DIRECTORATE GENERAL FOR NUCLEAR SAFETY AND RADIATION PROTECTION

6, place du Colonel Bourgoin - 75572 PARIS CEDEX 12
Tel. 01 43 19 36 36 - Fax 01 40 19 86 69
Site Internet de l'ASN : www.asn.gouv.fr

MINISTRY OF COMMUNITY, HEALTH AND FAMILY
MINISTRY OF ECONOMY, FINANCE AND INDUSTRY
MINISTRY OF ECOLOGY AND SUSTAINABLE DEVELOPMENT

IMPRIMERIE CARACTÈRE

2005

NUCLEAR SAFETY AND RADIATION PROTECTION IN FRANCE IN 2005

AUTORITE DE SURETE NUCLEAIRE

Direction générale
de la sûreté nucléaire
et de la radioprotection

NUCLEAR SAFETY AND RADIATION PROTECTION IN FRANCE IN 2005

NUCLEAR ACTIVITIES, IONISING RADIATION AND HEALTH RISKS

1 DANGERS AND RISKS OF IONISING RADIATION

1|1 Biological and health effects

1|2 Evaluation of risks linked to ionising radiation

1|3 Scientific uncertainty and vigilance

2 FIELDS OF ACTIVITY INVOLVING RADIOLOGICAL RISKS

2|1 Basic nuclear installations
2|1|1 Definition
2|1|2 The safety of basic nuclear installations
2|1|3 Radiation protection in basic nuclear installations
2|1|4 The environmental impact of basic nuclear installations

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

2|3 Production and use of ionising radiation

2|4 Radioactive waste

2|5 Contaminated sites

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

3 EXPOSURE TO IONISING RADIATION

3|1 Exposure of the population to NORM

3|2 Doses received by workers
3|2|1 Exposure of nuclear workers
3|2|2 Worker exposure to TENORM
3|2|3 Flight crew exposure to cosmic radiation

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

3|4 Doses received by patients

4 OUTLOOK

CHAPTER 1

Nuclear activities are defined by the Public Health Code as “activities involving a risk of human exposure to ionising radiation, emanating either from an artificial source - whether a substance or device - or from a natural source when natural radionuclides are or have been processed for their fissile or fertile radioactive properties, as well as interventions designed to prevent or mitigate a radiological risk following an accident or contamination of the environment”. These nuclear activities include those conducted in basic nuclear installations (BNIs) and during transport of radioactive materials, as well as in all industrial and research facilities and hospitals where 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 transport, use 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 transport of radioactive materials, and intended to prevent accidents and mitigate any consequences thereof.

Radiation protection is defined as the set of prevention and monitoring 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, which created the Directorate General for Nuclear Safety and Radiation Protection, also gave this Directorate - under the authority of the ministers for Health, Industry and the Environment - responsibility for defining and implementing nuclear safety and radiation protection policy. The DGSNR together with the regional offices for which it organises and supervises activities in its area of competence, is referred to as the “Nuclear Safety Authority” (ASN).

1 DANGERS AND RISKS OF IONISING RADIATION

1 | 1

Biological and health effects

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

When not repaired by the cells themselves, these lesions can lead to cell death and the appearance of health effects once tissues are no longer able to carry out their functions. These effects, called “deterministic effects”, have been known for a long time, as the first effects were observed with the discovery of X rays by Roentgen. They become apparent once the quantity of radiation absorbed exceeds a certain dose level, depending on the type of tissue exposed; the effects increase proportionally to the dose of radiation received by the tissue.

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

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

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

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

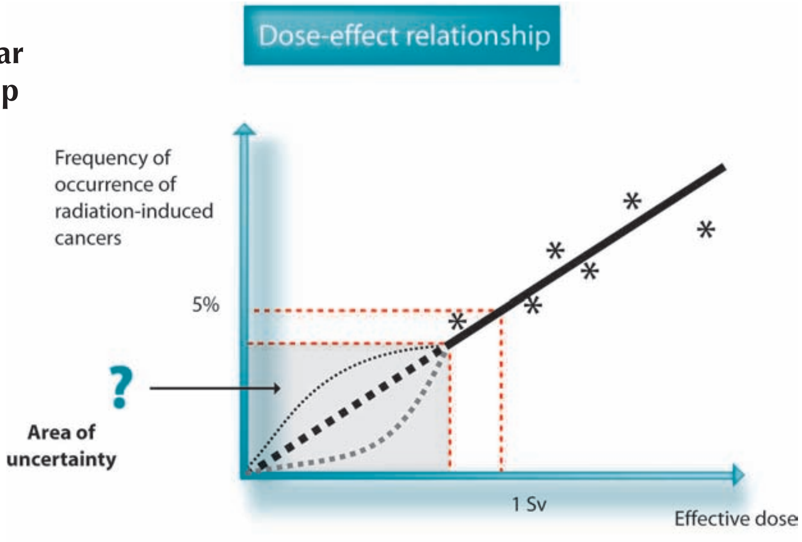
1 | 2

Evaluation of risks linked to ionising radiation

Cancer monitoring in France is based on departmental registers: 10 general registers and 9 specialised registers cover about 15% of the general mainland population and there are also 2 national child cancer registers (hematological malignancy and solid tumours in children), with the aim - as with any monitoring system - of identifying trends in terms of an increase or reduction in the incidence of this disease over a period of time, or of locating clusters of cases in a given region. This intentionally descriptive monitoring method cannot identify radiation-induced cancers, as their form is not specific to ionising radiation.

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

Diagram of the linear relationship without threshold



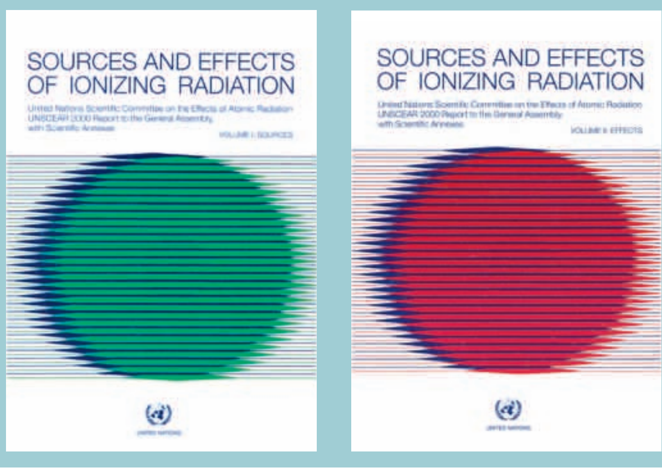
The study from the International Agency for Research on Cancer (IARC), published in the British Medical Journal of 29 June 2005, presents a compilation of the data concerning exposure of workers in the nuclear industries of 15 countries. This study, covering 407,391 workers, is the largest epidemiological study of nuclear workers so far carried out, and shows a calculated rise of 1 to 2 % in the risk of death from cancer. This is the first time that an increase in excess relative risk of cancer has been brought to light by the epidemiology of nuclear workers exposed to low doses of ionising radiation. This result does however confirm the assumption of a linear relationship without threshold with low doses of ionising radiation, on which current radiation protection rules are based.

