Seine as part of the monochloramine treatment of amoebae in the tertiary cooling system, in particular with a public inquiry from 10 November to 10 December (see § 5| 4| 2).

As a result of excessive scaling, replacement of the "packings" (heat exchange alveolar structures) in the air coolers of both reactors.

Upgrading of the fire response organisation after formal notice in 2002.

Submission of a dossier requesting renewal of the release and water intake licences, with a view to obtaining a single, overall licence (see § 5| 4| 1).

IAEA OSART mission in February: the IAEA's recommendations will be followed-up during a post-OSART inspection in 2004.

Participation by members of the Local Information Committee, as observers, in three inspections by the Nuclear Safety Authority.

Beginning of construction of a training simulator for the operation teams (see § 4| 1| 1).

PALUEL

Site :

Numerous unscheduled shutdowns as a result of equipment failures.

The PUI was triggered twice, once when raising a control rod assembly with the upper internals during operations prior to reactor 1 defuelling, and the other when a fire alarm was triggered in the fuel building.

PENLY

Site :

Commissioning of a long-term storage area for very low level waste.

Non-fatal 6-metre fall by a service company employee into a hot unit pit during reactor 1 outage.

Switch to PTD batch 93-2001 for chapter IX of the general operating rules (see § 4| 3| 1).
Completion of the conformity examination (see § 3| 4| 2).

SAINT-ALBAN
Site :
Nuclear Safety Authority review inspection from 29 September to 3 October, concerning effluent and waste management and involving 10 inspectors.
Continued ISO 14001 certification process.
Construction of a simulator for operation team training (see § 4| 3| 1).
Switch by two reactors to PTD batch 93-2001 in October (see § 4| 3| 1).

Reactor 1:
Shutdown with ten-yearly requalification of the main secondary system and repair work on the containment.

Reactor 2:
Two-week postponement of reactor shutdown owing to problems related to the summer heatwave and drought.

SAINT-LAURENT-DES-EAUX
Site :
Formal notice on 21 November to abide by the requirements of the NPP's effluent release and water intake order or to submit a duly justified modification application (see § 5| 4| 2).

Reactor 1:
Switch to PTD batch 93-2000 (see § 4| 3| 1).

Reactor 2:
ICPE licence for the replaced steam generator interim storage building.
Reactor safe shutdown in September owing to a change in the primary/secondary leak rate in a steam generator.
Ten-yearly outage in particular comprising replacement of the steam generators.
Switch to PTD batch 93-2000 "VD2 amendment" and introduction of the PAI modifications batch (see § 4| 3| 1).
Switch to the state-oriented approach (see § 4| 3| 2).

TRICASTIN
Site :
Post-OSART follow-up mission in November.
ISO 14001 certification obtained in October.
CIINB examination of the draft decree for modifying the plant's BNI boundary, in order to incorporate the VLL storage area and a steam generator storage building (see § 5| 5).
Problems with liquid release temperatures during the summer 2003 heatwave (see § 3| 12| 3).

8 SUMMARY AND OUTLOOK

Although the Nuclear Safety Authority believes that EDF has made progress in managing the collective dose received during maintenance operations and generally recognises an improvement in working methods, it nonetheless feels that the safety results paint a more mixed picture. The experience of 2003 shows that greater strictness and thoroughness is needed in day to day operating attitudes. The succession of small but repetitive incidents during certain delicate periods such as reactor restart, is an illustration of this.

Deregulation of the electricity market will be a determining factor in changes to supervision of the nuclear safety of pressurised water reactors. Cost reduction and competitiveness improvement programmes are flourishing and priorities are poorly defined, particularly with regard to new fuel programmes, for which the highly ambitious calendars fail to take account of the possibility of any kind of problem; although no negative safety effects have yet been proven, vigilance must remain the watchword, at a time when certain sites seem to want to anticipate changes to national maintenance and operation rules, whereas what they really need is calm consideration. The regulatory work done by WENRA on reactor safety standards harmonisation and its transposition in France into ministerial orders concerning the design of PWRs, their operation and management of fuel programmes, are therefore as relevant as ever. EDF will also be concerned by the current revision of the regulations concerning nuclear pressure vessels.

The Finnish decision to order an EPR reactor also requires closer work between the Nuclear Safety Authorities in order to optimise coordination of the technical evaluation work on this reactor project. This leads the Nuclear Safety Authority to take an early look at certain detailed studies for which there are still technical issues. A publication giving the State's position regarding the EPR reactor safety options will clarify the requirements on this point.

France's existing nuclear reactor fleet is standardised, which makes for particularly efficient feedback between the various reactors, but also creates an obligation to anticipate any risk of appearance of generic defects. This first of all involves the problem of aging: aging issues are now better understood and good progress has been made to control them, whether in the primary system or the civil engineering structures. Preparation is underway for the third ten-yearly outages for the 900 MWe plant series, but the dossiers prepared by EDF do not go beyond a 40-year time-scale, even though EDF mentions possible extension of the life of some reactors. Conformity examinations, a permanent search for problems by the engineering services, tests and inspections conducted during the ten-yearly outages are all opportunities to ensure that the current level of safety in the installations is clearly understood. This positive approach must therefore continue and leads to conformity work within a time-frame that has to be both justified from the safety standpoint, and be realistic in terms of implementation.

Above all, the safety level must be maintained, by definition of maintenance programmes covering all the equipment. At the maintenance level, optimisation measures initiated by EDF should, apart from economic ambitions, take into account both safety improvement concerns and the particular issues related to standardisation.

The operator must also maintain its aim of improving safety, by safety reassessments which compare the reactors with more recent standards. Since reactor startups are now completed in France, work performed on the EPR reactor project and information gathered on recent and future reactors were used to define reassessment guidelines associated with the third ten-yearly outages for the 900 MWe plant series. These reassessments are also an opportunity to take a look at extreme climatic conditions, in particular high temperatures and drought, which can have an impact on safety. This is also why the ASN will be continuing its process to update the basic safety rules and develop probabilistic safety studies, as part of its realistic risk reduction programme.

For the future, a substantial source of progress in the safety field should be more consistent inclusion of organisational and human factors, which is an area where the ASN is determined to adopt an approach respecting the responsibility of the operator but also enabling assurance that the latter implements the most efficient methods to design and operate the installations and define its organisational structures. Thus the fire prevention results obtained, which were measured during inspections, and even though improved, are still below those obtained by other nuclear operators and would seem to be held back by organisational options and staff motivation issues.

The increasing importance of radiation protection and environmental protection concerns has enabled EDF to improve its results in these areas in recent years. There is still room for progress in comparison with international best practices, particularly in terms of worksite management of dosimetry, contamination and waste, but the process initiated should enable the progress achieved to be built on. The reglement of certain practical situations on the sites still needs considerable effort, in particular to ensure conformity with the 31 December 1999 order and to provide better guarantees for the safe interim storage of certain waste on the sites.

NUCLEAR RESEARCH FACILITIES AND VARIOUS NUCLEAR INSTALLATIONS

CHAPTER 12

1 ATOMIC ENERGY COMMISSION INSTALLATIONS

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3 SUMMARY AND OUTLOOK

CHAPTER 12

NUCLEAR RESEARCH FACILITIES AND VARIOUS NUCLEAR INSTALLATIONS

“Nuclear research facilities and various basic nuclear installations” are all the basic nuclear installations covered by the civilian part of the atomic energy commission, the basic nuclear installations of other research organisations, and a few other installations which are neither power reactors, nor which take part in the nuclear fuel cycle.

1 ATOMIC ENERGY COMMISSION INSTALLATIONS

The facilities of the Atomic Energy Commission (CEA) Centres include various basic nuclear installations (experimental reactors, laboratories), used for research and development activities in the nuclear field. 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 documentation. The action of the Nuclear Safety Authority (ASN) may be considered at two levels:
- at national level, it implements an overall approach to “generic” issues 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 documentation 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.

Section 1|1 below lists the generic issues dealt with in 2003. Section 2 describes topical events in the various CEA installations currently operating. The installations undergoing clean-up or dismantling are discussed in chapter 14.

1 | 1

Generic issues

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 levels, assessment of seismic hazards, fire or criticality hazards, environmental protection, management of nuclear materials or radioactive waste (see Chapter 15), dismantling of facilities (see Chapter 14), radiological cleanness, definition of accident management reflex stages, electricity supplies, 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 1998, the CEA decided to renovate, clarify and reinforce its nuclear safety and quality organization. Two general instruction notes were released for this purpose. They notably set up safety commissions which assist the managerial staff in implementing an internal authorization system; these commissions comprise CEA experts of national repute in their particular fields of competence.

In 1999, CEA organizational provisions with regard to nuclear safety and quality were subjected to thorough examination by the ASN and its technical support organisations, in particular the Advisory

Committees for reactors and for laboratories and plants. Following this examination, the CEA had to specify the responsibilities, respective functions, allocation of resources and assessment tools to those responsible for action and for supervision in these fields.

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

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 an 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 expected it to exercise auto-evaluation 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 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. In a letter dated 28 May 2002, the DGSNR therefore informed the CEA of the practical measures to be adopted for these internal authorisations, in particular with regard to the subjects to be examined by the operator and the procedures for prior notification of the ASN. About fifteen installations were concerned as at the end of 2003, and the system will be rapidly extended to the other installations.

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

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

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

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

1 | 1 | 2

Nuclear material management at the CEA

In 1997, several incidents had revealed weaknesses in the CEA nuclear material management system. At the request of the Defence High Official of the Ministry for industry and the ASN, the CEA launched a large-scale action plan aimed at accounting for all objects in its possession containing nuclear material and upgrading the system used for the management of these objects.

This 11-point action plan in particular resulted in:

- 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.

The nuclear material inventory, as initially planned, was completed in February 2002. More than 325,000 objects have been registered.

In 2003, the CEA declared the discovery of unexpected objects on 3 occasions. On 22 July, the presence of EDITH type fuel was detected in a BNI 56 pit in Cadarache. On 29 July 2003, unregistered experimental cans containing uranium pellets were discovered during a tidying-up operation in BNI 40 in Saclay. On 16 December 2003, investigations as part of the periodic safety review on BNI 39, in Cadarache, revealed that a box containing packaged nuclear material had not undergone a formal criticality-safety study.

1 | 1 | 3

Management of sealed radioactive sources at the CEA

In 1999, CEA launched an action plan aimed at improving sealed radioactive source management in its Centres. This plan in particular comprises consistent application of a “source management guide” and a common data processing tool enabling the performance of an annual “national” inventory.

A series of inspections was launched in 2000 and 2001. Cases had been recorded of sources which had not undergone regulatory tightness inspections, which had not been withdrawn from service after 10 years of use, as required by the regulations, or which had been lost. A generic source management incident was declared and rated at level 1.

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 8 and 15). 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 unused sources. Details of these provisions are being analysed, once the ASN had approved the general principles in 2003.

Generally speaking, the CEA seemed slow in setting up its source organisation, given the security and radiation protection issues at stake.

1 | 1 | 4

Effluent release and water intake licence applications

In application of Decree 95-540 of 4 May 1995, concerning basic nuclear installation liquid and gaseous effluent release and water intake, a revision process for the CEA’s release and water intake licences was initiated in 1999. The release licence for the Grenoble site was examined by the Departmental health council at the end of 2003. The ASN aims to revise the release orders for the Cadarache and Saclay sites in 2004-2005.

One of the main issues in revising the release orders is to reduce the release licence levels to values consistent with the actual releases from the installations.

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 15).

The ASN informed the operators that it feels a safety review of old installations to be necessary about every ten years. At the CEA, safety reviews are in progress on the advanced fuels design and fabrication laboratory (LEFCA), the PEGASE interim storage facility, the Cabri and Masurca reactors on the Cadarache site, and the spent fuel test laboratory (LECI) on the Saclay 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. In 2004, the ASN will clarify what it expects from its periodic safety review of the CEA installations in terms of responsibility, content and scheduling.

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 eliminate the problem of the “special” 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 (report by Mr Muller and Mrs Nury; assessment by the IRSN). 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.

1 | 1 | 7

Phébus and Cabri reactor operating conditions

The Law of 9 May 2001, setting up a French Agency for Environmental Health Safety, provided that the IPSN should be separated from the CEA and become independent. The Government decided that, in this framework, operation of the Phébus and Cabri research reactors, previously operated by the IPSN on the CEA Cadarache site, would fall entirely to the CEA. This organisation has been effective since 22 February 2002, when the IRSN decree was signed. Since then, the IRSN has been using the Phébus and Cabri research reactors for its own experimental programmes, but is no longer responsible for their operation.

An agreement between the CEA and the IRSN concerning the IRSN's use of these reactors, was signed on 20 June 2003. This agreement sets the formal breakdown of responsibilities and financial and operational working methods adopted by the two organisations for operation and for performance of experimental testing, in accordance with the terms of the decree of 22 February 2002.

The ASN remains alert concerning the safety implications of this agreement.

1 | 1 | 8

Experimental reactor cores and experimental 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 performed in 2003 concerning 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 specifies the performance of periodic safety reviews on all experimental devices every ten years, which is an extremely positive innovation in terms of safety.

With regard to reactor core configuration management, a series of inspections began in 2001 and work designed to ensure better management of configuration modification operations will be undertaken in 2004.

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 14 of this report.

1 | 2 | 1

Cadarache Centre

The Cadarache Centre is located at Saint-Paul-lez-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 2013.

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 to the ASN and provided that additional requests were taken into account.

· Cabri and Scarabée reactors

The Cabri pool-type reactor is mainly used for experimental programmes aimed at better understanding nuclear fuel behaviour in the event of reactivity accidents.

The Scarabée reactor was installed in the same handling area as the Cabri reactor, with which it shared a certain number of auxiliaries. The reactor core was removed in 1996 and transported to La Hague in early 2002.

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.

Using the Cabri reactor for the new programme requires modification of the installation, 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 is conducting a safety review of the entire installation in order to define the work needed to bring the installation into conformity with the latest regulatory provisions, so that the reactor can continue to operate for a further twenty or so years. The preliminary safety analysis report for the modified installation was forwarded to the ASN in February 2002. It will be analysed by the Advisory Committee for reactors in early 2004.

The public inquiry prior to granting an installation modification decree, was held in the second half of 2003. The conclusions are expected at the beginning of 2004.

Initial dismantling work on the old sodium loop began in mid-2003.

· Phébus reactor

The Phébus reactor, put into service in 1978, is one of the CEA tools for the study of possible PWR accidents.

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 next test, FPT3, to be carried out under conditions similar to those adopted for FPT2, will take account of feedback from the previous tests. 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. It should take place in September 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, GENEPI. Accelerator coupling and start-up took place at the end of 2001 for performance of the MUSE experimental programme.

In 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. This review will have to take into account the considerable modifications made to accommodate the particle accelerator. The CEA still has to send in a number of files in 2004. These files will be examined by the Advisory Committee for reactors.

The CEA is well behind schedule in this installation safety review. The ASN therefore informed it that the performance of any further experimental programmes after MUSE would require its authorisation and that transmission of any missing documents would be an essential prerequisite to the issue of any authorisation. The CEA will also be required to define a schedule for the Masurca renovation and improvement works.

• Éole and 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.

Minerve reactor control room

Start-up of the experimental "FUBILA" programme, scheduled for early 2003, was delayed, as Japan was no longer able to fund the programme. The reactor is for the time being used to train shift teams. The FUBILA programme will start in 2005. 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 for performance of the HTC (high burnup fraction) programme. This programme funded by EDF was initially used to conduct measurements on MOX samples. The second part of the HTC programme, using UOX samples, will begin in May 2004. In the meantime, the "Valmont" programme began in November 2003 and should last until March 2004. This new programme will provide the data necessary for neutron qualification of the UMoAl fuel.

• CHICADE

CHICADE (chemistry, waste characterization) is a facility for research and development on medium- and low-level waste.

The Ministers for the Environment and Industry authorised final commissioning of CHICADE on 28 March 2003.

· Enriched uranium and plutonium 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. The CEA transmitted the safety options file for the MAGENTA facility project, designed to replace the existing MCMF on the Centre by 2009.

· 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. Each of the 6 phases of the works requires authorisation by the ASN, with the DSIN in July 2001 having authorised operation of the LECA until 2015 subject to full completion of the civil works renovation and reinforcement work. The operator began the 4th phase of the work on 1 August 2003.

· 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. 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 responsible 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 to 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.

The installation safety review has been in progress since 1997. The Advisory Committee for laboratories and plants met on 10 December 2003 to examine the safety of the laboratory, on the basis of the installation safety report and the general operating rules. It raised no objection to continued operation of the facility for the next ten years. With regard to the installation's behaviour in the event of a safe shutdown earthquake, the Advisory Committee examined the operational improvement proposals to prevent liquefaction of the underlying soils and reinforce the civil engineering structures and the equipment. Provided that various recommendations are implemented, the Advisory Committee considered these proposals to be acceptable. The ASN will send the CEA a certain number of requests, taking account of the comments and recommendations issued by the Advisory Committee.

1 | 2 | 2

Fontenay-aux-Roses Centre

This centre is currently undergoing dismantling and clean-up (see chapter 14).

1 | 2 | 3

Grenoble Centre

The CEA has decided to halt all research activities in the BNIs on this site. This site is dealt with in chapter 14.