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 conservative 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.

UNSCEAR

The United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) was set up in 1955 during the 10th session of the General Assembly of the United Nations. It comprises representatives from 21 countries and reports to the General Assembly of the United Nations. It is a scientific organisation whose aim is to validate and approve the results of national or international studies into the effects of ionising radiation on man.

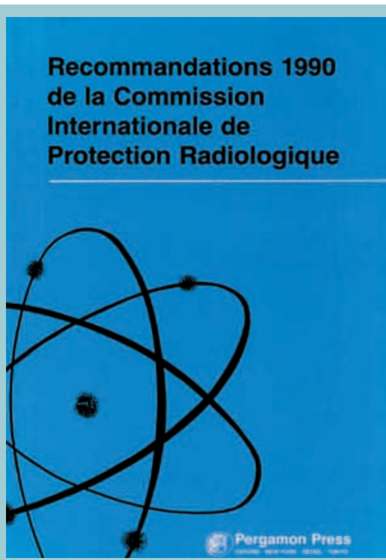
Every 5 years, UNSCEAR publishes a summary of the work conducted internationally in 2 fields: radiation sources (metrology) and the effects of radiation on man (radiobiology, radiotoxicology, etc.) (see next page). The next publication is scheduled for 2006.



UNSCEAR 2000 reports

ICRP

For many decades now, the International Commission on Radiological Protection (ICRP) has been publishing radiation protection recommendations which are usually adopted as the basis for international standards (particularly those issued by the IAEA) and community directives. New recommendations are currently being prepared. After consultation concerning an initial draft in 2004 on its website (www.icpr.org), new proposals were made in 2005 for a publication planned for 2007, following a further consultation. These recommendations will be issued together with fundamental documents concerning the biological and epidemiological bases for risk assessment, the values and units used in radiation protection, characterisation of the reference individual for dose estimates, optimisation of radiation protection and protection of the environment.



CIPR 60

In this context, and on the basis of the scientific work performed by UNSCEAR (see box), the International Commission on Radiological Protection (see ICRP publication 60) published coefficients for the risk of death by cancer due to ionising radiation, identifying a 4% excess risk per sievert for workers and 5% per sievert for the population at large. 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 due 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 detrimental effects has led to a reduction in risks but has not reached either zero risk nor zero impact, whether in terms of the doses received by medical or industrial workers, or those associated with releases from BNIs. However, many uncertainties and unknown factors persist and require the ASN to remain attentive to the results of the scientific work in progress, for example in radiobiology and radiopathology, with possible spin-offs for radiation protection, particularly with regard to management of risks at low doses.

One can in particular mention six areas of uncertainty:

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

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

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

• *Hereditary effect* - The appearance of possible hereditary effects from ionising radiation in man remains uncertain. Such effects have not been observed among the survivors of the Hiroshima and Nagasaki bombings. However, hereditary effects are well documented in experimental work on animals: the mutations induced by ionising radiation in the embryonic germ cells can be transmitted to the descendents. 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 absolutely ruled out, the probability of this type of event nonetheless remains low.

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

• *Environment* - The purpose of radiation protection is to prevent or reduce the direct or indirect harmful effects of ionising radiation on humans, including through damage to the environment: human protection entails protection of the environment, as illustrated by the impact assessments submitted to the public inquiries prior to granting of BNI discharge 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;
- TENORM activities.

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" (BNIs) 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 a 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 provisions of book V of the Environment Code (conditions applicable to installations classified on environmental protection grounds (ICPEs).

The BNI status as at 31 December 2005 is given in appendix B.

2 | 1 | 2

The safety of basic nuclear installations

The fundamental principle underpinning the organisational system and the specific regulations applicable to nuclear safety is 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 their inspections, the public authorities check correct implementation of these measures and draw the corresponding conclusions.

2 | 1 | 3

Radiation protection in 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, medical monitoring of 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.

2 | 1 | 4

The environmental impact of basic nuclear installations

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

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

Radiological monitoring of the environment around a BNI

2 | 2

Transport of radioactive and fissile material for civilian use

When transporting radioactive or fissile materials, the main risks are those of internal or external exposure, criticality, or chemical hazard. Safe transport of radioactive materials relies on an approach called defence in depth:

– the package, consisting of the container and its content, is the first line of defence. It plays a vital role

Transport of radioactive materials

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.

2 | 3

Production and use of ionising radiation

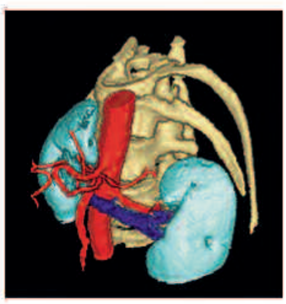
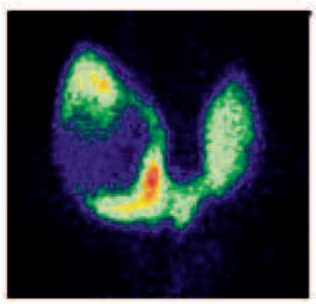
Ionising radiation, whether generated by radionuclides or by electrical equipment (X-rays), is used in very many areas of medicine (radiology, radiotherapy, nuclear medicine), human biology, research, industry, but also for veterinary and medico-legal applications as well as for conservation of foodstuffs.

In terms of radiation protection, most of these activities - also considered to be nuclear activities - are the subject of a general system of licences or, as applicable, a special system of licences (case of BNIs, ICPEs and installations subject to the Mining Code) in which, on the basis of information forwarded by the licensee, the various radiation protection related aspects are examined, with regard to protection of both the workers and the population at large. Environmental protection is also taken into account through requirements applied to discharges of liquid and gaseous effluent. In the case of use for medical purposes, patient protection issues are also examined.

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


1. 2.

3. 4.

1. First X-ray produced in 1895 by Wilhelm Conrad Röntgen, reproducing his wife's left hand.
2. Lung radiography.
3. 3D reconstitution of the kidneys, their blood supply and the bones in this region (spine and ribs).
4. Thyroid gland scintigraphy produced after injecting the patient with a radioactive tracer.

2 | 4

Radioactive waste

Radioactive waste packaging

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).

2 | 5

Contaminated sites

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

2 | 6

Technologically enhanced naturally occuring radioactive materials (TENORM)

TENORM activities justify supervision, and even risk evaluation and management, if 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

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

vicinity of the places where these activities are carried out. This is in particular the case with activities which use materials (raw materials, construction materials, industrial residues) containing natural radioelements not used for their radioactive, fissile or fertile properties. The natural families of uranium and thorium are the main radioelements encountered.

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

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

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

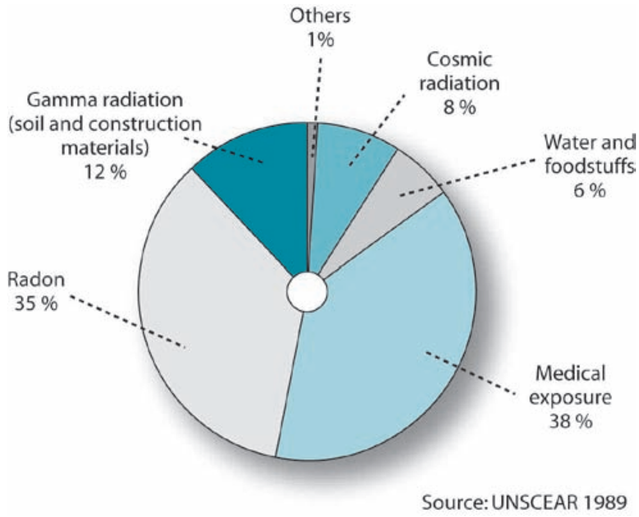
Finally the exposure of aircrews to cosmic radiation, aggravated by prolonged periods at altitude, also warrants dosimetric monitoring.

3 EXPOSURE TO IONISING RADIATION

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

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

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



Sources of exposure to radiation for the French population (annual averages)

3 | 1

Exposure of the population to NORM

Exposure of the population to naturally-occuring ionining radiation (NORM) is the result of the presence of radionuclides of terrestrial origin in the environment, radon emanations from the ground and exposure to cosmic radiation.

Terrestrial radiation (excluding radon)

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

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

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

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

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

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

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

Natural radioactivity of mains water

The new programmes for radiological monitoring of public mains water and non-mineral bottled waters (see chapters 3 and 5) will eventually allow production of a complete balance of the radiological quality of water intended for human consumption, primarily on the basis of total alpha and beta radioactivity measurements. The corresponding information is incorporated into the DDASS health/environment information system (SISE-Eau) and will shortly enable an inventory of the natural radioactivity of mains water to be produced.

Exposure to radon

Exposure to "domestic" radon (radon in the home) was estimated by measurement campaigns, followed by statistical interpretations (see IRSN atlas). The average radon activity value measured in France is 63 Bq/m³, with about half the results being below 50 Bq/m³, 9% above 200 Bq/m³ and 2.3% above 400 Bq/m³. These measurements led to a classification of the departments according to the radon exhalation potential of the land (see chapter 3). For methodological reasons, the results of this supervision are still however too imprecise for an accurate assessment of the doses linked to the actual exposure of the individuals. If we assume a home occupancy ratio of 90%, these values give an average annual dose of 1.5 mSv.

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

Measurement of radon in the home

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

In order to gain a clearer understanding of the radon doses to which the population as a whole is exposed, a study into the feasibility of incorporating radon measurement into the residential health file required in the event of sale or rental of a property, to ensure fuller information of the purchaser or future tenant, is provided for in the national health and environment plan - PNSE). This study, coordinated by the ASN and the IRSN, should be starting in 2006.

1. IPSN, 1985

External exposure due to cosmic radiation

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

If we assume the average time spent inside the home (which itself attenuates the ionic component of the cosmic radiation), the individual effective dose in a locality at sea level in France is 267 µSv per year, whereas it could exceed 1100 µSv per year in a mountain locality such as Cervières at 2,836m altitude. The average annual effective dose per individual in France is 331 µSv per year.

3 | 2

Doses received by workers

3 | 2 | 1

Exposure of nuclear workers

The system of monitoring of external exposure of persons working in facilities where ionising radiation is used 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 information system managed by the IRSN and are published annually. The SISERI system will also eventually allow collection of data supplied by "operational dosimetry", in other words, real-time measurement of external exposure doses and the dosimetric results of any internal contamination.

2004 statistics

Results of dosimetric monitoring of worker external exposure in 2004 (source: IRSN)

Total population monitored: 255,321 workers

Monitored population with a recorded dose below the detection threshold: 227,942, or about 89 %

Monitored population with a recorded dose of between the detection threshold and 1 mSv: 15,545, or about 6.1 %

Monitored population with a recorded dose of between 1 mSv and 20 mSv: 11,783, or about 4.6 %

Monitored population which exceeded the annual dose of 20 mSv: 64 including 13 above 50 mSv

Collective dose (sum of individual doses): 63.7 Man.Sv

Annual average individual dose in the population which recorded a non-nil dose: 2.3 mSv

The results of dosimetric monitoring of worker external exposure in 2004 on the whole shows that the prevention system put in place in facilities where sources of ionising radiation are used is effective, because for more than 95% of the population monitored, the annual dose remained lower than 1 mSv (dose limit for the public). However, these statistics do not accurately reflect the whole picture, because in a few cases, the dosimeter exposure did not necessarily correspond to exposure of the worker (dosimeters not worn but exposed) and it is likely that some workers do indeed fail to wear their dosimeters.