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 activities of this Centre comprise:
- fundamental research (physics, biology, chemistry, metallurgy), supported by a wide range of laboratories using heavy equipment, such as research reactors and particle accelerators;
- applied research (research and development on reactors, isotopic separation, application of ionising radiation);
- design, manufacture and commercialisation of artificial radioelements.

The Centre also houses a unit of the INSTN (national teaching institute for nuclear science and techniques).

· CIS bio International facility

The CIS Bio International facility produces radioelements for biomedical applications and radioactive sources for medical or industrial use.

At the beginning of 2000, the major part of CIS Bio International capital was purchased from the CEA by the German pharmaceutical group Schering.

In reply to the ASN's request in 2000 for nuclear operator responsibility to be transferred from the CEA to CIS Bio International, the first versions of the files needed for said transfer were sent between April and July 2002. None of these files was accepted as-is. In particular, a number of conventions still need to be agreed by CIS Bio and the CEA to enable the facility to operate independently. A new version of the files is awaited.

The many incidents that occurred in 2003 confirm shortcomings in the safety and radiation protection culture observed in previous years, insufficient managerial level staff qualified in these fields, and operational problems linked to the obsolescence and complexity of the facility. It would also appear that the operator accords excessive priority to production over safety and radiation protection.

The installation head presented his plan of action to the ASN for rapid correction of this unsatisfactory situation. This plan also comprises medium-term elements devoted to the overall safety review of the BNI, which has become necessary.

The presence of the ASN in the facility was intensified in the last quarter of 2003.

· Spent fuel test laboratory (LECI)

The function of the Spent fuel test laboratory is to analyse the various components of the 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. In 2003, the CEA submitted a large number of files for commissioning the LECI extension, called PELECI, which are currently being examined by the ASN and its technical support organisation. An Advisory Committee meeting should be held on this subject in the first half of 2004.

· 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 U_3Si_2Al 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. It is also used for neutron radiography of miscellaneous equipment. The control and instrumentation of this reactor will be modified in 2004 so that it can also be used for training activities as of autumn 2005.

After the initial observations, in particular after the incidents which occurred in July 2002, the ASN asked the CEA to make significant improvements to the second level monitoring of this facility and to conduct an audit into safety provisions in it, to highlight any shortcomings in safety culture.

The conclusions of this audit were transmitted to the ASN in October 2002. An action plan aimed at improving staff motivation and involvement in the quality and documentation systems, remedying the present levels of under-staffing and strengthening coordination between the teams was presented by the CEA. The ASN is paying particular attention to monitoring this facility. The results of the CEA's action plan were examined by the ASN in June 2003. This examination showed that the CEA had correctly followed its action plan.

In 2003, the CEA continued the Osiris reactor renovation work, partly as a result of the installation periodic safety review: non-destructive testing of the primary system piping, improved containment of the reactor ventilation part.

· 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.

Further to detection of a very slight leak from the reactor pool, intensive investigations were carried out in 2001 on the reactor transfer channel, but the exact cause could not be identified.

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. These documents were examined by the ASN and its technical support organisation, and led to the corresponding authorisations being granted at the end of 2003.

The CEA should shortly decide on whether or not to continue operation of this reactor after 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 decided on final shutdown of reactor operations in autumn 2005. Training activities will be transferred to the Isis reactor.

1 | 2 | 5

Rhone Valley Centre

The Rhone Valley Centre administratively groups the sites of Marcoule (Gard) and Pierrelatte (Drôme). Non-defense-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 basically 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.

As part of the internal licensing system, the head of the Rhone Valley Centre authorised start-up of the “shielded process cubicles”, in the DRA building, which will house research into reprocessing of fuels and irradiated targets (research axis 1 specified by the 1991 Law – Article L.542 of the environment code – concerning management of high-level, long-lived radioactive waste).

Jointly with the DSND, consideration was given to the possibility of declassifying a large part of the classified basic nuclear installations at Marcoule as part of their dismantling process.

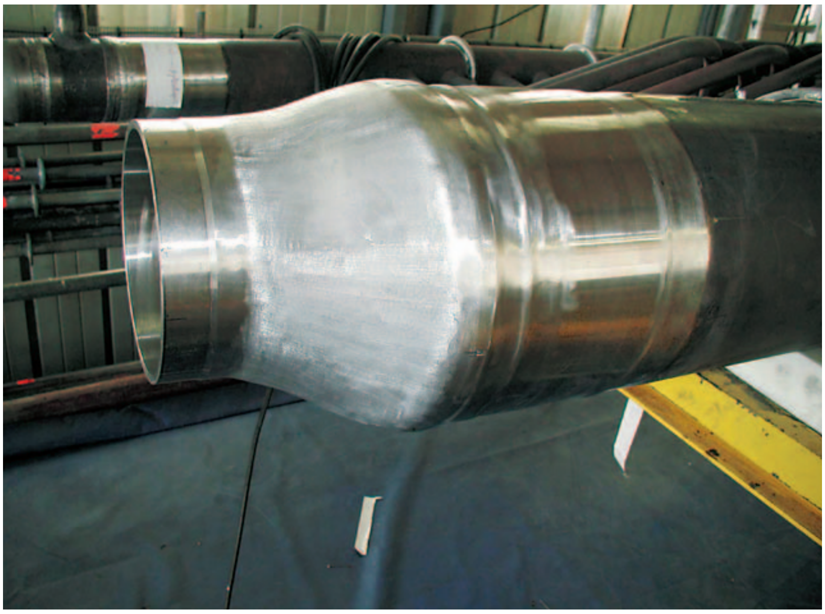
1 | 2 | 6

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 a final 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.



Steam generator module

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 start-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.

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, either in temporary channels (interim storage facility or other processing installation such as CENTRACO), or in final disposal channels (repositories). 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 15 (§ 7).

· CEA Fontenay-aux-Roses site

BNI 34, known as the radioactive effluent and solid waste treatment station, works specifically on the clean-up and dismantling of the CEA's Fontenay-aux-Roses site. The incinerator is being dismantled and the radioactive liquid effluent treatment station has been dismantled. 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 14).

· Grenoble site

Since 31 December 2003, BNI 36-79, known as the effluent and waste treatment station, only provides interim storage for solid waste and aqueous effluent.

· Cadarache site

The function of BNI 37, known as the effluent and solid waste treatment station, is radioactive waste packaging, if necessary after compacting, and decontamination of radioactive aqueous liquid effluents. 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. BNI 37 also provides interim storage for aqueous and organic effluent. During the course of 2003, BNI 37 had to repackage several drums of radioactive organic liquids stored in the ZELORA facility, following particularly rapid pitting corrosion. The CEA procured drums with a special liner for repackaging those drums with a significant risk of corrosion. ZELORA is authorised to operate until 2006. The ASN asked the CEA to consider treatment of these radioactive organic liquids as a priority. During the course of 2003, some of these drums were removed to CENTRACO for incineration. Some drums are as yet without an operational disposal channel.

Final shutdown of most of the existing BNI 37 installations is scheduled for a time-scale between 2004 and 2006. These installations will eventually be replaced: this concerns the Rotonde project for sorting solid waste and the AGATE project for processing liquid effluent. The CEA aims for AGATE commissioning by 2009 (see chapter 15).

· Saclay site

BNI 72, known as the solid waste management zone, comprises facilities for interim storage and processing of radioactive solid waste.

Following the 2003 shutdown of high-level cell operations for sorting and packaging of the Centre's waste, the CEA organised waste sorting at the producers. BNI 72 also has a lead decontamination unit which uses melting and a facility for supplementary encapsulation and packaging of packages in concrete overpacks. BNI 72 also provides interim storage for waste packages. It is an old facility for which a periodic safety review is scheduled for 2004-2005. Beforehand however, the CEA intends to consider how to redefine the functions that are to be retained in this BNI.

BNI 35, known as the radioactive liquid effluent management zone, processes low-level aqueous effluents and provides interim storage for aqueous and organic effluents. Old effluents are waiting for a recovery solution or appropriate processing channel. The treatment of radioactive aqueous effluents consists in evaporating them and packaging the radioactive concentrates in a matrix. The bituminisation installation was finally shut down in February 2003. The STELLA installation, operation of which is scheduled for 2006, should enable concentrate encapsulation in cement. The periodic safety review for BNI 35 as a whole is scheduled for 2004-2005, to coincide with the Advisory Committee for plants' examination of the provisional safety analysis report for STELLA commissioning. STELLA will be a significant improvement in terms of facility safety, given the fire and explosion hazards inherent in the use of bitumen. Until such time as STELLA is operational, BNI 35 stores its radioactive aqueous effluents, pending processing, in its existing tanks and then in the RESERVOIR extension tanks. The ASN should shortly be authorising operational use of RESERVOIR for interim storage of aqueous effluents.

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 an ASN inspection in early 2002, the inspectors found that the provision for response to a fire in the AMI was inadequate, in terms of both response times and familiarity with the installations by the emergency response personnel. This situation led EDF to reorganise in depth. Since 1 January 2003, responsibility as nuclear operator of the AMI lies with the manager of the Chinon site. The Nuclear Safety Authority approved the updated safety report and general operating rules of the AMI.

These documents constitute the safety reference framework applicable during the renovation work being done on the installation.

EDF hopes to continue to operate the AMI after 2005, using methods significantly reducing the risk inherent in the installation and is currently conducting a safety review accordingly. Clean-up activities, particularly storage of old waste, are continuing.

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. Certain experimental devices involving no added radioactivity could be reused within the framework of the replacement SOLEIL project, to be built nearby. During 2003, the operator sent the ASN the files necessary for transition to final decommissioning of the installation.

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 frontier.

The safety of these installations is regulated by a convention binding the French Government and the CERN. This convention stipulates that the provisions made in French BNI legislation shall apply to the LEP, the LHC and related facilities. It also designates the DSIN (now the DGSNR) as the French Government representative to deal with technical matters concerning the convention. A new convention was signed in July 2000 by the French Ambassador and the representatives of the CERN international organization.

The CERN is now concentrating 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 located in the 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.

The ASN has a seat on the CERN's radiation protection committee, in charge of all radiation protection problems on the site.

The LHC is still scheduled for commissioning in 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.

In June 2002, the GANIL applied for authorisation to start-up the CIRIL 6 radiobiology laboratory. This authorisation was granted by the DGSNR in August 2003.

The GANIL aims to submit an application for significant modifications to the installation in the near future.

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, Marseilles, Sablé-sur-Sarthe and Dagneux.

On 20 November 2003, the DGSNR authorised resumption of industrial operation of the Pouzauges ionisation facility.

On 18 October 2001, the Director of the Gammaster Provence SA company submitted a request to the Ministers for Industry and for the Environment for authorization to set up a new ionisation installation on the territory of the commune of Noiron-sous-Gevrey (Côte-d'Or). Examination of this application was interrupted by the ASN when the company notified it in early 2003 that it was abandoning the project.

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.

The installation's seismic reinforcement work, requested by the ASN following the meeting of the Advisory Committee for reactors in May 2002, has started. It should continue for a period of two to three years.

Files are expected in 2004 to enable completion of the installation periodic safety review.

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:

- 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 2003, SOMANU submitted an application for authorisation to extend the active parts storage building in its Maubeuge shop. This is currently being analysed by the ASN.

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. Shutdown of the surface treatment installations which began in 2001, was completed in 2003.

Two requests for modification of its authorization decree were presented by the SOCATRI. The first concerned the possibility of releasing liquid and gaseous effluent, and was accompanied by a release licence application which has been dealt with. The draft terms and conditions are under preparation (see Chapter 12, § 1|4). The second request is aimed at solving the interim storage problem for long-lived waste (notably that containing radium) belonging to the ANDRA. This request involves modification of the maximum authorized activity level for the ANDRA interim storage platform, without modification to the total activity of the installation.

The decree authorising modification of the SOCATRI covering these two requests was signed by the Ministers on 10 June 2003 and published in the *Journal Officiel* on 17 June.

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 for good 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 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 litre shielded metal drums, they are shipped as ultimate waste to the ANDRA's Aube repository.

The CENTRACO melting unit is designed to process low-level, short-lived metal waste generated by the routine operation of nuclear installations, by maintenance, by process modifications, by dismantling of nuclear facilities, etc. 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.

CENTRACO intends to produce sleeved ingots as of 2004.

Operating feedback from the incineration unit led the operator to envisage revision of its May 1988 release licence.

2 | 10

The ITER project

The ITER project concerns an experimental installation the aim of which is scientific and technical demonstration of control of thermonuclear fusion energy during long-term experiments with significant power levels (500 MW for 400 s). Cadarache is the site proposed by the French government and accepted at European level for construction of this deuterium-tritium plasma controlled magnetic fusion machine. Pending creation of the international ILE (ITER Legal Entity) which should be the

Storage of melt process ingots and process waste operator, the CEA has started technical discussions with the ASN, and in February presented a safety options file, which was examined during a meeting of the Advisory Committee for laboratories and plants in November. The ASN feels that the installation's safety options are acceptable. Additional data have been requested, primarily concerning management of the beryllium risk (chemical toxicity), radioactive waste and the tritium inventory.

An international decision concerning the final location of ITER is expected for early 2004.

3 SUMMARY AND 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 on 1 July 2002 which, for specified installations, enables it internally to authorise certain operations or modifications which do not compromise the safety demonstration. This system will gradually be extended and should apply to most CEA installations by the end of 2004. It should give the operator greater flexibility, while guaranteeing the required level of safety under its responsibility and should enable the ASN to give greater attention to subjects which represent more important safety issues.

Another specificity of research installations is the frequently unique character of each of them, as compared with the French power reactors, which are all of the same basic type and are consequently amenable to generic treatment. The ASN nevertheless endeavours to develop cross-disciplinary operating feedback analysis and follow-up approaches. Since 2000, emphasis was placed on nuclear material management, radiation protection, waste, effluent and sealed source management, and servicing and modification quality.

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 thus experienced drastic and unforeseen cuts in their investment and even operating resources, leading the ASN to make a rapid examination of requests for changes to operating conditions. In one case, the operator envisages final shutdown of the installation. The ASN will ensure that in the coming years, budgetary constraints have no impact on the safety and radiation protection of research installations operations.

CHAPTER 13

NUCLEAR FUEL CYCLE INSTALLATIONS

1 MAIN TOPICS COMMON TO ALL INSTALLATIONS

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1|2 Retrieval of waste due to past practices

1|3 Revision of release licences

1|4 Incident management and operating feedback

2 MAIN INSTALLATIONS

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2|1|1 Comurhex uranium hexafluoride preparation plant
2|1|2 COGEMA TU5 shop and W plant
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2|2 Eurodif uranium isotope separation plant at Pierrelatte

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
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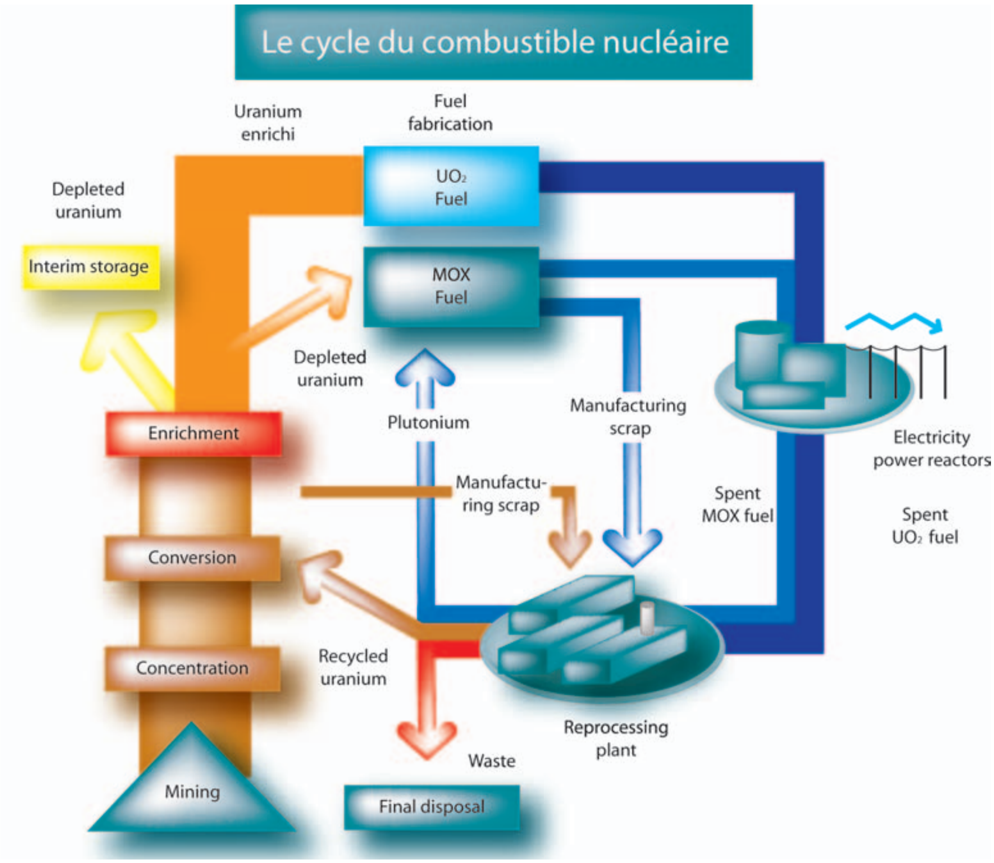
2|4|3 Regulatory framework for the facilities
2|4|4 The main authorisaitons issued
2|4|5 Site radiation protection
2|4|6 Site releases and environment monitoring
2|4|7 The marine discharge pipe

3 SUMMARY AND OUTLOOK

The 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 subject to BNI 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 4%. 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 release 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 ATPu shop or 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 COGEMA group organisation comprises an executive committee and four activity areas (Mines-chemistry, Enrichment, Processing-recycling-engineering, Services) grouping 11 business units (operational result centres), 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

Facility	Material processed	Tonnage	Product obtained	Tonnage
Comurhex Pierrelatte	Uranyl nitrate (based on reprocessed uranium)		UF_4 UF_6 U_3O_8	0 0 672
COGEMA Pierrelatte TU5 shop	Uranyl nitrate (based on reprocessed uranium)	5035	U_3O_8	1518
COGEMA Pierrelatte W shop	UF_6 (based on depleted uranium)	17 137	U_3O_8 produced U_3O_8 stored	13 647
Eurodif Pierrelatte	UF_6 (based on natural uranium)	23 839	UF_6 (depleted uranium) UF_6 (enriched uranium)	21 383 3039
FBFC Romans	UF_6 (based on enriched natural uranium) UF_6 (based on enriched reprocessed uranium)	1681 60,8	UO_2 (powder) UO_2 (fuel elements) UO_2 (URE-fuel elements)	551 811,9 51,4
ATPu Cadarache	UO_2 (based on depleted uranium) PuO_2	19 1,5	MOX (fuel rods) Scrap	16,8 5,1
MELOX Marcoule	UO_2 (based on depleted uranium) PuO_2	123,2 9,15	MOX (fuel elements)	113,82
COGEMA La Hague	Reprocessed irradiated fuel elements		Vitrified waste packages produced	
	UP3	407,8	UP3 (number of containers)	289
	UP2 800	707,3	UP2 800 (number of containers)	318
			NU produced	1115
	UP2 400	0	PuO_2 produced	11,06
	Irradiated fuel elements unloaded into pit	1439,2		

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 release, 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 release 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 or spent fuel management systems 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 immediately 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 present a feasibility study of this new management system, accompanied by a revision of the "nuclear fuel cycle" dossier, specifying and justifying any differences.