For each field of activity, the following two tables give the breakdown of the populations monitored, the collective dose and the number of times the annual limit of 20 mSv was exceeded. They clearly show a considerable disparity between doses according to the sector. For example, the medical sector, which accounts for a significant proportion of the population monitored (nearly 45%) only accounts for about 15% of the collective dose. However, it does comprise 32 (out of 51) occasions of

BNI worker dosimetry (year 2004-source: IRSN)

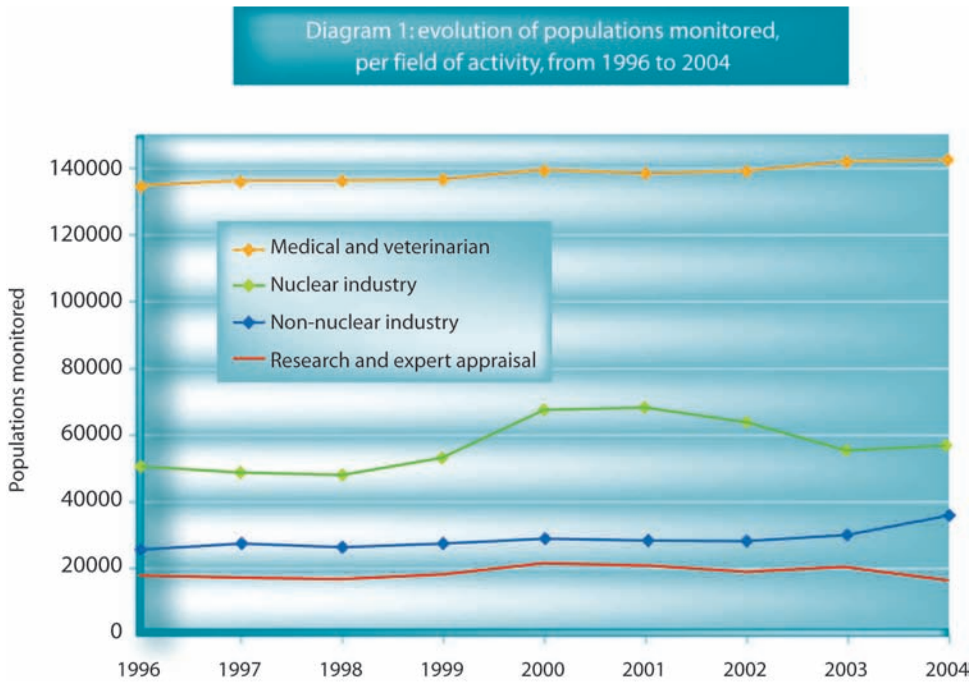
	Number of persons monitored	Sum of doses (Man.Sv)	Doses > 20 mSv
EDF	19,406	9.50	0
COGEMA + MELOX	7,201	1.77	0
CEA	6,600	1.17	0
IPN Orsay	3,132	0.02	0
Outside contractors	31,174	21.63	4

Dosimetry of workers in nuclear-related activities (year 2004-source IRSN)

	Number of persons monitored	Sum of doses (Man.Sv)	Doses > 20 mSv
Medicine	115,578	8.43	32
Dental	23,773	0.49	2
Veterinarians	6,915	0.56	4
Conventional industries	29,174	20.02	9
Research	70,211	0.04	0
Misc.	7,613	0.26	1

the annual limit being exceeded, including 7 (out of 13) above 50 mSv. As a comparison, the collective dose at EDF is of the same order of magnitude, but with a smaller monitored population (7 times smaller), but no occasion on which the annual limit was exceeded.

Evolution from 1996 to 2004



The latest statistics published by the IRSN in December 2005 show relative stability of the populations subject to dosimetric monitoring since 2000 (see diagram 1). However, the collective dose, consisting of the sum of the individual doses, has been falling (about -50%) since 1996 at a time when the populations monitored have grown by about 13%. The optimisation approach implemented by the nuclear operators during the 1990s is no doubt the explanation for this positive trend (see diagrams 2 and 3).

Diagram 2: evolution of the populations monitored and of collective doses, from 1996 to 2004

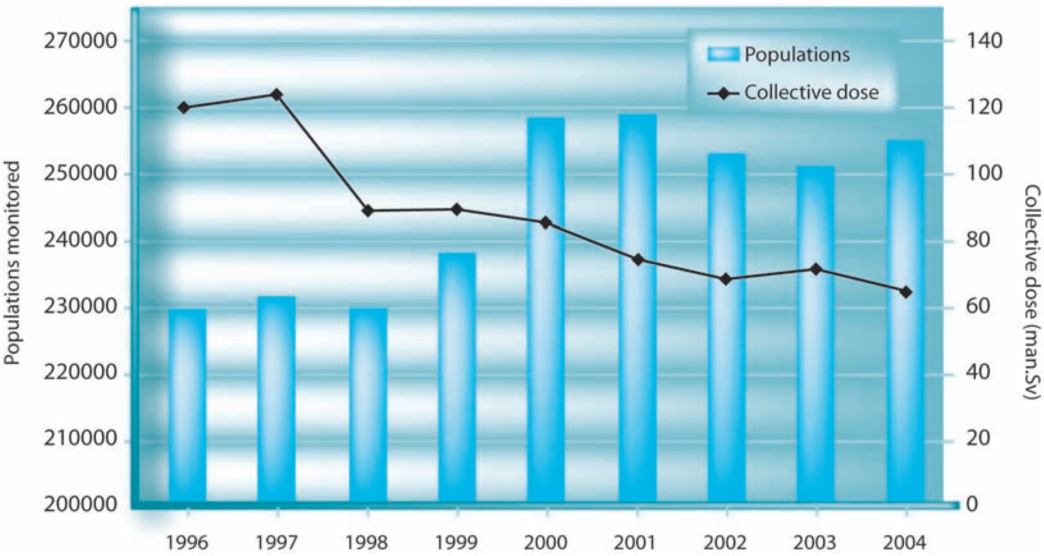
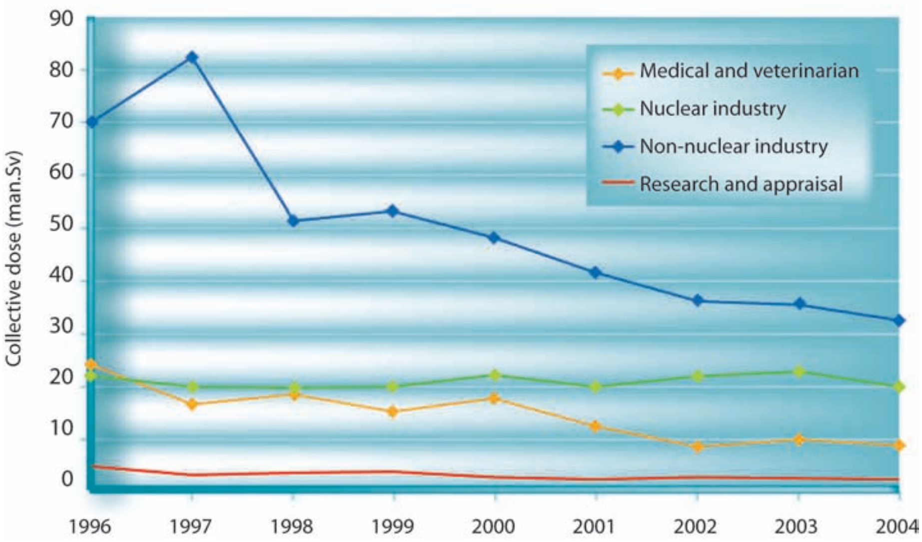
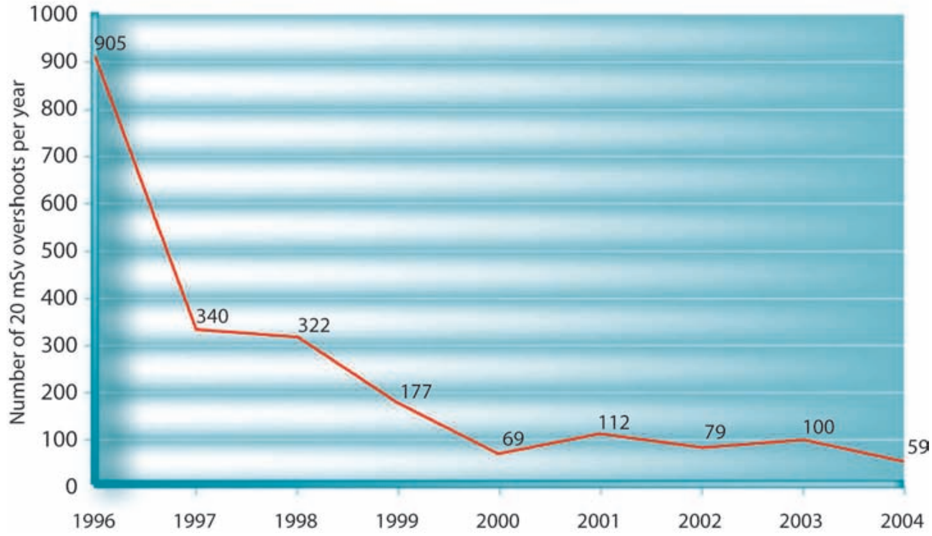


Diagram 3: evolution of collective doses, per field of activity, from 1996 to 2004



The number of monitored workers whose annual dose exceeded 20 mSv has also been falling significantly (see diagram 4). Even though each overshoot leads to a special investigation, jointly with the occupational physician, the variations observed since 2000 are considered to be statistical fluctuations.

Diagram 4: evolution of number of workers monitored for whom the annual dose is higher than 20 mSv, from 1996 to 2004



The ASN is particularly attentive to the correct working of SISERI in that the statistics provided by the IRSN constitute national indicators of choice concerning the evolution of worker exposure and assessment of the effectiveness of the steps taken by the operator to apply the principle of optimisation.

3 | 2 | 2

Worker exposure to TENORM

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

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

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

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

3 | 2 | 3

Flight crew exposure to cosmic radiation

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

In order to collect 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 (www.sievert-system.com).

3 | 3

Doses received by the population as a result of nuclear activities

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

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 to directly control compliance with the exposure limit for the population (see chapter 3). However, for BNIs, radioactive effluent discharges 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 discharges 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 BNIs. Prior methodological studies are required in order to obtain a clear knowledge of these facilities, in particular the impact of discharges containing small quantities of artificial radionuclides originating from the use of unsealed radioactive sources in research or biological laboratories, or in nuclear medicine departments. These are in progress within the IRSN at the request of the ASN.

3 | 4

Doses received by patients

We have no system for monitoring patient exposure, in particular because this exposure is not subject to any strict limitation, owing to its medical benefits. It is hard to accurately identify the overall exposure of medical origin, as we do not know the numbers of each type of examination practiced and the doses delivered for the same examination can vary widely. However, global statistics (UNSCEAR 2000 report, volume 1, p. 401) drawn up for 1.53 billion inhabitants of the developed countries (1991-1996 data) indicate an annual effective dose rate per inhabitant of 1.2 mSv for radiology, 0.01 mSv for dentistry and 0.08 mSv for nuclear medicine. In western Europe, for diagnostic radiological imaging, the annual effective dose per inhabitant in France was assessed at 0.7/0.8 mSv, whereas it is 0.33 mSv for the United Kingdom and 1.9 mSv for Germany.

Action plan for monitoring exposure of patients to ionising radiation

Based on recommendations published in 2002 by the InVS, the ASN produced an Action plan at the end of 2003 designed to set up and develop monitoring of exposure of patients to ionising radiation of medical origin (PASEPRI). The multi-year plan was drafted in close collaboration with the relevant departments of the IRSN and the InVS, then submitted to the various institutional partners involved for approval. Implementation of this plan began in 2004.

It is regularly monitored by a committee chaired by the Director General of the ASN.

One of the actions included in the PASEPRI is to have the IRSN and the InVS set up an observatory of medical exposure to ionising radiation, from which the following lessons can be learned (CNAM 2002 data):
– the annual number of radiological examinations (conventional and dental radiology) would seem to stand somewhere between 55 and 66 million, of which 67 % is with conventional radiology;
– the 4 most common conventional radiological examinations are radiography of the lower and upper limbs (32 %), the spine (16 %), the thorax (12 %) and the breast (11 %);
– oral radiography accounts for 85 % of dental examinations;
– scanner examinations of the head and spine represent 38 % and 26 % respectively of the total number of scanner examinations;
– the total annual number of conventional radiography examinations (excluding dental) and scanner examinations is between 60 and 72 million, of which 92 % is for conventional radiography alone;
– if we include nuclear medicine and surgical radiology examinations, the total number of examinations (excluding dental) would be somewhere between 61 and 74 million, for an average annual effective dose of between 0.66 and 0.83 mSv.

4 OUTLOOK

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

a) Implementing a true scientific watch in the field of ionising radiation, in accordance with the recommendations of the Vrousos commission and the national health and environment plan, implies the provision of considerable resources, which are not currently available. In the meantime, the IRSN is required periodically to publish summaries on the research topics on which it is working.

b) Close attention must continue to be paid to the work of the ICRP, which is updating its recommendations published in 1990. New recommendation proposals are expected in 2006. The ASN will therefore closely monitor this work, particularly as the IAEA and the European Commission have announced their intention to conduct a joint updating of the international "basic standards" which underpin community directives and European regulations concerning radiation protection.