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

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.

COGEMA La Hague – general view

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 DRYPAC and cementing processes, together with the conditions under which these processes could be applied to STE2 sludge treatment, were presented by COGEMA. Cementing tests failed to give satisfactory results. Three solutions could now 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 shows that considerable development work is still needed before industrial retrieval of the sludge can take place.

Since sludge retrieval has to start as soon as possible, COGEMA will need to demonstrate the adequacy of the process envisaged, with a view to starting retrieval and packaging operations in 2005 or otherwise propose transfer of the sludge in question to another interim storage area.

HAO silo

COGEMA is considering dealing with the hulls and end-pieces in this silo by compaction in the ACC shop. The first step would consist in 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.

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.

Other waste

In September 2002, COGEMA presented the ASN with a safety file dealing with the recovery of CEA waste from past practices stored in the ATTILA pit. This file is being examined by the ASN.

The ATPu

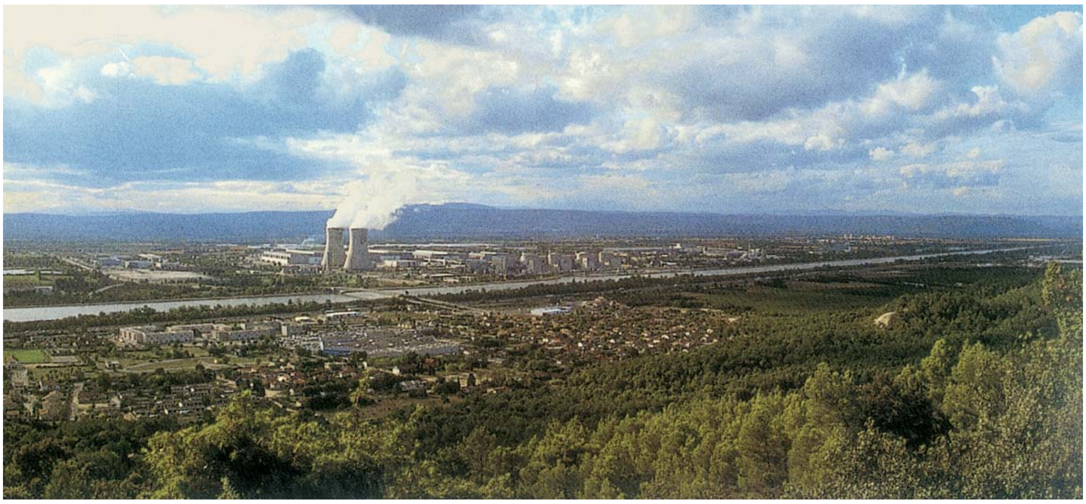
Since industrial production at the facility ceased in July 2003, the operator has been making the changes necessary for implementing packaging of the scrap from its previous manufacturing operations, prior to its shipment to the COGEMA La Hague site. These operations should last until the end of 2006.

1 | 3

Revision of release licences

The ASN initiated the revision of certain release licences, with a view to correcting three types of unsatisfactory situation:

- old plants, where the licence application for regularisation purposes has not been entirely examined by the authorities and where release levels are controlled in the context of a contractual system;
- installations where effluents are discharged via purification plants belonging to other nuclear operators. Such installations do not have their own specific release licences;
- installations where the release licences are to a varying extent disproportionate with respect to technical possibilities and actual release rates involved or are incompatible with foreseeable plant modifications.



Tricastin site – general view

The operators of the Comurhex and Eurodif plants at Pierrelatte presented a new release licence application dossier in mid-1999, in cooperation with the operator of the Tricastin auxiliary company (SOCATRI) with a view to assessing the total environmental impact of release from the Pierrelatte installations. Further to the public inquiry, which took place from February 15 to March 23 2001, the inquiry committee expressed a favourable opinion, accompanied by reserves and recommendations. However, 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 are required to submit a new release licence application, which will be the subject of a public inquiry.

The revision of the COGEMA La Hague release licences took place in the more general procedure of revision of the authorisation decrees for this plant (see § 2|4|3 and § 2|4|6).

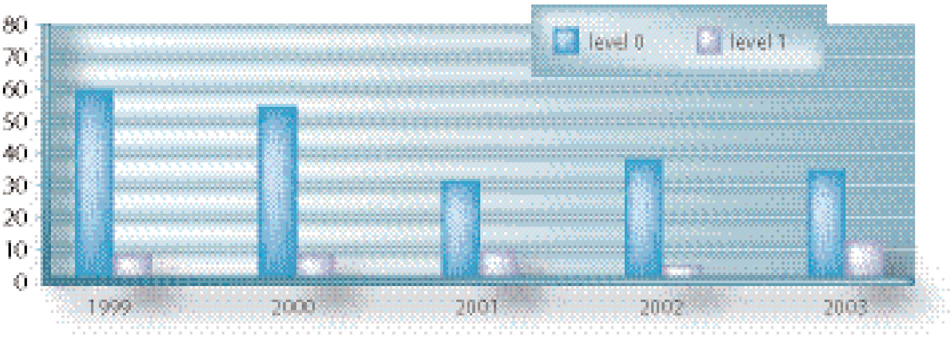
1 | 4

Incident management and operating feedback

The detection and handling of anomalies and incidents occurring during daily plant operation is of prime importance for safety. Lessons learned from the subsequent corrective actions provide a basis for defining new requirements for safety-related elements or for new operating rules for quality-related activities. 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.

Trend in the number of the significant incidents reported by fuel cycle installations between 1999-2003



ASN monitoring of these incidents 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.

In 2003, in particular, the number of leaks on water/UF6 exchangers in the Eurodif enrichment facility, which was the main type of incident declared by this operator, is sharply down in relation to previous years (5 in 2003 as opposed to 26 in 1999).

In terms of operating feedback, the ASN in a letter of 15 May informed all operators of an incident in a classified BNI, involving an annular tank which had partially lost a neutron poison device, asking them to describe the action taken by them to tackle this type of malfunction in the BNIs they operate.

Similarly, problems with centralised management of radiation protection measures were the subject of a similar letter, dated 26 November 2003.

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 part of the Comurhex plant in Pierrelatte is designed to manufacture uranium hexafluoride from natural uranium, while its BNI part manufactures it from uranium derived from reprocessed fuel. The latter part mainly consists of two workshops:

- the 2000 structure, which converts uranyl nitrate from the reprocessing plants into UF4 or into U_3O_8; the U_3O_8 uranium oxide which can be produced in the 2000 structure is used for the same purposes as that produced in TU5 (see § 2|1|2);
- the 2450 structure, which converts the UF_4 (with a uranium 235 isotope content of more than 1%) from the 2000 structure into UF_6. This UF_6 is intended for re-enrichment of the reprocessed uranium for recycling in the reactor. This unit is currently shut down and the operator does not envisage restarting it in the near future.

The production capacities are 350 t of U/year for the UF_4 from reprocessing and 900 t of U/year for the U_3O_8.

Seismic hazard

In July 2001, the ASN had asked Comurhex to assess the earthquake resistance of its basic nuclear installation. The studies designed in particular to check the strength of the reprocessed uranyl nitrate tanks are still in progress.

Comurhex – general view

Radiation protection

In terms of radiation protection, the main risk is irradiation by reprocessed uranium. There is also a potential risk of internal contamination.

In this respect, the ASN's inspections revealed that the ventilation and tightness of the equipment were the main areas in the facility requiring progress on this subject. Some equipment was in effect not tight enough and the ventilation systems were unable to retrieve all the uranium efficiently.

In 2003, no internal dose was received.

As part of the radiation protection management process and the ALARA approach, the operator will nonetheless have to improve the way in which it deals with the risk of worker internal exposure.

2 | 1 | 2

COGEMA TU5 shop and W plant

COGEMA operates on the Pierrelatte site BNI 155,which comprises:

- the W plant (nuclear installation, within the BNI perimeter, classified on environmental protection grounds) for conversion of depleted uranium hexafluoride (UF_6) into uranium oxide (U_3O_8), which is a solid component offering safer storage conditions;
- the TU5 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.

The uranium from reprocessing is partly placed in interim storage on the COGEMA Pierrelatte site and partly sent abroad for enrichment.

Uranium oxide interim storage

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, together with the uranium produced by reprocessing in the TU5 shop.

Radiation protection

Because of the materials handled, the risk of irradiation is limited, but there is a potential risk of internal contamination.

2 | 1 | 3

COGEMA plant at Miramas

This plant is solely used for the interim storage of depleted uranium solid and stable compounds.

In 2002, the ASN authorised transfer of stored DV70 containers of depleted uranium to the COGEMA Pierrelatte site. The first transfer took place in October 2002 and transfers continued until November 2003.

2 | 2

Eurodif uranium isotope separation plant at Pierrelatte

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 give preferential passage to the uranium isotope 235 contained in the gas, thereby increasing the proportion of this fissile isotope in the UF_6 at each passage.

Each enrichment module has a compressor for raising the UF_6 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 UF_6 is introduced in the middle of the cascade, with the enriched product drawn off at one end and the depleted residue at the other.

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 proved to be necessary to determine the seismic behaviour of the U annex building, taking account of the seismic movement determined according to the new RFS 2001-01. The investigations show that the seismic resistance of the U annex building cannot be guaranteed and 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.

An in-depth study of the phenomena of UF_6 hydrolysis and the resulting density of UO_2F_2 deposits was also transmitted by the operator. The steps taken by the operator to prevent and limit the associated risks are satisfactory.

Planned developments

The ultracentrifugation process should eventually replace gaseous diffusion. COGEMA has transmitted the safety options dossier for the future ultracentrifugation enrichment units. This dossier is currently being analysed by the ASN and its technical support organisation. The operator will at a later stage forward the preliminary safety report and the dossier, which will be the subject of a public inquiry, for creation of a new enrichment facility, scheduled to replace the Eurodif plant by 2012.

Eurodif – general view

Radiation protection

Because of the materials handled, the risk of irradiation is limited.

The maximum irradiation likely to be received is due to handling and storage of empty UF6 containers but which are not washed and which still contain uranium daughter products (thorium and protactinium).

There is also a potential risk of internal contamination.

In 2003, no internal dose was received. The operator is keeping its dosimetry below the dose targets specified.

Radiation protection management and organisation are satisfactory.

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, ATPu at Cadarache (until July 2003) or MELOX at Marcoule. The latter two establishments manufacture 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.

Summary - outlook

Following a common safety review of these installations in 1992, primarily focused on operating feedback, the ASN decided to conduct another separate analysis for each one.

Fuel element fabrication plant (BNI 98)

Further to the meetings of 5 and 6 February 2003, the Advisory Committee for laboratories and plants announced that it was in favour of continued operations and made a number of recommendations which were sent by the ASN to the operator, in the form of formal requests.

These requests mainly concern:
- adoption of realistic radiation protection targets, including a drive towards progress involving a reduction in internal dosimetry, particularly by improving workstation containment;
- criticality and the explosion risk;

FBFC - pellet visual inspection

- reinforcement of seismic risk prevention measures in certain buildings, further to the SMS review for each site;
- greater integration of human factors.

These requests, which should be dealt with in the short term, employ principles which will have to be followed in full during the changes to which - as it had announced - the Framatome-ANP group has committed the FBFC plant at Romans-sur-Isère. An application for authorisation to increase the plant's annual production capacity was thus sent on 6 December 2002, to the Minister for the Economy, Finance and Industry, the Minister for Ecology and Sustainable Development and the Minister Delegate for Industry. This request, which tends to modify the prior authorisations issued by decree in 1978, led to the initiation of a new decree authorisation procedure with a public enquiry. The release limits to be adhered to will remain unchanged.

The public inquiry was held from June to early July 2003 in the Drôme and Isère departments. The prefect of the Drôme, coordinating the regional part of the procedure will, subsequent to the administrative conference, forward his opinion to the above-mentioned ministers.

As part of the procedure initiated, the ASN will obtain the opinion of the Advisory Committee which will examine the preliminary safety report concerning the capacity increase and will also be required to state its position concerning the new radiation protection targets and certain shop modernisation options.

Installations of the CERCA company (BNI 63)

The shop operator received temporary authorisation to start operation of the Télémaque pilot. This pilot, the purpose of which is fabrication of uranium and molybdenum alloy powder, uses an atomisation process utilising these metals in the form of a molten alloy. The final licence for this pilot was however suspended pending the results of the operational review analysis, which will be conducted at the end of this trial period.

The safety review for this installation was started in 2001 and will be continued following that of BNI 98. The main risk resulting from operation of these shops is criticality. Other than the traditional process analysis, emphasis will be placed on the human factor, the importance of which was highlighted by the Tokai-Mura accident in Japan in September 1999.

Radiation protection

The operator defines a single dose target, applicable to the site as a whole. It covers all types of uranium used, both natural or reprocessed in the case of BNI 98, or highly enriched for the CERCA shops.

The containment design is only intended for a limited number of workstations, which means that in normal operation, the internal and external dosimetry components must be taken into account. Given the radiological properties of uranium, the internal component is easily the most important in Romans.

No incidence of the regulatory limit being exceeded was recorded in 2003.

The operator conducted a precise assessment of the atmospheric contamination levels and implemented procedures and actions to limit the internal doses received by the operators.

Following the BNI 98 safety review, the ASN asked the operator to standardise and reinforce workstation containment.

2|3|2

Plutonium technology shop (ATPu) and chemical purification laboratory (LPC) at Cadarache

Owing to the specific seismic risk of the Cadarache site and the incompatibility of the installation with current seismic design rules, COGEMA halted industrial activities in the ATPu in mid-July. 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 commits the ATPu and the LPC, which is the fabrication complex in Cadarache (CFCa) operated by COGEMA, to a common decommissioning process, the first step of which should lead to the publication of a final shutdown and dismantling decree. For each of the two installations, the operator will therefore have to produce the dossier required by article 6 ter of decree 63-1128 of 11 December 1963 amended, as well as the impact assessment required by the decree of 12 July 1977.

The installation will package the scrap from its previous fabrication activities (see § 1|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, certain activities will require adaptation of the safety reference framework, in particular to take account of the gradual decay of plutonium to americium, which characterises the older nuclear materials containing plutonium.

In November, the operator submitted an application to have the ATPu produce rods intended for the production of four test assemblies based on American military plutonium, in order to demonstrate the feasibility of eliminating stocks of surplus American military plutonium by turning it into 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. The dossier is currently being examined by the ASN.

Radiation protection

After a difficult 2001, dosimetry results were satisfactory. The operator has brought its collective dosimetry down to 2000 levels, a reduction of some 25%.

The change in shop activity, given the higher americium content of the scrapped materials, will lead the operator to reinforce its radiation protection measures, on the basis of which a revision of the technical specifications shall be proposed. The progress-oriented approach, implementing the ALARA principle, shall be updated to take account of these new activities.