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

• thus, the national action plan to identify exposure to ionising radiation of medical origin (PASEPRI) set up by the ASN in 2004, jointly with the IRSN and the InVS, began in 2005 to contribute new and more precise data concerning estimates of the doses delivered to patients. It will continue in 2006, in association with the learned societies concerned;

• furthermore, the ASN is continuing with implementation of the action plan concerning the risks linked to radon in the home. This plan is leading to preparation of the measures necessary for including radon measurement in the residential health file required for real estate transactions. It should eventually contribute to improving understanding of radon exposure in those departments most concerned by this radioactive gas.

PRINCIPLES AND PLAYERS IN THE SUPERVISION OF NUCLEAR SAFETY AND RADIATION PROTECTION

CHAPTER 2

1 ACTION PRINCIPLES

1|1 Responsibility

1|2 Justification

1|3 Optimisation

1|4 Limitation

1|5 Precaution

1|6 Participation

2 SUPERVISORY INSTITUTIONS

2|1 ASN

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

2|1|2 Regional offices

2|1|3 The working of the ASN

2|2 Institute for Radiation Protection and Nuclear Safety

2|3 Expert groups

2|3|1 Advisory Committees

2|3|2 Standing Nuclear Section of the Central Committee for Pressure Vessels

2|4 The other leading supervisory players

2|4|1 Parliamentary Office for the Assessment of Scientific and Technological Options

2|4|2 Consultative bodies

2|4|3 High Health Authority

2|4|4 Public health and safety agencies

2|4|5 Other consultative bodies

3 OUTLOOK

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

The fundamental aim of nuclear safety as defined by the IAEA in its Safety Fundamentals (Safety Series, no. 110, 1993, available on the IAEA website, www.iaea.org), is to protect individuals, society and the environment by establishing effective defences against radiological risks and maintaining them in nuclear installations.

This aim takes the form of a number of operational objectives:
- in operating conditions, exposure to ionising radiation as a result of nuclear activities must be kept below the specified limits and at a level that is as low as reasonably achievable;
- accidents must be prevented in nuclear installations;
- should they occur, the consequences of any accidents must be attenuated.

1 ACTION PRINCIPLES

The performance of nuclear activities is controlled by a number of principles, some of which are enshrined in legislation and regulations.

1 | 1

Responsibility

The principle of responsibility states that the prime responsibility for activities entailing a risk lies with those who carry out these activities:
- responsibility of the licensees for the safety of basic nuclear installations (BNIs);
- responsibility of the consignors for the transport of radioactive materials;
- responsibility of the users for radiation protection of the public;
- responsibility of the suppliers for recovery of radioactive sources;
- responsibility of the employers for radiation protection of workers;
- responsibility of the prescribing doctor and the practitioner of the procedure for radiation protection of patients;
- responsibility of the polluters for harm to the environment;
- responsibility of the producers for waste disposal.

Responsibility of the operators and responsibility of the Nuclear Safety Authority

Environment Charter

Text adopted on 28 February 2005 by Parliament and enacted on 1 March 2005 by the President of the Republic

"The French people,

"Whereas,

"The emergence of mankind was dependent on natural resources and balances;

"The future and very existence of mankind are inseparable from the natural environment;

"The environment is the shared heritage of all human beings;

"Man is exercising a growing influence on the conditions governing life on the planet and his own development;

"Biological diversity, individual development and the progress of human societies are affected by certain types of consumption or production and by over-exploitation of natural resources;

"Preservation of the environment must be pursued in the same way as the other vital interests of the Nation;

"In order to ensure sustainable development, the choices designed to meet the needs of the present must not jeopardise the ability of future generations and other peoples to satisfy their own needs;

"Do proclaim:

"Art. 1 - Everyone has the right to live in a balanced and healthy environment.

"Art. 2. - Everyone has the duty to take part in preserving and improving the environment.

"Art. 3. - In the conditions laid down by law, everyone shall avoid harming the environment or, failing which, mitigate the consequences of such harm.

"Art. 4. - Everyone shall contribute to repairing the damage he or she has caused to the environment, in the conditions laid down by law.

"Art. 5. - When a particular damage, albeit uncertain in the light of current scientific knowledge, could seriously and irreversibly affect the environment, the public authorities shall employ the principle of precaution in their particular areas of competence to ensure that risk assessments are made and provisional, proportionate measures are taken to prevent the damage occurring.

"Art. 6. - Public policies shall promote sustainable development. To this effect, they shall reconcile the protection and improvement of the environment with economic development and social progress.

"Art. 7. - In the conditions and limits laid down by law, everyone shall be entitled to access environment-related information in the possession of the public authorities and to take part in public decisions having an impact on the environment.

"Art. 8. - Environmental education and training shall contribute to the exercise of the rights and duties defined in this Charter.

"Art. 9. - Research and innovation shall contribute to the preservation and improvement of the environment.

"Art. 10. - This Charter inspires France's actions at a European and international level."

The polluter-pays principle introduced into the Environment Code is an application of the principle of responsibility in that it ensures that the polluter responsible for environmental damage resulting from its activity bears the cost of pollution prevention and mitigation measures. This in particular leads to taxing of BNIs and installations classified on environmental protection grounds (ICPEs).

Constitutional law 2005-205 of 1 March 2005 concerning the Environment Charter states that "any person causing damage to the environment must contribute to reparation of said damage" (article 4).

1 | 2

Justification

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

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

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

1 | 3

Optimisation

The principle of optimisation, which is another fundamental principle of radiation protection enshrined in the Public Health Code, states that human exposure to ionising radiation as a result of nuclear activities must be kept as low as reasonably achievable in the light of current technology, economic and social factors and, as applicable, the medical purpose of the exposure.

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 its counterparts in the other fields of activity supervised by the ASN: nuclear safety, environmental protection, radioactive waste management.

The Environment Code thus introduces the principle of preventive action and correction of environmental damage, primarily at source, using the best available techniques at an economically acceptable cost (article L. 110-1).

Optimisation of the safety of nuclear installations to a large extent depends on use of the concept of defence in depth, in particular characterised by the installation of successive barriers preventing the dispersal of radioactive substances into the environment. This concept is employed to compensate for any potential human or technical failures. It is based on several levels of protection, both technical and organisational, designed to maintain the effectiveness of the physical barriers placed between the radioactive substances and workers, the public and the environment, whether in normal operating conditions or incident situations and, for certain of the barriers, in the event of an accident. Operational implementation can be summarised thus: although the steps taken to prevent errors, incidents and accidents are in principle designed to prevent them happening, their occurrence is nonetheless postulated and the means of dealing with them must be examined and set up, in order to reduce their consequences to levels considered to be acceptable.