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 requesting and obtaining a decree approving diversification of production, the operator asked for authorisation to increase the plant's annual production from 115 t of oxide (or 101 t of heavy metal) to 145 t of heavy metal. The new procedure to revise the amended 21 May 1990 authorisation decree, begun in late 2002, was examined in 2003. The steps marking this procedure were mainly:
- from January to March, joint public inquiry in the Gard and Vaucluse departments,
- end of April, Advisory Committee for laboratories and plants safety review of the installation in the new operating conditions;
- 4 September, publication in the *Journal Officiel* of an amending decree containing the requested authorisation.

Radiation protection

The use of plutonium oxide requires continuous containment of the material. During normal operation, the design means that the internal dosimetry component is nil. External exposure is mainly due to gamma radiation and neutron emissions from the mixtures of plutonium and uranium oxides and certain daughter products.

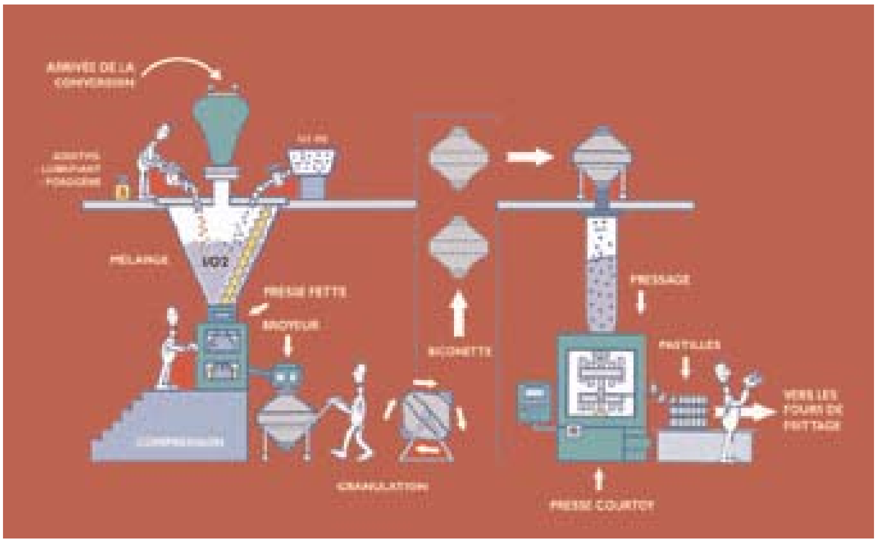
The internal dose received can only result from loss of containment. Incidental in nature, these losses are mainly due to perforation of gloves or to maintenance operations. However, measurable doses received in such circumstances are extremely rare.

In 2003, no internal dose was received on the site.

However, since 2000, the collective and individual external doses have been rising. This change 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.

Within the framework of the above-mentioned procedure, the Advisory Committee for laboratories and plants, during its 23 April 2003 session, recommended:
- assessment of the expected medium-term change in the collective and individual dosimetry resulting from the increased capacity, future production and the new method of calculating the neutron component;
- continuing to reinforce action to optimise radiation protection in order to control this change.

It was in this difficult context that in 2003 the operator adopted a radiation protection objective which was realistic enough to make the progress-oriented approach adopted under application of the ALARA principle more effective.



FBFC - pellet fabrication

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 hectares, 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 reprocessing plant UP2 400, designed to reprocess spent fuel from gas cooled reactors. It became operational in January 1967 at the same time as the STE2, the role of which was to purify liquid effluent before release into the sea. In 1974, the CEA was authorised to modify the UP2 400 plant to allow reprocessing of PWR spent fuel. Finally, in 1981, COGEMA was authorised 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 in three decrees of 10 January 2003, to modify the operating conditions of UP2 800, UP3 and STE3. 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:

COGEMA La Hague – general view

- BNI 33 covering plant UP2 400, the first reprocessing unit, and AT1, a prototype installation currently being dismantled;
- BNI 38 covering effluent treatment station n° 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 n° 3 (STE3).

The production shops in the UP2 400 plant have all been shut down.

SITOP project

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, as of the end of 2001, to ensure the competitiveness of the site. This new organisation is the subject of the SITOP project (for site optimisation).

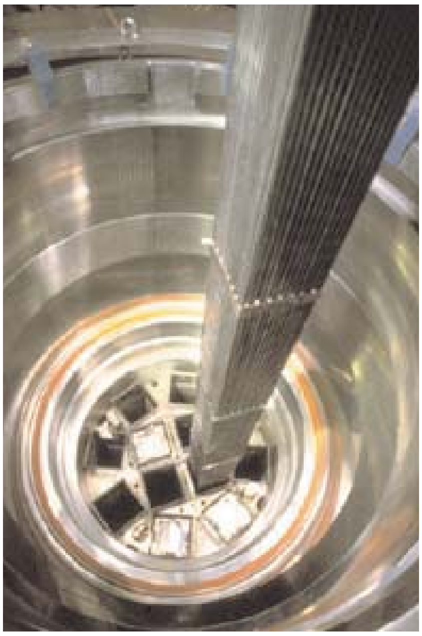
This project is currently being assessed internally, in particular with regard to the human factors aspects, as ordered by the ASN.

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 unloading at La Hague

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.

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, form shearing up to the finished products, utilise chemical processes and generate gaseous and liquid effluents. This 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 releases are processed by washing in a gas treatment unit. Certain residual radioactive gases, in particular krypton, are simply checked before being released 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).

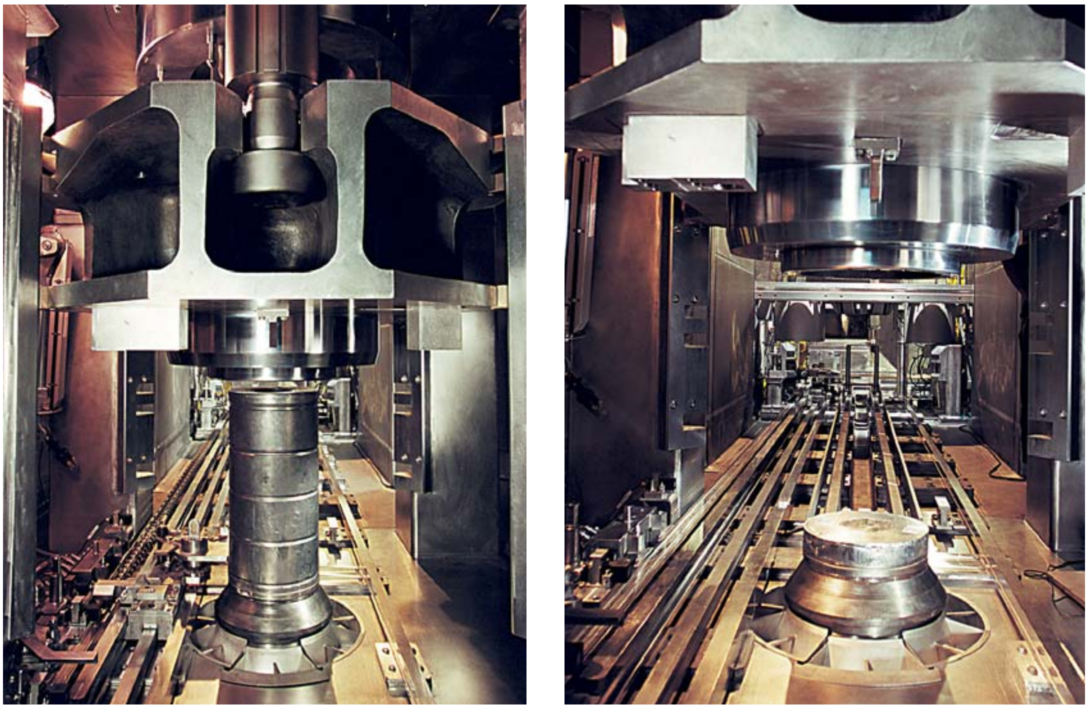
Solid waste is packaged on the plant site. Two methods are used: compacting and encapsulation in cement.

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.

Final shutdown of old shops

Most of the old shops on the site will have to be finally closed down prior to dismantling. The ASN asked the operator to forward a calendar for these operations. Production at the R4 shop began in the UP 800 plant in April 2002, to replace the medium level MAPu shop in the UP2 400 plant. 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



Hull compacting at La Hague

dossier presenting the operations planned for the final decommissioning phase in the various shops concerned in this plant. It 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 new decrees and the new ministerial order regulating installations and their releases are the final stage in a process initiated by the Nuclear Safety Authority at the end of 1993 and which, in September 1999, at the request of the COGEMA president, led to modification of the authorisation decrees. This dossier was the subject of a public inquiry, which began on 2 February 2000 and ended on 17 May 2000. The procedure, particularly the public inquiry, brought to light no reasons for opposing the COGEMA application.

The revision of the La Hague site authorisation decrees 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 described in the previous decrees are in fact now quite considerably different from those currently in the reactors, and this difference will only increase in the future. This authorisation was therefore needed to manage current fuel throughput. The authorised modifications will combine improved nuclear safety with environmental protection through the use of the best techniques available.

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 of the 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 in the *Journal Officiel* define a new operating framework for the facilities and article 5 requires that any extension of the current operating framework within this

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;
MAU:	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.

new framework, receive specific authorisation issued by interministerial order. An initial order along these lines was signed on 15 July 2003 (see § 2|4|4).

In addition, and as is currently the case, the actual operations involved in processing the substances and materials authorised by interministerial order will require an operational agreement for each special processing programme outside the previously authorised framework. This will ensure that account can be taken of the time elapsed between the framework extension authorisation and the actual performance of processing, to ensure that the performance conditions envisaged by the operator are compatible with the safety of the facilities and with human and environmental protection. The interministerial orders will specify that the operational agreement is to be issued by the Director General for Nuclear Safety and Radiation Protection.

A number of complaints filed by environmental defence associations called into question the decrees and the order authorising releases from the La Hague installations. These proceedings are still continuing in the courts.

Unloading in Cherbourg

2 | 4 | 4

The main authorisations issued

The ASN has issued COGEMA La Hague with various authorisations, some of which are recalled below.

· UP2 400

On 4 August 2003, the operator received approval for the work prior to the dose rate measurements and clean-up of the Attila pit (building 128).

HAO/North shop

Operational approval was given on 25 July for reception and unloading in the HAO/North shop of MTR type “silicide” fuel assemblies and fuel cans, irradiated in the Siloé reactor.

· UP3 and UP2 800 plants

Reception and unloading in the NPH and T0, shops, interim storage in the NPH shops and C, D and E pits and transfer via the le TIP (NPH/C pit transfer system) of a batch of 599 EDF PWR fuel assemblies, with an initial average uranium 235 enrichment before burnup of between 3.87 and 4.03 %, were authorised on 11 April 2003.

o UP3 plant

Reception in T0, interim storage in the C, D, E pits and TIP transfer of a batch of 200 irradiated EDF MOX fuel assemblies were authorised on 13 January 2003.

Reception and transfer by the TIP, interim storage in the C, D and E pits and reprocessing in the UP3 plant of BWR type UOX3 fuels irradiated in the Leibstadt and Philippsburg reactors, were authorised on 11 April 2003.

· UP2 800 plant

NPH and BST1 shops

The NPH and BST1 shops, previously included in the UP2 400 plant, became part of the UP2 800 plant under the terms of a decree authorising modification of the boundary of the site BNIs. Their content and operation were authorised in the previous conditions on the basis of safety files. The content of these files was not questioned so a new authorisation, with the same conditions, was issued within the new regulatory framework. The Director General for Nuclear Safety and Radiation Protection, delegated by the Ministers for Industry and the environment, signed an order accordingly on 15 July 2003. This order was published in the *Journal Officiel* on 4 September 2003.

UCD shop

Processing in the UCD of drums from the MOX fuel fabrication plant and containing technological waste and metal cans which had held plutonium oxide powder, was authorised on 11 March 2003.

NPH pit

Operational approval for reception, unloading and interim storage of non-irradiated MOX fuel elements from the Hanau (Germany) fabrication plant was given on 18 July 2003.

Glass pouring at La Hague

2 | 4 | 5

Site radiation protection

The establishment comprises several shops designed for various activities and nuclear materials (uranium, plutonium and fission products).

On this site, the potential risks are therefore irradiation, external and internal contamination.

However, the design adopted for construction of the new UP2 800 and UP3 plants, combining automation and containment of radioactive materials, has led to a significant drop in the doses received. At the same time, gradual closure of the UP2 400 plant has reduced individual doses still further.

The maximum individual exposure is therefore far below the annual limit set by the regulations.

Through efficient radiation protection management and organisation, the operator is keeping its dosimetry at low levels.

Nonetheless, the fuel reprocessing authorised by the new decrees could lead to a rise in dosimetry.

2 | 4 | 6

Site releases and environment monitoring

The ministerial orders authorising radioactive effluent release from the COGEMA plant at La Hague dated from October 1980 and were supplemented in March 1984. They defined the maximum annual release values. Release from La Hague, notably liquid release, 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 released in this case differ from those from a nuclear reactor and the quantities are larger, as it must be remembered that:

Gaseous releases for 2003 and a reminder of those of 1999 and 2002 are given below

Gaseous release (in TBq per yr)	Limits 2003 order	Limits 1984 orders	1999[1] releases	2002[2] releases	2003[3] release	Estimates 2004[4]
Tritium	150	2200	80	63,2	67	86
Iodines	0,02	0,11 (halogens)	0,008 (halogens)	0,005	0,005	0,007
Rare gases incl. krypton 85	470 000	480 000 (gases other than tritium)	295 000	245 000	252 000	295 500
Carbon 14	28		18,8	16,9	16,5	18
Others β and γ emitters	0,001[5]	0,074 (aerosols α and β emitters)	0,000 12 (aerosols α and β emitters)	0,000 11 (aérosols α and β emitters)	0,000144	0,001
α emitters	0,000 01				0,000 00183	0,000 0018

[1] for 1562 t of reprocessed fuel
[2] for 1060 t of reprocessed fuel
[3] for 1115 t of reprocessed fuel
[4] for 1100 t of reprocessed fuel
[5] this limit is applicable as of 12 January 2005; until then, the annual limit remains fixed at 0.074 TBq

- 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 ASN is of the opinion that the La Hague site release licences should be renewed within the framework of the more general procedure for revision of the authorisation decrees for the installations on this site. Since publication of the ministerial orders concerning releases in 1980 and 1984, the UP2 800, UP3 and STE3 plants have reached their nominal capacities and significant progress has been achieved, with regard to both liquid release, notably by the adoption of new liquid effluent management procedures, and gaseous release, by more efficient treatment. The non-radioactive component of this release (nitrates, tributyl phosphate, cobalt, sulphur, phosphorus, metals, etc.) was subjected to no limitation in ministerial orders concerning release at sea, and had to be regulated in the same way as the radioactive component.

It should be borne in mind that the regulatory release limits established in 1984 involved no particular health problem. The calculated impact of the maximum authorised release on the most exposed group remained well below admissible limits: the calculated annual dose of 0.12 mSv may be compared with the admissible limit for the population of 1 mSv/yr.

The draft ministerial order authorising liquid and gaseous effluent release and water intake prepared by the ASN was, after approval by the Ministers for Industry and the Environment, presented to the Departmental Health Council for the Manche department and the Seine-Normandie river authority, which gave a favourable opinion. The Order, signed by delegation of the Ministers for Industry, the Environment and Health on 10 January 2003, includes discussion meeting clauses for reduction of the impact of chemical and radioactive substances, thereby complying with the objectives of the Sintra declaration, issued in 1998, within the framework of the OSPAR convention. It should be noted that the new limits defined in the Order of 2003 already lead to a significant reduction in the impact on the most exposed population groups: the maximum dose calculated for these groups is reduced to 0.02 mSv per year.

Since the publication of the 22 February 2002 decree creating the Directorate General for Nuclear Safety and Radiation Protection (DGSNR), the DGSNR has taken over responsibility from the OPRI

The liquid releases for 2003 and a reminder of those of 1999 and 2002 are given below

Liquid releases (in TBq per yr)	Limits 2003 order	Limits 1984 orders	1999 releases	2002 releases	2003 releases	2004 estimates
Tritium	18 500	37 000	12 900	11 900	11 900	13 070
Iodines	2,6	/	1,83	1,34	1,28	1,61
Carbon 14	42[1]	/	9,93	7,85	8,65	9,02
Strontium 90	12[2]	220	2,16	1,42	0,515	0,62
Caesium 137	8[3]				0,76	0,71
Ruthenium 106	15	/	7	5,65	7	8
Cobalt 60	1,5[4]	/	0,32	0,38	0,36	0,45
Caesium 134	2	/	0,058	0,065	0,042	0,04
Others β and γ emitters	60[5]	1700	29,6	23,7	7,9	9
α emitters	0,17[6]	1,7	0,040	0,039	0,023	0,02

[1] This limit value takes account of total carbon 14 releases in the liquid effluent, assuming elimination of all gaseous releases.

[2] The limit is 2 for normal releases and 10 for releases linked to shutdown and dismantling (MAD) and recovery of waste from past practices (RCD)

[3] The limit is 2 for normal releases and 6 for MAD and RCD releases

[4] The limit is 1 for normal releases and 0.5 for MAD and RCD releases

[5] The limit is 30 for normal releases and 30 for MAD and RCD releases

[6] The limit is 0.1 for normal releases and 0.07 for MAD and RCD releases

for monitoring COGEMA's radioactive effluent releases. The DGSNR, with the technical support of the Institute for Radiation Protection and Nuclear Safety (IRSN), defines the nature, frequency and technical procedures to be implemented by COGEMA for environmental surveillance purposes. It analyses the monthly records sent in by COGEMA, containing the detailed day-to-day accounting of radioactive releases.

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.

Within the framework of redrafting the La Hague site release licences, the ASN - in cooperation with the Directorate-General for Health and the IRSN - re-examined the environmental surveillance programme prescribed for COGEMA.

The quantity of fuel reprocessed has risen from about 400 t in 1987 to about 1115 t in 2003, with a maximum of about 1670 t in 1996 and 1997.

The following table evaluates the impact of the annual releases, in terms of effective dose, on the "reference groups", in other words the groups of persons among the population for 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 of 1984 orders	Limits of 2003 orders	Real releases 1999	Real releases 2002	Real releases 2003	Estimates 2004
0,120 mSv	0,020 mSv	0,011 mSv	0,008 mSv	0,008 mSv	0,010 mSv

2 | 4 | 7

The marine discharge pipe

Background

Towards 11 March 1997, weather conditions associated with spring tides left a few meters of the marine liquid effluent discharge pipe out of the water for a few hours over several days. Contact dose rates on this part of the pipe of about 300 µSv/h were measured. The descaling operations carried out on the pipe in the Summer of 1997 significantly reduced this irradiation level. About 50 kg of scale were released into the sea further to these operations, affecting sediments with a grain size below 2 cm, located at the end of the pipe in an area of 1900 m^2, by 20 cm in depth.

COGEMA investigated means of retrieving the affected sediments and, in the meantime, implemented a radiological surveillance plan in the area.

COGEMA communicated to the administrative authorities and to the CSPI (special standing information committee for the COGEMA La Hague complex) all monthly measurements performed at the pipe end since September 1997.

In addition, with a view to preventing reoccurrence of the March 1997 incident, COGEMA modified the longitudinal section of the pipe in the tide-affected zone, bringing it closer to the bedrock. The purpose of this modification was to lessen the length of emerged pipe during spring tides and equip the remaining part with biological shielding and mechanical protection (concrete jumpers). This work was completed during 2000.

Demolition of concrete coating zone 2

Cleaning the end of the pipe

Considering the currently available data on sediment contamination and the cost of conceivable cleaning procedures, the ASN deemed this operation not a priority requirement. However, it remains attentive to the development of the situation and reserves the possibility of requesting implementation of depollution operations, should this become necessary. Towards the end of 2001, the ASN undertook a new radiological mapping of the sediments, which revealed that the pollution had decreased, although remaining clearly perceptible.

Dismantling the former discharge pipe

With a view to preparing the actual dismantling operations themselves, COGEMA in 2000 conducted investigations in the immediate vicinity of the former pipe. The purpose of this survey was, on the one hand, to determine the exact routing of the structure and, on the other hand, to characterise the radiological and physical condition of the pipe.

On the basis of these surveys, COGEMA produced a safety file and an impact study on the dismantling operations. The details of these operations and the related impact study were presented to the CSPI (special standing information committee for the COGEMA La Hague complex) before initiation of these operations, which were prepared during August 2001. After separation and removal of the concrete block at the end of the old pipe in September 2001, the operator is dismantling the terrestrial part of this pipe.

On 20 June 2003, the operator was therefore authorised to dismantle the final part of the old pipe, located in the tide-affected zone (zone 3).

The ASN monitors the progress of this work on a weekly basis, with the main concern being to check that there is no contamination of the environment as a result of these operations.

Throughout all these operations, the ACRO (association for radiological supervision in Western France), commissioned by the CSPI continued, as in the past, to ensure environmental surveillance at the same time as COGEMA.

3 SUMMARY AND OUTLOOK

In 2003, front-end fuel cycle installations raised no particular safety or radiation protection problems.

With regard to fuel cycle consistency, examination of the dossier submitted by EDF in 2001 and 2002 revealed nothing that could rule out the new envisaged fuel management systems. It showed the need for updating at regular intervals of the data forwarded by EDF as well as for each new fuel management system, to demonstrate the compatibility of the options presented with the installations of the cycle and to anticipate future fuel cycle installation developments envisaged by the manufacturers.

The new COGEMA La Hague site authorisation decrees and the new release licence were published at the beginning of 2003, setting a precise and suitable framework for operation of the plan over the coming years.

The ASN expresses a positive opinion on the stringency and dependability with which COGEMA ensures the safety of the La Hague complex facilities. But it nevertheless continues to attach particular importance to safety and radiation protection on this site, to which about 10% of all its inspections are devoted. This is in particular justified by the nature and quantity of radioactive materials stored on the site. Intended to enhance its competitiveness in a context where many facilities have reached maturity and where the new reprocessing contracts have a fixed-price basis, the new organisation will continue to be monitored throughout its implementation, notably with regard to human factor aspects. Finally, among the priority safety subjects, the retrieval of waste due to past practices and the shutdown and dismantling of a certain number of old shops in the UP2 400 plant are areas which are and will continue to be a subject of constant attention on the part of the ASN.

Following public inquiries, the effluent release licence applications for the Tricastin site facilities were approved. However, despite finalisation of the technical provisions, signing by the ministers is dependent on examination of a supplementary dossier taking account of releases recently identified.

Finally, the safety review on the Romans-sur-Isère nuclear site will have to continue, taking account of the ASN requests concerning the fuel elements fabrication plant (BNI 98) and the examination by the Advisory Committee for laboratories and plants of safety in the shops operated by the CERCA company (BNI 63).

CHAPTER 14

SAFE SHUTDOWN AND DISMANTLING OF BASIC NUCLEAR INSTALLATIONS

1 TECHNICAL AND ADMINISTRATIVE PROVISIONS

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3 OUTLOOK

4 LIST OF BASIC NUCLEAR INSTALLATIONS DECLASSIFIED AS AT 31.12.2003

5 LIST OF BASIC NUCLEAR INSTALLATIONS FINALLY SHUT DOWN AS AT 31.12.2003

CHAPTER 14

SAFE 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 unregulated status, subject to possible adjusted easements.

The Nuclear Safety Authority (ASN) now strives to integrate relevant experience feedback from past dismantling projects in France and abroad. The ASN aims to encourage complete dismantling either immediately or after slight postponement, provided that upstream of launch of the regulatory procedures, the operator is able to present and justify the chosen dismantling scenario, from the final cessation of operation up to the final dismantling of the installation. Regulatory practices concerning BNI dismantling operations were updated along these lines in early 2003.

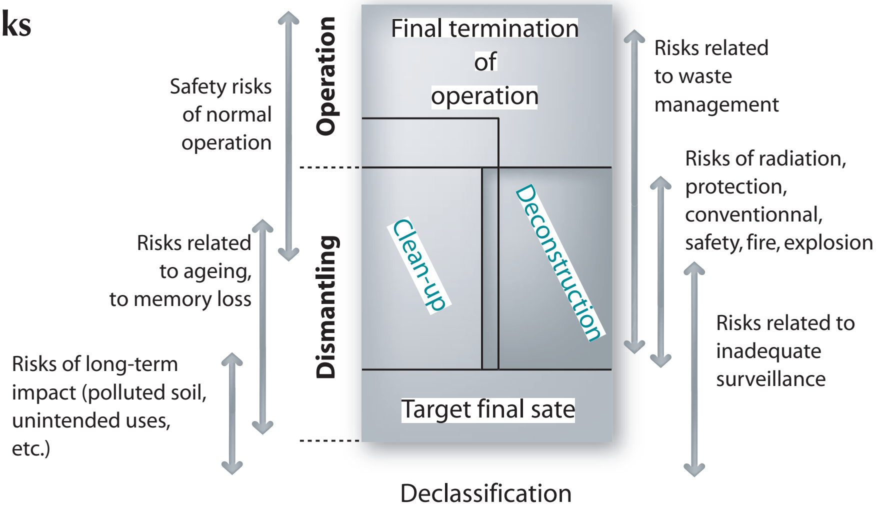
The Nuclear Safety Authority (ASN) considers the dismantling operations currently proceeding as test cases, providing an opportunity for the operators to define and implement a dismantling strategy (dismantling level to be reached, detailed operating schedule) on the one hand, and a management policy for the large amounts of radioactive waste that will be generated (notably the very low level waste), on the other. If carried through to their conclusion, they would also constitute examples demonstrating the technical and financial feasibility of an entire dismantling process.

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 risks



The figure below 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 enter 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 memory 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 not very 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 more appropriate means (radiological, fire), 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 would seem necessary in most cases that there be a means of preserving the memory of the past existence of a basic nuclear installation on a site, along with any utilisation restrictions corresponding to the condition of the site. The procedures for downgrading after clean-up are mentioned in chapter 15.

The ASN specified the regulatory framework for BNI dismantling operations in a note signed on 17 February 2003, following extensive work to clarify and simplify the administrative procedures, while improving the extent to which safety and radiation protection are taken into account.

New practical measures for application of article 6 ter of the amended decree of 11 December 1963 are now in place in order to:
- clarify the definition of the leading technical and administrative stages in dismantling to ensure that it is better tailored to the diversity of nuclear installations;
- encourage complete dismantling initiated either immediately or after slight deferral;

- encourage presentation and justification by the operator of the dismantling scenario chosen, ahead of initiation of the regulatory procedures, from the decision to cease operations up to complete dismantling;
- clarify the administrative notion of downgrading of a basic nuclear installation and the related criteria.

This revision leads to a clearer definition of the two main phases in the life of an installation, each of which is associated with a single authorisation decree, the authorisation decree for the operating phase and the final shutdown and dismantling decree for the dismantling phase. This creates a more balanced picture, both technically and administratively, between the importance given to the dismantling phase and that given to the operating phase.

All of these provisions are detailed in note SD3-DEM-01 of 17 February 2003, available on the ASN's web site.

2 NUCLEAR INSTALLATION DEVELOPMENTS IN 2003

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 Nuclear Safety Authority 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 for all its decommissioned nuclear installations (Brennilis, Bugey 1, Saint-Laurent A, Chinon A, Chooz A and Superphénix) this new dismantling strategy, 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 February 2002, the ASN asked EDF to produce an abstract presenting its overall view of dismantling of these 9 reactors, along with the associated technical justifications (safety of each installation, radiation protection, management of associated waste, especially graphite, organisation set up, skills maintenance, description of target final state). These documents were transmitted in January 2003 and are being investigated prior to examination by the Advisory Committee for laboratories and plants, scheduled for the first quarter of 2004.

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 certain stipulations 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, should be published in the *Journal Officiel* in early 2004.

The application for authorisation for complete dismantling of the reactor was submitted by EDF in July 2003.

In 2002, the main activity on the site was the pursuit of the clean-up work of the effluent treatment station (STE) and the spent fuel building (BCI) in order to be able to propose to the DGSNR that these buildings be downgraded from a nuclear waste zone to a conventional waste zone and then demolished. In 2003, a first nuclear building, the solid waste interim storage (EDS), was downgraded and then demolished..

Brennilis — a cleaned-up area in the BCI

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 maintained under operator surveillance.

After observing non-compliance with certain obligations of the decree of 27 August 1996, the Nuclear Safety Authority 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 pools that are to be cleaned up.

- 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 2003, the main activities concerned the continued removal and dismantling of conventional equipment and fuel pool water evaporation operations.

In addition a complete update and revision of the safety documentation were produced, corresponding to the current final shutdown stage of the installation; the new documents were sent to the Nuclear Safety Authority in March 2003.

Saint-Laurent A2 — pit decontamination

- Bugey 1 reactor

The decree authorising final shutdown operations was signed on 30 August 1996. The main work performed in 2003 concerned packaging of the graphite sleeve containers for shipment to the Aube repository, sampling of concrete and demolition of the pumping station.

In addition a complete update and revision of the safety documentation were produced, corresponding to the current final shutdown phase of the installation; the new documents were transmitted to the ASN in June 2002.

Bugey 1 — Demolition of the pumping station

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.

Furthermore, in order to take account of the change in the dismantling level of this reactor and pave the way for complete dismantling operations, EDF in 2003 submitted an application for modification of the decree of 19 March 1999.

En 2003, the main work done was demolition of the conventional buildings and clean-up of the "hill-side" buildings.

Chooz A — Demolition of the turbine hall

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 December1998.

In early 2003, all the fuel assemblies had been removed from the reactor and stored in the APEC. The reactor vessel only contains special assemblies presenting no risk of criticality, and lateral neutron shielding. The final decommissioning operations continued, particularly in the turbine hall.

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. These various applications will be the subject of an administrative procedure, technical examination and a public inquiry in 2004.

Onsite spent fuel storage unit (APEC)

This facility was definitively 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.

2 | 2

CEA installations

In January 2003, the ASN asked the CEA to provide it with a certain number of documents enabling it to assess the overall dismantling strategy for the CEA's civilian installations, in particular in terms of consistency and management of the related waste. The ASN envisages referring to the Advisory Committees on this subject.

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 denuclearised 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 dossier applying for authorisation for complete dismantling and modification of the boundary of the Centre's BNIs was transmitted to the ASN in December 2003. It will be submitted to a public inquiry in 2004.

- Radioactive effluent and solid waste treatment station and solid waste interim storage station

Despite the cessation of certain activities (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.

- 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. These operations should be completed by 2003.

Characterisation of Petrus tanks

Characterisation of the Petrus high level tanks underwent an internal authorisation process at the end of 2003.

- 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. Clean-up of the filter hall floor took place in 2002.

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. 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 section of the National Institute of Nuclear Sciences and Technologies (INSTN) whose main vocation is teaching.

- Effluent and solid waste treatment station and decay storage

As part of the denuclearisation of the Grenoble centre, the CEA's initial strategy was to extend the life of the main components of the effluent and solid waste treatment station (BNI 36) by 10 to 20 years, and to continue to operate the decay interim storage facility (BNI 79) until 2020, so that these installations would be available for dismantling of the Centre. During the safety review of BNIs 36 and 79, the CEA revised its initial strategy and in 2001 opted for gradual shutdown of the activities in these two BNIs by the end of 2010. In particular it announced the shutdown of all waste treatment and packaging activities in BNI 36 and the closure of interim storage of any new high-level drums in the BNI 79 decay pits as of 2005, with total clear-out of these pits by the end of 2010.

Installation of BNI 79 decay pits containment

- 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 still present in the installation has been removed.

- Mélusine and Siloé reactors

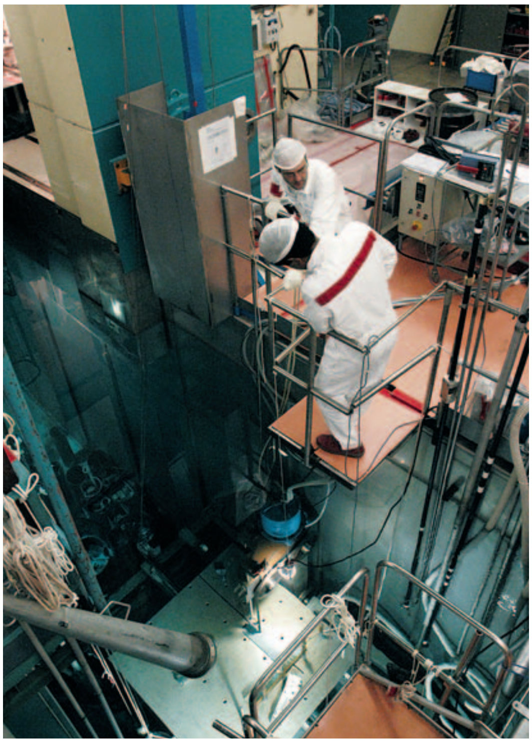
TN 106 transport packaging in the LAMA

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 for its dismantling and downgrading should be published at the beginning of 2004. Certain advance work has been done to drain the reactor pool.

The Siloé reactor, located on the CEA site in Grenoble, has been shut down since 23 December 1997.

Decommissioning operations began in 1999 and should be completed very shortly, according to the provisions approved by the ASN in October 1999. The CEA sent the ASN the additional data for the final shutdown and dismantling file requested. The work to characterise and remove objects from the pool continued..



Siloé — underwater cutting

Mélusine — empty reactor pit

2 | 2 | 3

The Cadarache site installations being dismantled

- Rapsodie reactor

Rapsodie, a fast neutron experimental reactor, was shut down on 15 April 1983. Its operation ended formally 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 cleanup and partial dismantling have resumed. About 35 tons of contaminated sodium was to have been removed to the ATENA destruction unit which the CEA was considering putting into service in 2008. The CEA Administrator General however stated in November 2003 that he was unable to fund the project within the specified time-frame. Additional data is awaited regarding the replacement strategy. The CEA sent the ASN an update to the installation RGE and has begun to look at rationalising the ICPEs within the BNI boundary.

- Fuel assembly shearing laboratory (LDAC)

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 decontaminated and is awaiting downgrading.

- 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, its operation stopped formally on 18 December 1997.

The decree authorising the CEA to carry out installation final shutdown and dismantling should be published at the beginning of 2004.

- 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, which was updated in 2003. The ASN also authorised dismantling of the installation’s incinerator.

- 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 of the installation should be published at the beginning of 2004.

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 continued clean-up of cells 3, 5, 11, 12 and 15. The ASN also gave the LHA operator formal notice to comply, within cell 0, with one of the technical specifications of which it had been notified.