The concept of defence in depth is organised into 5 levels:

1. prevention of operating anomalies or deviations and system failures (design, definition of operating range and organisation);

2. maintaining the installation or transport package within the authorised operating range, through surveillance and detection of deviations (operation);

3. keeping accidents within the design scenarios (means of action for responding to envisaged situations);

4. prevention of deterioration of accident conditions and limitation of the consequences of serious accidents;

5. limitation of the consequences for the populations in the event of a major accident (emergency preparedness).

1 | 4

Limitation

The principle of limitation, also one of the fundamental principles of radiation protection enshrined in the Public Health Code (CSP), states that the exposure of a person to ionising radiation resulting from a nuclear activity cannot raise the total doses received above the limits set by the regulations, except when this person is exposed for medical or biomedical research purposes.

The notion of limit clearly does not apply only to radiological exposure of the general public and workers, but also to other sorts of hazards and detrimental effects: for example to the non-radiological parameters of discharges from installations subject to licensing.

1 | 5

Precaution

The Environment Charter transforms the principle of precaution into a constitutional principle (article 5). According to this principle, the absence of certainty, in the light of current scientific knowledge, should not delay the adoption of effective, proportionate measures to prevent a risk of serious and irreversible damage to the environment at an economically acceptable cost.

With regard to the biological effects of ionising radiation at low doses and low dose rates, the principle of precaution adopts a linear dose-effect relationship without threshold (see chapter 1).

1 | 6

Participation

The Environment Charter introduces the principle of participation whereby everyone has access to information about the environment, including hazardous activities and substances, and the public is involved in drafting projects with an important impact on the environment.

In the nuclear field, public inquiries - which are in particular held as part of the decision-making process for licensing or dismantling nuclear installations, or licensing water intake and effluent discharge by nuclear installations - enable local residents to participate in the decisions made by the public authorities. Articles L.121-1 and following of the Environment Code also created a National Public Debates Commission (CNDP), responsible for ensuring that the public is indeed involved in the drafting of national-interest planning and construction projects of the State, local authorities, public institutions and private individuals, in those categories of operations specified by decree, if their socio-economic stakes are high or they have significant impacts on the environment or regional planning. In 2005, two public debates organised by the CNDP concerned the ASN in particular: the public debate on radioactive waste management and that concerning the plan to build an EPR type reactor in Flamanville (Manche département).

This right to information concerns all fields of ASN activity, and in particular:
- information of the public about events occurring in BNIs or during the transport of radioactive materials, about discharges or releases from BNIs;

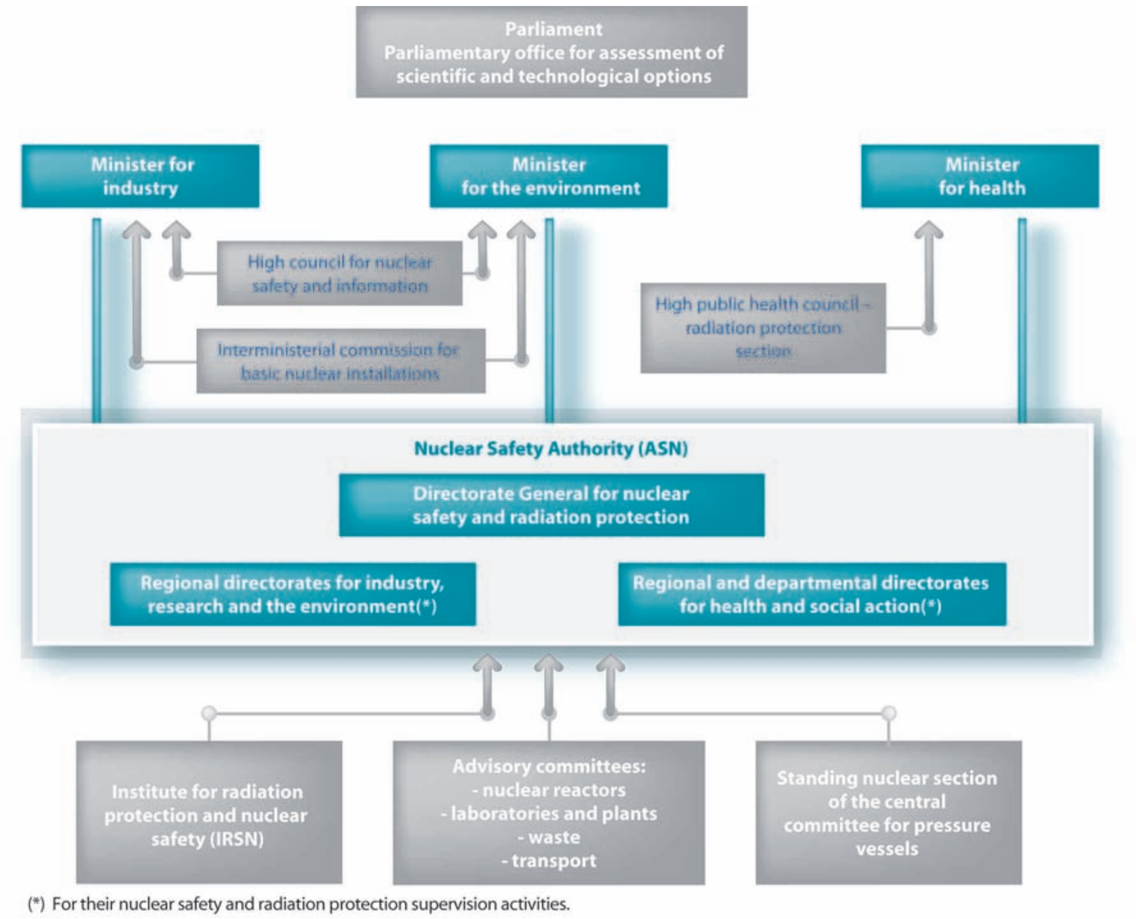
- workers information about their individual radiological exposure;
- patient information about the medical act, in particular its radiological aspect.

In accordance with the duties entrusted to it, the ASN contributes to public information about nuclear safety and radiation protection. Chapter 6 of this report details the ASN information actions.