- 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. Installation dismantling is not scheduled 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.

Decree 2002-1254 of 8 October 2002 authorising final shutdown and dismantling of this installation was published in the *Journal Officiel* on 15 October 2002. As at the end of 2003, these operations are virtually completed.

- 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 “cessation of operation” stage.

The decree authorising the CEA to carry out the shutdown and dismantling operations on the ALS installation should be published at the beginning of 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 the course of 2002 and 2003 (upgrading of the ventilation system, radiological mapping, etc.) with a view to resumption of dismantling operations in about 2004-2005.

- 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

Other installations

2 | 3 | 1

FBFC plant at Pierrelatte

Until March 1999, the FBFC company produced slightly enriched uranium oxide based new fuel at its Pierrelatte plant. By decree 2000-434 of 22 May 2000, FBFC was authorised to proceed with final shutdown and dismantling operations at this installation.

The FBFC plant in Pierrelatte was removed from the BNI list on 15 May 2003 at the same time as contractual easements were taken out on behalf of the State. These precautionary easements will enable a trace of the past history of the plot to be kept in the mortgage registry.

Signature of the easement document for the FBFC site

2 | 3 | 2

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 yet to be signed.

2 | 3 | 3

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.

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. The ASN has requested additional data to supplement these two files.

3 OUTLOOK

The definition of new regulatory practices applicable to BNI dismantling operations, in early 2003, is the final step in a revision process that has been under way for a number of years.

Since the beginning of 2003, the nuclear operators have submitted numerous files in accordance with the guidelines of this new regulatory practice. These files are currently being examined by the ASN and primarily concern the many installations which have been shut down for several years, but for which the operators had not yet initiated the regulatory procedures for obtaining dismantling authorisation. 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 generic files giving an overall description and a safety and radiation protection justification of their strategy and schedule for dismantling their many closed installations. These dossiers will be subject to in-depth examination in 2004 and 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 forthcoming change in the status and the partial privatisation of EDF and AREVA raises the question of funding of installation dismantling and waste management. A system must be set up to guarantee that these funds are available and sufficient when the time comes. The ASN will remain attentive to ensuring adequate treatment of these issues in the legislative and regulatory measures to be adopted in 2004.

4 List of basic nuclear installations declassified as at 31.12.2003

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	Assaini-Servitudes(***)
SNCS Osmanville	(formerly BNI n° 152)	Ioniser	1990	1995	2002 : Removed from BNI list	Cleaned-up

(*) Fontenay-aux-Roses - (**) Attila : reprocessing pilot plant located in a BNI 57 cell - (***) Servitudes : des servitudes conventionnelles au profit de l'État ont été souscrites sur les parcelles concernées.

5 LIST OF BASIC NUCLEAR INSTALLATIONS FINALLY SHUTDOWN AS AT 31.12.2003

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 31.12.2003 (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		En cours de mise à l'arrêt définitif
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

CHAPITRE 15

RADIOACTIVE WASTE, CLEAN-UP AND POLLUTED SITES

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8 **OUTLOOK**

CHAPITRE 15

RADIOACTIVE WASTE, CLEAN-UP AND POLLUTED SITES

INTRODUCTION

This chapter deals in a general way 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 deals with:
- how radioactive waste is managed in operational activities;
- how clean-up of sites and installations is regulated, to prevent pollution;
- how past or current pollution (polluted sites) is dealt with to guarantee protection of the environment and the public.

Finally, certain installations designed for radioactive waste disposal concentrate intentionally radioactivity in a single place; how the surrounding public and environment are protected falls within the domain of waste repository safety, which must be dealt 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 its concentration, 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. It mainly comes from site facilities containing no radioactive materials (administrative buildings, technical facilities, etc.). It may also consist of packaging removed before the equipment or products contained are transferred to nuclear areas of the sites. This conventional waste is sorted, compacted and disposed of according to the same rules and in the same installations as other conventional industrial waste.

Radioactive waste for its part comes from site areas which are or are likely to be contaminated or activated. Management of this waste involves a series of operations aimed at ensuring, in the short or long term, the protection of individuals, preservation of the environment and limitation of related constraints imposed on future generations. Management must thus be reliable, stringent and transparent.

It 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.

1 | 1

Radioactive waste categories

Radioactive wastes vary considerably by their activity level, their half-life, 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, mainly comprising short-lived radioelements (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. The absence to date of definitive disposal solutions for certain waste will be noted.

Table 1: Existing or future disposal channels for the main radioactive solid wastes

Period Activit	Very short-lived	Short-lived	Long-lived
Very low level	Management by radioactive decay	Dedicated surface repository Recycling channels	
Low level		Surface disposal (Aube repository) except tritiated waste, sealed sources (under investigation)	Dedicated subsurface disposal facilities under investigation
Medium level			Channels under investigation of article L.542 of the Environment Code (law of 30/12/91)
High level		Channels under investigation under the terms of article L. 542 of the Environment Code (law of 30/12/91)	

.– 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.

– Very low-level waste (VLL)

Apart from the waste which previously came from the exploitation of the uranium mines, very low level waste today chiefly comes from dismantling of nuclear installations, conventional industrial sites which employ low-level radioactive substances in their production processes, 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 gramme.

– Short-lived medium and low level waste

The activity of short-lived medium and low level waste is mainly due to radionuclides emitting beta or gamma radiation, with a half-life of less than 30 years. In this waste, long-lived radionuclides are strictly limited. This type of waste comes from nuclear reactors, fuel cycle facilities, research centres and university laboratories and hospitals. It consists mainly of manufacturing waste and used equipment and materials, sealed sources, cleaning rags and protective clothing. This category also includes products from gaseous and liquid waste treatment at nuclear installations.

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 § 5 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 m^3 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.

Most sealed sources fall into this category: in industrial or medical activities, the radioactive elements used are frequently contained in perfectly leaktight recipients. The tightness of the container is guaranteed either by periodic leak tests, or 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-is 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.

Some waste also contains significant quantities of tritium, a short-lived radioelement which is hard to contain, owing to its volatility, unlike the other radionuclides.

Working groups coordinated by the Directorate General for Nuclear Safety and Radiation Protection (DGSNR), sometimes with the assistance of the services of the Defence Nuclear Safety and Radiation Protection Delegate (DSND), bring together the ANDRA and the producers of the waste concerned, in order to find management channels appropriate to this type of waste.

– 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 DGSNR 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 process 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. It is characterised by intense heat release which, for each 150 litre container, can reach 4 kW, making cooling necessary. This high level waste also 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).

1 | 2

Radioactive waste and polluted site 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, including sites polluted by radioactive substances. The latest edition of this inventory was released in 2002. It can be ordered free of charge from the http://www.andra.fr/fra/observatoire/ web site. In November 2001, the ANDRA released a synthesis of the national radioactive waste inventory as produced since 1993, for the form of this inventory will be considerably modified over the next few years.

With regard to polluted sites, the Ministry of Ecology and Sustainable Development has for a number of years been carrying out work to survey all former industrial sites in France, through regional historical inventories, leading to production of a database, the data bank of former industrial sites and service activities (BASIAS). It is available from the following web address http://basias.brgm.fr.

On 9 December 1998, the government gave the Chairman of the ANDRA an assignment consisting in “proposing any reform aimed at enhancing the reliability of the inventory of this waste and in particular extrapolation of the data to cover the medium and long terms”. The report submitted in June 2000 recommends in particular the compilation of a national reference inventory, based on a broad conception of the notion of waste (including spent fuel without further use) and providing prospective assessments of future waste currently inside 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 the four-year contract signed between the State and the ANDRA. The first “new style” inventory should be released at the end of 2004, replacing the periodic inventories hitherto produced; an updated version should be produced in 2006. The ASN is a member of the steering committee for this new inventory.

The table below presents data resulting from the discussions organised by the Chairman of the ANDRA. The figures shown are approximate and can vary depending on the various packaging options selected and the spent fuel management strategy adopted. 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 represent in 2020 more than a billion terabecquerels, for a total volume of just a few thousand cubic meters.

Table 2: Approximate values of existing waste stocks, annual throughputs and expected total quantities after final shutdown and dismantling of existing industrial equipment (reprocessing of 1000 tons of spent fuel per year, depending on MOX fuel requirements)

Categories of BNI waste	Existing stocks at 31.12.98	Estimated annual throughput (m^3/yr) (excluding dismantling)	Expected volumes after final shutdown and dismantling of the existing industrial equipment (m^3)
Very low level	about 50,000 tons	n.a.	1 to 2,000,000
Short-lived medium and low level	625,000 m^3 stored or immersed	12,000 to 15,000	1,300, 000
Tritiated, short-lived, medium and low level	1,500 m^3	n.a.	3 500
Long-lived low level – Graphite	14,000 m^3 not packaged	0	14,000
Long-lived medium level	21,000 m^3 packaged 15,000 m^3 to be packaged	530	56,000
High level	1,630 m^3 vitrified 260 m^3 to be packaged	130	5,000
Unused spent fuel	9,900 tons of heavy metal	100	15,000

n.a.: not available
(source: Report sent to the government by the Committee on radioactive waste inventory methodology, led by Yves Le Bars, Chairman of the ANDRA, La Documentation française, 2000)

1 | 3

Radioactive waste management framework

Radioactive waste management falls within the general scope of Law 75-633 of 15 July 1975 (Article 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. It entails:

- drafting of “waste surveys” for each nuclear site, adopting an approach already used for certain installations classified on environmental protection grounds (ICPE). The waste survey will involve drawing up an inventory of waste management provisions on a site, comprising in particular the definition of “waste zones”, with a view to identifying areas of the installation where waste could have been contaminated by radioactive substances or activated by radiation and those where waste produced contains no added radioactivity. The waste surveys must be approved by the ASN;

–for each type of radioactive waste, definition of authorised and appropriate disposal channels, based on impact studies and on which the general public has been informed or consulted;

– setting up of waste monitoring systems, ensuring traceability.

Most of the nuclear operators completed preliminary waste surveys before the beginning of 2002. These waste surveys had to be further improved in order to be fully acceptable. Taking account of its analysis of the first waste surveys submitted, the ASN in September 2002 published a revised version of its guide for the drawing up of nuclear installation waste studies (available on www.asn.gouv.fr), stipulating notably the criteria on which the waste zoning of an installation areas and roadways should be based.

The waste survey system should enable initiation of a progressive process for the overall upgrading of waste management, particularly with regard to transparency, and the development of optimised management channels.

Waste from areas in a nuclear installation where it may have been contaminated by radioactive substances or activated by radiation is, as a safeguard, considered to be at least “very low level” waste in the management channels provided in this respect. Conventional waste is disposed of in conventional channels. Basic traceability is in all cases guaranteed.

– 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.

The circular states that as of July 2003, presentation of the institution waste management plan will be a pre-requisite to renewal of the radioelement possession licences.

The texts implementing the decree of 4 April 2002, which will replace this circular, are currently being drafted. They will be based on the same approach as in basic nuclear installations, but with the simplifications made necessary by the scale of the radiological risk and the volumes of waste to be considered. Each institution or company authorised to use unsealed sources will therefore be asked to produce a waste management plan, describing the zoning of the installation, application of the principles of upstream waste sorting and traceability, the outgoing items inspection methods and the disposal channels used. These plans will be subject to approval by the entity which issued the source possession licence, except in simple cases, in which application of standard provisions ensures compliance with the regulations.

– 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 can be envisaged. 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. The purpose of this decree is to improve waste supervision and follow-up provisions throughout the treatment and disposal stages, by imposing traceability systems (registers, periodic administrative reports and waste follow-up dispatch notes).

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 landfills, foundries and incineration plants. These systems constitute an extra line of defence in the supervision of radioactive waste management channels.

1 | 4

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.

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 § 7|3).

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.

ANDRA — package reception in the VLL waste repository in Morvilliers

Finally, 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|5

The national radioactive waste management plan

The preceding paragraphs show the various technical and regulatory aspects of radioactive waste management: categories (according to the disposal method), inventory, regulations at source, role of the various players. All of these aspects are gradually put in place over the years, as inadequacies in certain areas are brought to light.

It is clear that there is a need for an overall framework allowing consistent management of all radioactive waste, whoever the producer, in order to guarantee safe management and the necessary funding, in particular by determining the relevant priorities.

Picking up on a request by the Parliamentary Office for assessment of scientific and technological options in 2000, based on the report produced in 2002 by the Deputy of the Drôme Michèle Rivasi, the Nuclear Safety Authority organised meetings early in the year to study 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. The search for overall, durable solutions also involves participation by all parties concerned in environmental protection. This is why the ASN attaches great importance to having members of parliament and representatives of environmental protection associations take part in the work involved in drafting the plan.

The plenary working group is also taking into consideration the conclusions of the main working groups already active in this field. Some of them, such as the working group for sources with no further use, were created specifically for this purpose. Others, such as the group responsible for examining the conditions for disposal of waste with enhanced natural radioactivity, as defined by the regulations, comprise participants in the plenary group.

The plan is based on work designed to identify the waste that exists throughout the country. This primarily concerns the ANDRA observatory. The absence of any forward-looking aspect of this document should be remedied by a description of the disposal channels envisaged within the framework of another ANDRA exercise, called the “National inventory” see § 1|2).

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.

Finally, the production of such a plan complies with certain requirements the European Union is striving to implement as part of the draft radioactive waste directive.

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.

2 WASTE MANAGEMENT BY THE PRODUCERS

2 | 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, where possible, 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

2 | 1 | 1

CEA waste management

The CEA operates treatment, packaging and/or 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. Solid waste for which there are operational channels (reprocessing, disposal through incineration or melting, disposal in approved surface repositories) is disposed of accordingly. 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 large volume of which is generated by the CEA, in particular through its dismantling activities, is stored onsite pending removal to the VLL 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 holds solid and liquid waste from past practices which can sometimes be difficult to retrieve (technical difficulties linked to spontaneous overall solidification of effluent, lack of characterisation) or for which there is no operational disposal channel. The ASN ensures that retrieval and/or treatment of this waste is one of the CEA's priorities in its waste management policy, and that in the meantime, adequate surveillance is provided.

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). The PEGASE facility at the Cadarache Centre (pool interim storage) underwent a safety review on 15 January 2003. Before making a final decision on whether to continue PEGASE operations until 2015, the ASN asked the CEA to provide additional seismic studies and, for the fuel elements fabrication by-product drum storage areas, studies concerning the risks of dissemination of radioactive materials and fire-fighting measures. Considering the limits, in terms of space and heat removal capacity, of the Cadarache CASCAD facility (dry interim storage bunker for spent fuel elements, with natural convection cooling), the CEA will have to specify its intentions regarding the future of certain fuels, given the fact that the plans to set up a new installation called ECUME have been abandoned.

New installations and resources at the CEA

CEDRA

The CEDRA facility (radioactive waste packaging and interim storage) is scheduled for commissioning in 2006 with regard to the interim storage function and 2009 for the processing function. CEDRA will be located on the CEA's Cadarache site. 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 with regard to its interim storage. CEDRA will also take the waste from past practices on the site. In October 2003, the Interministerial Commission for BNIs issued a favourable opinion concerning the draft decree authorising creation of the CEDRA facility.

AGATE

The AGATE (advanced effluent treatment management shop) project will take the place of BNI 37's radioactive effluent treatment and packaging activities. AGATE will be located on the Cadarache site. It is currently scheduled for commissioning in late 2009. In November 2003, the ASN sent the CEA its comments on the updated safety options file for AGATE.

MAGENTA

The MAGENTA (cellular storage shop) installation is scheduled for 2008 for eventual replacement of the CEA's MCMF installation on the Cadarache site. The role of MAGENTA will be to store CEA and COGEMA nuclear materials without further use. It will be located on the Cadarache site.

At the end of 2003, the CEA informed the ASN that the ECUME (Marcoule spent fuel interim storage) and ATENA (sodium destruction shop) projects had been abandoned, after review of the CEA's strategic plan concerning its installations.

In early 2004, the ASN asked the CEA to specify the replacement channels envisaged for the waste that was to have been processed or stored in these facilities.

Retrieval of waste from BNI 56 trenches

The Cadarache interim storage area (see § 7|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. Recovery work should begin in 2004.

2 | 1 | 2

Waste management by COGEMA at La Hague

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. This examination should take place at the end of 2004.

Fission products

After a decay period in stainless steel tanks, the fission product solutions resulting from spent fuel reprocessing are calcinated and then vitrified. The resulting molten glass, incorporating the fission products, is poured into stainless steel containers. After solidification of the glass, the containers are transferred to an interim storage installation where they are air-cooled pending disposal (Law of 1991) or shipment 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 managed. 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 shop. The packages complying with ANDRA technical specifications for surface disposal are sent to the Aube repository. If this is not 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 shop. 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 shop 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.

Waste from past practices

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 current safety requirements and the waste must therefore be retrieved, a process that can involve significant investment.

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 is currently experiencing problems with characterising the sludges in these silos, which is a pre-requisite to commencement of any packaging operation. The ASN is currently assessing COGEMA's proposals on this subject.

2 | 1 | 3

EDF waste management

Operating waste

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:

- process waste from gaseous or liquid effluent treatment used to reduce the activity level prior to release. This includes ion exchange resins, water system filters, evaporator concentrates, liquid sludge, pre-filters, 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);

- special waste from exceptional replacement and maintenance operation (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 sludge are coated with a hydraulic binding agent, using permanent installations (in the plant nuclear auxiliaries building or waste treatment building) or mobile equipment, depending on the reactor type and the units concerned.

In 2002, the waste management policy developed by EDF, both centrally and in the NPPs, both for operating waste and for waste from past practices, was jointly reviewed by the Advisory Committees for reactors and for waste. On the basis of this examination and the findings obtained during its own inspections in 2000 and 2001, the ASN asked EDF in December 2002 to improve safety conditions in the buildings in which most of the waste management is carried out on the NPPs, to initiate processing and disposal of obsolete steam generators, and to look for disposal channels for the waste stored in pools, chemical waste and graphite waste. The ASN also asked EDF for clarification of its waste management organisation.

The future of EDF spent fuel

After unloading, EDF transfers its spent fuel to interim storage pools provided in buildings 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 portion of spent fuel which is not reprocessed will have to be disposed of through channels devised in 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 11), has repercussions on the fuel cycle installations (see Chapter 13) 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 linked 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

2 | 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|3).

2 | 2

Radioactive waste management in medical, industrial and research activities

2 | 2 | 1

Origin of waste and radioactive effluent

Many areas of human activity utilise radioactive sources; this is particularly the case with diagnostic and therapeutic activities. But it is also the case of industrial and research activities. This use of radionuclides in sealed and unsealed sources may lead to the production of radioactive waste and effluent.

Sealed sources are primarily used in radiotherapy (telegammatherapy and brachytherapy appliances) and for measurement. Given their characteristics (radionuclides usually with half-lives of several years and high activity levels) these sources must be recovered by their supplier when no longer in use. Decree 2002-460 of 4 April 2002 reinforced the sealed source recovery requirements previously adopted by the CIREA (see chapter 3). These sealed sources are not likely to produce radioactive effluent in normal conditions of use and storage.

The conditions in which unsealed sources are used in nuclear medicine, biomedical and industrial research are 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 liquid effluent comes from source preparation (liquid radioactive residues, water used to rinse contaminated items, scintillating products used to assay certain radioelements, etc.) and above all the patients themselves who naturally eliminate the radioactivity administered to them.

To the radioactive hazard can be added other hazards, in particular the risk of infection from pathogens (viruses, bacteria, parasites) contained in this waste and effluent generated by health care activities. This usually represents the highest risk and requires specific handling rules and appropriate packaging if it is to be correctly controlled, failing which it can cause nosocomial infections (infections contracted in health care establishments).

Apart from the radioactive waste and effluent resulting from nuclear medicine practiced within health care establishments, there is also diffuse production by the patients when they return home. This production only lasts a few days, the time needed to eliminate any residual radioactivity administered. The patients must therefore be given instructions in order to minimise the consequences of these discharges on the environment (waste such as incontinence pads, compresses, bandages and so on should be kept for a few days). The French biophysics and nuclear medicine society (SFBMN) is currently working with the DGSNR on drafting general instructions to supplement the information at present given to patients by nuclear physicians and their teams.

2|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 abide by the provisions of § 1|3 of this chapter, in particular circular DGS/DHOS 2001/323 of 9 July 2001.

The collection and management of radioactive waste and effluent is based on 4 principles:

- the waste must be sorted and packaged as early 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 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 will be 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 must be systematically checked before disposal;

- the waste and effluent must be disposed of using appropriate channels. Waste originating from the use of radionuclides with a half-life of less than 100 days can be disposed of in the household waste channel, provided there is no infectious or chemical hazard. If there is such a hazard, the health care waste will be routed to one of the specialised channels. Aqueous liquid effluent containing radionuclides with a half-life of less than 100 days may 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/or 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 a period of interim storage putting to good use the phenomenon of radioactive decay (as a general rule, at least 10 half-lives of the radionuclides concerned), medical waste may be disposed of in conventional or hospital waste circuits, provided that a sufficiently low level of radioactivity is guaranteed (about 1.5 to 2 times the background noise) and there is adequate traceability of the waste. A portal 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;

- sanitary facilities of the nuclear medicine department used by patients to whom diagnostic or therapeutic doses have been administered. 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 two buffer tanks operating alternately with one being filled and the other used for decay storage. This arrangement avoids direct release of radioactive effluent into the general 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 opposite 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;

- discharges from sanitary facilities intended for injected patients must spend time in a septic tank type radioactive decay pit, before being routed 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.

Buffer tanks

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 following table gives the various activity concentration values applicable to drainage of buffer tanks or to the establishment's outfall.

Activity concentration check points	Applicable activity concentration value	Comments
Diagnosis buffer tanks	7 Bq/l	Tanks for effluent from diagnostic or therapeutic radionuclide dose preparation and administration premises (<740 MBq).
Therapy buffer tanks	100 Bq/l	Tanks linked to the sanitary facilities in the rooms for patients receiving therapeutic doses of iodine 131 >740 MBq.
Septic tank	–	Septic tank connected to the nuclear medicine sanitary facilities reserved for patients who have received diagnostic or therapeutic doses (<740 MBq). The septic tank operates in a continuous cycle, so there are no effluent outlet activity concentration values.
Hospital outfall	1000 Bq/l for ^{99m}Tc 100 Bq/l for ^{131}I	These are reference guideline values for the checks to be performed regularly (at least 4 times per year, over a minimum period of 8 hours) or continuously with an appliance at the outfall. If the value is exceeded, a fuller investigation over a longer period must be carried out to determine a mean activity concentration which, if higher than the guideline values, will require the establishment to take a fresh look at its effluent discharge procedures in order to improve them.

2 | 3

Management of waste containing natural radioactivity

The Public Health Code states that industrial activities which are likely to enhance natural ionising radiation must conduct “supervision of exposure [of persons] and an estimation of the doses”. These activities are likely to generate waste which has concentrated the natural radioactivity and thus trigger the landfill entry portals. 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.

Some of these installations are no longer active. However, most of them are (or were) regulated in accordance with Part 1 of Book V of the Environment Code. The Nuclear Safety Authority 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 aim of the Nuclear Safety Authority is to ensure that the sorting and packaging of this waste is managed as far in advance as possible, so that the waste is systematically routed to the appropriate channels. 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.

3 INSTALLATIONS CLEAN-UP

This section deals with the steps taken to clean-up installations and premises which contained radioactive materials, to guarantee that all the parts which could have been in contact with radioactive substances are removed and that the remaining parts can be considered conventional.

Dismantling operations can also pose safety problems, and are dealt with in Chapter 14. 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).

3 | 1

Basic nuclear installations

The clean-up method today favoured 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 zoning of the waste 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 the nuclear waste from the nuclear waste zones, before implementing an appropriate inspection programme on the remaining items, to confirm that they are indeed non-radioactive. 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 thickness of concrete, a programme to confirm the conventional nature of the remaining walls was implemented.

As the pilot site using this methodology the solid waste interim storage (EDS) building in Brennilis was the first nuclear building to be cleaned-up using this methodology. This final waste zoning modification was approved by the Director General for Nuclear Safety and Radiation Protection in January 2002. The building was then demolished in April 2002. The products of this demolition, considered to be conventional waste, could be reused on the site as back-fill.

In 2003, 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. Correct application of this methodology will be checked by the Nuclear Safety Authority through applications for approval of final waste zoning modifications for these buildings, which should be submitted to the DGSNR, and are expected for early 2004.

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.

3 | 2

Medical, industrial and research installations

The ASN has little data concerning clean-up of medical, industrial and research installations. However, the clean-up methodology to be followed for this type of installation will be similar to that followed for nuclear installations: it involves defining waste zoning for differentiating between nuclear waste and conventional waste. After disposal of all nuclear waste in duly authorised channels, the conventional nature of the remaining items must be confirmed and submitted to the Director General for Nuclear Safety and Radiation Protection for approval.

4 POLLUTED SITES

According to the interministerial Circular of 16 May 1997, a site polluted by radioactive substances means any abandoned or operational site on which natural or artificial radioactive substances have been or are being utilised or stored in conditions such that the site constitutes a health or environmental hazard.

Handling and treatment of polluted sites are priority activities for the Nuclear Safety Authority. This is why, when 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.

4 | 1

Activities since 2002

4 | 1 | 1

General remarks

The activities carried out since the creation of the DGSNR confirm the wide diversity of polluted sites. The pollution can be due to past activities for which the industrial operator responsible is no longer present (radium industry for instance), to “declining” economic activities (uranium mining, rare earth mine workings, etc.) or to new industrial activities. The health and environmental impacts also vary widely and the depollution targets to be defined depend on the future use (industrial, housing estate, school, park, etc.) chosen for the site concerned. After checking the depollution 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.

Rehabilitation of the INRA's Pech-Rouge vineyard by CEA/Cadarache

The Pech-Rouge vineyard, near Narbonne, belongs to the INRA. It was intentionally contaminated in the 1960s, primarily with caesium 137 and strontium 90, as part of the experimentation conducted by the CEA at the time into transfer of radioelements to the environment.

The INRA gave the Cadarache CEA the task of examining how to rehabilitate the vineyard, with the clean-up work remaining under the responsibility of the INRA. On 20 December 2002 the ASN authorised performance of the rehabilitation work on the basis of the rehabilitation file transmitted by the CEA in July 2002 and subject to a number of additional requirements being taken into account.

Interior of the Pech-Rouge experimental site. On the left: Big bags ready for loading and covered open-tops. On the right: LAMAS 2 — onsite gamma measurement laboratory truck

The rehabilitation work took place during the second quarter of 2003. All clean-up criteria were met. However the zone to be cleaned proved to be more extensive than anticipated, which increased the volume of waste to be disposed of.

A constraint on behalf of the State and entered in the mortgage register, will be put in place to ensure that a permanent record is preserved of the past activities on the Pech-Rouge vineyard and establish appropriate surveillance. This should guarantee that in the future, the successive owners of the land cannot be unaware of the situation and will prohibit any reworking of the land without radiological monitoring and any cultivation of edible products on this plot of land. The ASN participates in the drafting and will sign the constraint order.

4 | 1 | 2

Radium fund committee

The interministerial meeting of 20 June 2001 decided to create a “radium fund” to provide financial assistance to help owners of sites contaminated by the radium industry in the 1920s-1930s to rehabilitate their sites. The dossiers concerned are examined by a panel of experts comprising representatives from the Directorate for the Prevention of Pollution and Risks, the Directorate General for Nuclear Safety and Radiation Protection, the Directorate General for Energy and Raw Materials, the National Agency for Radioactive Waste Management, the Institute for Radiation Protection and Nuclear Safety, the Departmental Directorate for Health and Social Affairs, the Union of Site Depollution Professionals, the Building Industry's Scientific and Technical Centre, the Association of French Mayors, and various environmental protection associations (ACRO, CRIIRAD). The prefect's office concerned may also take part in the debates. 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. Nonetheless, no clean-up work was actually done in 2003.

For the more complex cases, the committee drafted technical data sheets summarising all the solutions examined, along with the technical and economic advantages and drawbacks. It is now up to the ministers concerned to choose the solution best suited to each of the properties.

4 | 1 | 3

Management of incidental contamination

The obligation of systematic installation of detection gantries in the industrial waste disposal or recycling centres has revealed traces of radioactivity in the waste to be treated, leading to management of incidental radioactive contamination. Initial feedback from the few incidents in 2003, which caused radioactive contamination in establishments in which there is normally no radioactivity (metal foundries), where radionuclides are not normally used in an unsealed form (brewery using a level measuring device equipped with a sealed source) showed the need to be able to inform the head of the establishment rapidly of his main responsibilities and of the risks in the field of radioactive contamination.

This is why the ASN drafted a note which is to be promptly sent out to all heads of establishments in which unexpected radioactive contamination is detected.

To improve the corrective action following on from such an incident, contact will shortly be made with companies working on the radioactive decontamination market, to examine practices regarding decontamination of this type of sites and to specify good practices to guarantee:

- effective decontamination, consistent with clean-up doctrines used in installations utilising radionuclides in unsealed form;

- quality management of radioactive waste, consistent with the existing waste disposal channels.

4 | 2

Outlook

The Nuclear Safety Authority and the Directorate for the prevention of pollution and risks will on 4 May 2004 be organising a symposium on the subject “Radioactive contamination: how to deal with polluted sites?”. This symposium will be an opportunity for an exchange of views in this field by the public authorities, industry, environmental protection associations/and departmental and regional authorities. It will concern general policy and the legal framework, risk assessment, depollution objectives, clean-up methodologies, financial consequences, and media management during discovery of a site and during the works. It will lead to an inventory of polluted radioactive sites in France and of their management. It will also provide feedback from management of polluted radioactive sites abroad.

The proceedings of the symposium and the discussions between the various players concerning clean-up methodology and legal, media and financial aspects, will lead to a revision of the “methodology guide for management of industrial sites potentially contaminated by radioactive substances of October 2000 (version 0)”, to clarification of doctrine concerning polluted radioactive sites and to systematic use of constraints consistent with the regulatory framework, the media context and clean-up practices.

5 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.

Since August 2003, a very low level waste repository has also been in service.

Surface or subsurface storage projects are being defined for other types of low-level waste.

5 | 1

Manche waste repository

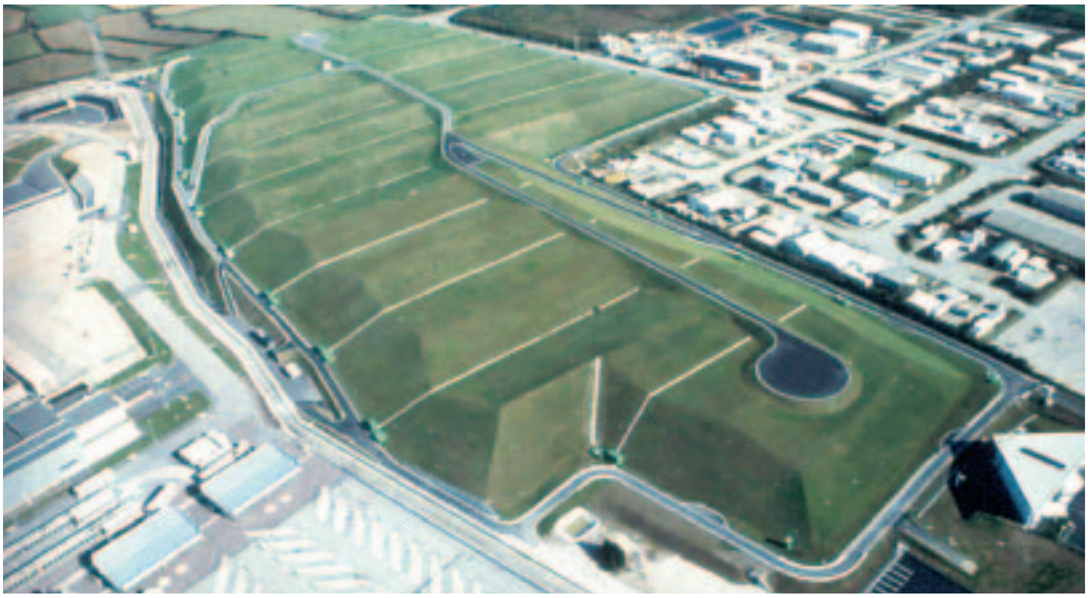
The Manche waste repository, with its 530,000 m³ capacity, was set up in 1969 at Digulleville and operated until July 1994. The final covering (leaktight and grass-covered), to protect the structures containing the waste against all water infiltration, was completed in June 1997. The localised settling of this covering layer detected in September 1999 would not appear to have worsened significantly since. However, this aspect remains under close surveillance.

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 order were signed and were published in the Official Gazette in 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,



ANDRA — Manche waste repository

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

5 | 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 one million cubic metres of waste packages, entailing about 400 structures. Apart from the storage structures, the repository comprises a waste packaging shop, equipped for two types of operation: compaction of 200 l drums, using a 1000 ton press, and grouting of the 5 or 10 m^3 metal containers enclosing the waste.

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 2002, the ANDRA informed the ASN that storage of these reactor vessel heads would not be taking place before 2004. In 2003, construction began on the structures to house the vessel heads.

Aube waste repository

After ASN's authorisation in November 2001, the ANDRA disposed of the CEA's ATENA remote-manipulator in May 2002. This large package required specific concrete injection procedures inside the disposal structure.

In 2002, the ASN authorised reception of irradiating packages from COGEMA La Hague. Package disposal began in early 2003.

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. This application is currently being examined by the ASN.

In June 2002, the ANDRA sent the ministers responsible for 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. The files for these applications should be subject to a public inquiry in 2004.

Disposal of irradiating packages

5 | 3

Very low level 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, tech-

VLL waste repository

nical studies had been conducted by the ANDRA and by SITA FD since 1996 with a view to creating a repository intended for very low level radioactive waste. In 1999, the ANDRA and SITA FD created a consortium called Omégatech and began to look for a site for such an installation. Field reconnaissance surveys were conducted in 1999 and 2000. The site finally chosen is not far from the Aube waste repository. The procedures involved in the installation creation authorisation (as an ICPE), 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 on environmental protection grounds (ICPE), with a capacity of 650,000 m^3, has been operational since August 2003.

5 | 4

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 quality order of 10 August 1984.

When Basic Safety Rule RFS III.2.e was published in May 1995, this text was presented as being applicable for a limited period. It has since appeared advisable to revise this rule, notably with a view to better defining package approval documents and taking into account technological progress achieved in the waste packaging field. With a view to launching efforts in this respect, at the end of 1999, the ASN asked the ANDRA and the main waste producers (EDF, COGEMA and the CEA) for information on the operating experience obtained from application of this RFS, indicating where applicable any modifications they deemed necessary. In response to this request, the ANDRA sent the DSIN, in September 2000, a document, drawn up in cooperation with the waste producers, proposing a revised RFS text. This proposal was discussed by a working group bringing together the ANDRA, the DGSNR and the IRSN. A draft text was then transmitted by the DGSNR to the waste producers for comments in July 2003. A discussion meeting was organised in November 2003 to examine the producers' comments.

This draft RFS will be submitted to the Advisory Committee for waste during the second quarter of 2004. It could then be distributed in 2005.

At the same time, meetings were held by the Advisory Committee for waste, to examine the situation regarding the waste produced by each nuclear operator (see § 2).

5 | 5

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 quickly as possible, as it is currently being stored in conditions which sometimes pose health problems.

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.

– 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.

In 2003, the ANDRA sent the ASN its concepts for an alternative solution to subsurface disposal. The proposed solution is to place the waste in a mining site or an underground cavity.

A working group, led jointly by the ASN and the DSND, periodically reviews these repository projects

6 DISPOSAL OF LONG-LIVED HIGH-LEVEL WASTE: APPLICATION OF ARTICLE L.542 OF THE ENVIRONMENT CODE (LAW OF 30 DECEMBER 1991)

Article L.542 of the Environment code (derived from Law 91-1381 of 30 December 1991) defined the main research paths for 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 DGSNR is also taking part in the work leading to drafting of 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 | 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, mainly by chemical means, 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, which implies extensive research.

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 extensive 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 objection to resumption of operation, enabling the CEA to restart power operation of the reactor in July 2003. At a later stage in this research, the implications of possible industrialisation of the separation and transmutation processes would have to be examined.

6 | 2

Underground laboratories

Article L.542-3 of the Environment code provides for thorough analysis of the feasibility of reversible or irreversible disposal of radioactive waste in deep geological formations, notably by means of underground laboratories to be constructed.

Further to the ANDRA licence application examination procedure, which had comprised in 1997 a technical assessment and consultation of the general public and local councils, the government decided on 9 December 1998 to authorise installation of an underground laboratory at Bure, on a frontier site between two departments, the Haute-Marne and the Meuse. It also decided that a selection procedure should be initiated for a new granite site, since that previously selected at La Chapelle-Bâton in the Vienne department had been deemed not entirely satisfactory.

On 3 August 1999, the authorisation decree for the installation and operation of the Bure laboratory was signed. On the same day were also signed the decree regarding the CLIS (local information and follow-up committee) for underground laboratories and the decree concerning the concertation mission prior to selection of a second underground laboratory.

After the failure of the concertation mission, owing to strong local opposition, and on the basis of a report submitted by this mission in July 2000, the government issued a communiqué confirming its desire to see research into reversible disposal of radioactive waste in deep geological formations, in accordance with one of the three research paths of Article L. 542-3 of the Environment code, being continued on two different sites. The government indicated that discussions would be organised on the terms and conditions of concertation and that the general public would be provided with information on the back-end of the fuel cycle.

In connection with the Bure laboratory excavation work, the ANDRA provided the ASN with a set of documents presenting the experimentations to be carried out during the shaft sinking work. These documents were examined by the ASN and its technical support organisations in 2000. 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. This approval was accompanied by requests for additional experiments to be conducted in certain geological strata encountered during shaft sinking.

The ANDRA began the shaft sinking work in August 2000. Excavation work however had to be interrupted owing to a fatal accident on 15 May 2002. After a six-month halt imposed by the courts, the emergency interim proceedings judge of the court of first instance of Bar-le-Duc authorised resumption of shaft sinking work on 21 November. Actual resumption of the work could not take place until May 2003, as it meant that the site personnel had to be remobilised and the safety improvements requested by the technical assessment body (APAVE) implemented. In November 2003, the bottom of the access shaft was at a depth of 300 m and the bottom of the auxiliary shaft at 250 m. It will therefore be impossible to excavate the laboratory horizontal galleries at a depth of -500 m before the end of 2004.

Through inspections at the headquarters of the ANDRA and on the Bure site, the ASN checked that all quality assurance steps are being taken to ensure that the experiments conducted during excavation of the shafts provide the expected results, and that the measures designed to limit hydraulic and mechanical disruption of the shaft environment have indeed been implemented.

After an overall assessment at the beginning of the year 2000, carried out with the assistance of the Advisory Committee for waste and concerning the various studies conducted by the ANDRA, both for characterisation of the Bure site and for definition of the disposal concepts and associated safety approach, the ASN asked the ANDRA in June 2000 to forward various files over the 2001-2002 period, to allow a preliminary safety verification of the underground storage concepts it had adopted. In

October and November 2001, the relevant Advisory Committee examined the ANDRA experimentation programme for the Bure underground laboratory. Given the tight schedule in the lead-up to 2006, priorities were established concerning the experiments to be conducted.

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. On the basis of an identification of the key points linked to the safety of the Bure site, a programme of assessments by the Advisory Committee for waste of the various elements of this file was defined for the period 2002-2004. Within this framework, the hydrogeological model of the site was examined in November 2002. General examination of the 2001 dossier and the approach adopted was carried out in June 2003, and assessment by the Advisory Committee of the mechanical behaviour of a possible repository and the chemical factors governing its evolution, should take place in March and June 2004 respectively.

At the same time, international examination of this dossier through a peer review process was organised in the first half of 2003 by the OECD's nuclear energy agency, at the request of the Ministry for the economy, finance and industry and the Ministry for research.

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 should be examined by the Advisory Committee for waste in the second half of 2004.

Bearing in mind the various assessments it will be required to carry out, the ASN - in association with the IRSN and the ANDRA - set up a working group in 2003 responsible for updating Basic Safety Rule III.2.f concerning deep underground repositories for 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.

6 | 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. Subsequent to this, the ASN informed the CEA of its requirements concerning the preparation of the safety options files to be sent to it by the end of 2003. The ASN is considering defining its position in 2006 on the safety of long-term interim storage concepts, by means of a reference guide or a Basic Safety Rule.

6 | 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 packages 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.

Discussions on this topic would appear to be sufficiently advanced for work to start in 2001 on the drafting of a reference guide for 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. Even if a compilation schedule for this guide was defined by the CEA and the ANDRA in October 2001, at the request of the ASN, actual drafting had progressed little by 2003, reflecting the problems with reconciling current R&D on the packages in question, long-term storage and the operation of a future deep disposal facility. In June 2003, it was therefore considered preferable simply to draft a reference note concerning these packages.

7 INTERIM STORAGE OF RADIOACTIVE WASTE AND SPENT FUEL

In terms of radioactive waste, the notion of storage is fundamentally different from that of disposal. Storage is designed to house the waste for a specified time. After this time, the waste must be recovered. Storage cannot be considered a long-term solution for disposal of waste. Even if it does not rule out reversibility, disposal however is designed for conservation of the waste with no time limit.

Other potentially recyclable materials, such as spent fuel, are also stored.

There are two types of storage for waste and spent fuel:

- temporary storage involved in daily management of the installations, made necessary to enable sufficient volumes of the waste and spent fuel to be grouped for transport or reprocessing, or to allow radioactive decay of very short-lived radionuclides;

- storage of waste and spent fuel for which there is as yet no disposal channel.

This section only concerns the second type of storage. These installations must be designed to allow safe storage for a sufficiently long time for an appropriate disposal channel to become available. The existing storage facilities are designed according to the usual design rules. They do not take account of the problems linked to long-term storage, which is the subject of research under the terms of Article L.542 of the Environment code (see § 6|3).

7 | 1

Basic nuclear installations intended for interim storage of radioactive waste and spent fuel

The CEA has several installations for storing waste and spent fuel which service life is limited to a few decades and which undergo periodic safety reviews.

The CEA's BNI 22 in Cadarache comprises CASCAD (Cadarache bunker) and PEGASE. CASCAD is a dry storage bunker comprising pirts, for spent fuel for which reprocessing has been temporarily postponed. The fuel is cooled by natural convection. The PEGASE installation, a former research reactor, was modified after final shutdown of the reactor in order to ensure primarily, from 1980, underwater storage of spent fuel and dry storage of drums containing fuel element fabrication by-products. In 2003, PEGASE underwent a safety review, but it could not be completed.

The Cadarache storage area (BNI 56) mainly stores radioactive solid waste, generally long-lived and packaged. The waste packages are stored in hangars and in pits. The storage area also has trenches filled with low and medium level waste (see paragraph 2/1). These activities are supplemented by underwater storage in two pools of spent nuclear fuel mainly from the gas cooled reactor (GCR) plant series, which is in the process of being sent to STAR (BNI55) for processing and packaging before storage in an appropriate installation.

The CEA stores high level waste in decay pits in BNIs 79 (Grenoble), 73 (Fontenay-aux-Roses) and 72 (Saclay). These pits should be completely cleared during the coming decade (see Chapter 12).

In 2002, EDF sent the ASN a conceptual safety options file for a planned installation called ICEDA (activated waste packaging and storage installation). As things currently stand, EDF considers that the ICEDA project is just one of many solutions for handling long-lived medium level waste generated by the operation of nuclear power plants and the dismantling of reactors currently decommissioned. In 2003, the ASN informed EDF of its main expectations with regard to the preliminary safety report, following the examination by itself and its technical support organisation of the safety options file. Several installations at La Hague are also devoted to waste storage (see Chapter 13).

7 | 2

Waste resulting from nuclear operator past practices

As a result of their past activities, wheter industrial or for research purposes, COGEMA, the CEA and EDF stored radioactive waste on their sites (La Hague, Saclay, Marcoule, Cadarache, AMI Chinon, EDF GCR reactors, silos at Saint-Laurent-des-Eaux). This storage was in conformity with the regulations and rules of good practice applicable at the time. The lack of or age of the packaging of this waste and the initially planned service life of the storage facilities combined with the increasingly stringent safety requirements, means that this waste has to be recovered so that it can be more durably packaged.

Current and future actions are of several types:

- study of new recovery, treatment and packaging processes;

- precise characterisation of waste resulting from past practices;

- implementation of treatment and packaging installations meeting current installation and packaging safety criteria; these could be either new installations or reconditioned installations, such as the CEA effluent treatment stations;

- retrieval of waste, by using specific equipment or treatment installations: La Hague sludge recovery installation (see Chapter 13, § 2/1/2), equipment for treating the waste from the "trenches" and pits in the Cadarache storage area;

- use of storage installations designed and sized for a time-frame compatible with the creation of final solutions following research into the management of long-lived high and medium level radioactive waste.

The ASN strives to ensure that there is no slippage in the schedule for these large-scale programmes (they are scheduled to last several decades).

Among the waste resulting from past practices, the ASN pays particular attention to that for which there is currently no appropriate disposal channel. To examine these questions, the High Commissioner for Atomic Energy (currently the DSND) and the Director for the Safety of Nuclear Installations (at present the DGSNR) at the request of the minister for industry, in 1997 jointly set up a working group bringing together the waste producers, the ANDRA and the other entities concerned. This group is examining possible solutions for disposal of tritiated waste and waste containing graphite (see § 5|4).

Until such time as the waste is retrieved, the ASN ensures that these frequently ageing waste storage installations are given adequate surveillance and that sufficient remedial measures are taken to ensure compliance with current safety criteria. In the more difficult cases, replacement of the installation may be necessary.

In this context, the ASN asked EDF in 1999 to begin work to improve the safety of its irradiated graphite sleeves storage silos on its Saint-Laurent-des-Eaux site. In 2002, the ASN asked EDF to empty these silos by 2010.

7 | 3

Interim storage of radioactive waste not produced by the nuclear industry

Radioactive waste which is not generated by the nuclear industry and for which there is no disposal channel, is generally long-lived low or medium level waste. It is primarily waste containing natural radioelements of the uranium family, used in an industrial process which, either intentionally or not, leads to concentration of these elements to a point at which special measures to protect against radiation are necessary. Waste generated by clean-up of former industrial sites employed in the radium industry generally falls into this category. It also includes radioactive sources used for a variety of purposes: lightning arresters, smoke detectors, medical needles made of radium, etc.

When a solvent owner exists for this waste, it is its responsibility to take the necessary steps to store it (for example: waste generated by the Rhodia rare earths processes). Nonetheless, in a certain number of cases, this condition is not met, or it is preferable not to leave the object with a private individual (radium needles for example). Responsibility for storing a certain number of these types of waste must therefore be assumed by the public authorities.

The ANDRA is taking a certain number of steps concerning these storage facilities. As it has little storage capacity of its own, it calls on the services of nuclear operators such as the CEA (Saclay, Cadarache) or SOCATRI in Pierrelatte. Modification of the SOCATRI decree (decree 2003-511 of 10 June 2003, published in the *Official Gazette* on 17 June 2003) allows interim storage in satisfactory safety conditions of a large amount of diffuse radioactive waste. The ANDRA's aim is by June 2004 to deal with all the dossiers still pending. Opening of the CSTFA in 2003 should also enable the backlog of diffuse nuclear materials and polluted site clean-up waste to be absorbed. It would however seem that the ANDRA still does not have sufficient available storage capacity to meet all the demand, in particular with regard to heavily tritiated waste and depleted uranium metal. In addition, the agreements between the ANDRA and the nuclear operators to which it subcontracts, are not always clear. Finally, the ANDRA has no public financing for these operations and has to pay for them out of its own funds.

The DGSNR asked the ANDRA to review this situation, so that concrete proposals could be made. The aim is to achieve a system that is clear and open, and in which the public duty which is the disposal of radioactive waste without the existence of a solvent owner, can be lastingly financed. This aspect will have to be dealt with in the national radioactive waste management plan.

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Interim storage Basic Safety Rule

With a view to drafting a basic safety rule applicable to interim storage of solid and liquid radioactive waste and fuel for which there is no current use, the operators, at the joint request of the DGSNR and DSND, transmitted in 2002 files presenting feedback of their experience with operation of storage installations. A working group comprising representatives of the storage facilities nuclear operators and the ASN, was set up to prepare a draft basic safety rule which was transmitted to all nuclear operators in 2003 for consultation. The draft text will be presented to the Advisory Committee for waste in 2004.

8 OUTLOOK

The ASN aims to see the problem of nuclear waste dealt with safely and consistently, whatever the origin of the waste and the disposal methods.

The significant event of 2003 was the decision to initiate production of a national radioactive waste management plan (PNGDR), involving waste producers and disposal channels, administrations, but also local and national elected representatives and environmental protection associations. The aim is to provide a consistent framework for management of radioactive waste in France. Drafting of the PNGDR could lead to an initial document opened for public consultation in 2004.

The ASN is therefore convinced of the importance of rapid production of “waste surveys” by the operators of basic nuclear operations, so that there is a clear and open framework for management of waste from these installations. For the other activities involving radioactive materials, new regulations are under preparation, to ensure consistency with the waste survey philosophy, in particular with regard to zoning of the installations.

The ASN is vigilant with respect to the continued retrieval of waste due to past practices placed in interim storage under unsatisfactory conditions and of clean-up activities on former nuclear sites or sites polluted by past practices.

As some waste has no disposal channel, it must be stored. The ASN has initiated the drafting of a basic safety rule for storage of radioactive waste and materials aimed at clarifying and modernising the safety criteria for these installations. Furthermore, with regard to “orphan” waste, action was instigated with the ANDRA, the CEA and the DGEMP, to clarify the conditions (including financial) in which it is dealt with and stored.

The ASN will also supervise compilation of the preliminary design documents for the new nuclear waste repositories (for waste containing graphite, radium, VLL waste, etc.) notably with regard to the impact of the repositories and the safety assessment methods used. It ensures that these methods are compatible with those used for conventional waste landfills and with impact assessment methods for polluted sites. The ASN is of the opinion that the timetables and main policy decisions stipulated in Article L.542 of the Environment Code (derived from the Law of 30 December 1991) should be adhered to for research concerning long-lived, high level waste. The ASN ensures that the various projects developed within this context provide credible technical solutions which are acceptable from the long term safety standpoint. It will base its decisions on reference documents it will produce, which could subsequently be transformed into Basic Safety Rules in view of the government proposals which will be formulated and the Parliamentary debate which will take place. These documents will mainly concern the safety options for the various systems conceived by those involved in research into long-term waste management. The ASN also participates in the interministerial bodies responsible for writing the government’s report to Parliament in 2006.

The ASN is convinced of the need to expedite research on definitive management solutions for waste for which no disposal channel has yet been identified. This is an essential requirement insofar as the interim storage facilities, some of which are beginning to age, were designed for the temporary reception of waste. The ASN invites the waste producers to adopt a more consistent waste management policy, involving the retrieval of waste due to former practices and their safe interim storage, efforts to minimize production of waste currently without disposal channels and consolidated actions for the development of new channels. The ASN will assist with setting up of new disposal channels by providing a suitable legal and regulatory framework, in cooperation with the other government authorities concerned.