2 SUPERVISORY INSTITUTIONS

High-risk activities are the prime responsibility of those who undertake them (see point 1.1). An industrial operator is responsible for the safety of its nuclear installations. A physician is responsible for radiation protection of his/her patient when prescribing or using ionising radiation for diagnosis or for therapeutic purposes.

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.



Supervision of nuclear safety and radiation protection in France

Within the public authorities, responsibility for supervision of the safety of nuclear installations and radioactive material transports lies with the ministers in charge of nuclear safety, while responsibility for supervision of radiation protection lies with the ministers for Health and 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 (DGSNR) gave this directorate responsibility - under the authority of the ministers for Health, the Environment and Industry - for defining and implementing nuclear safety and radiation protection policy.

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

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

2 | 1

ASN

The Nuclear Safety Authority comprises a directorate at central level, the Directorate General for Nuclear Safety and Radiation Protection (DGSNR), and regional offices. In the performance of its duties, the ASN calls on the expertise of external technical support organisations, in particular the Institute for Radiation Protection and Nuclear Safety, and asks various Advisory Committees for their opinions and recommendations.

2 | 1 | 1

Directorate General for Nuclear Safety and Radiation Protection

The role of the DGSNR is to propose and implement the government's nuclear safety and radiation protection policy, in civil matters.

Article 2 of the above-mentioned decree of 22 February 2002 specifies its responsibilities.

2 | 1 | 2

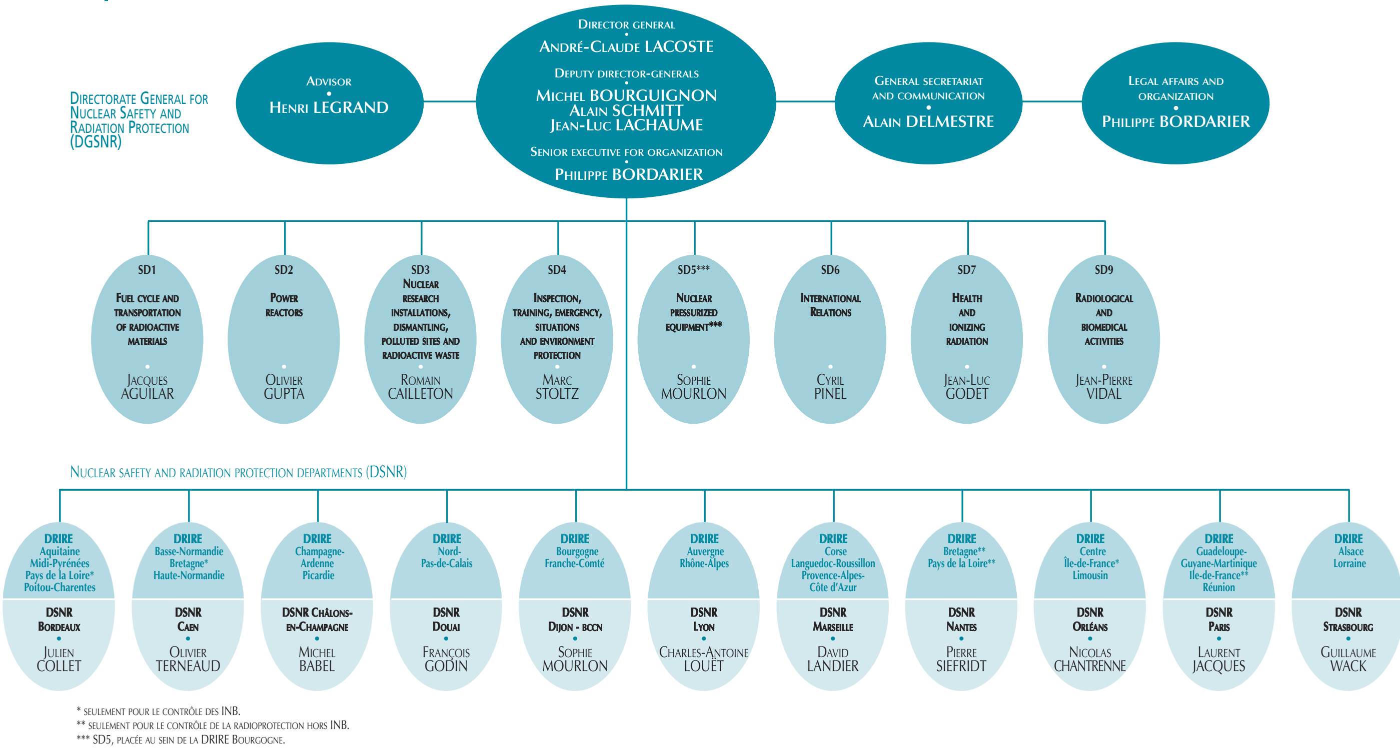
Regional offices

The DGSNR coordinates and supervises the activities of the Nuclear Safety and Radiation Protection Departments (DSNRs) of the Regional Directorates for Industry, Research and the Environment (DRIREs), and also relies on the Regional and Departmental Health and Social Action Directorates (DRASSs and DDASSs) for supervision of radiation protection.

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

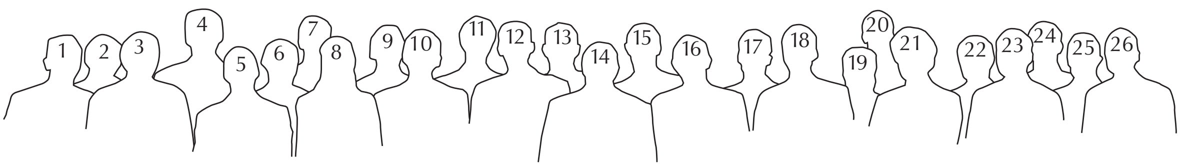
The Nuclear Safety and Radiation Protection Departments (DSNRs) operate under the authority of the directors of the DRIREs in a geographical area consisting of one or more administrative regions, as shown in the breakdown below.

The DSNRs carry out most of the direct supervision of the BNIs, radioactive material transports and local nuclear activities, through:



ASN organization chart as of January 1st, 2006

Nuclear Safety Authority management committee



1 Guillaume Wack (DSNR Strasbourg)
2 Jean-Pierre Vidal (SD9)
3 Jean-Luc Godet (SD7)
4 Bernard Doroszczuk (Director of the DRIRE of the Centre region, representing the directors of the DRIREs)
5 David Landier (DSNR Marseille)
6 Michel Babel (DSNR Châlons-en-Champagne)
7 Olivier Terneaud (DSNR Caen)
8 Sophie Mourlon (BCCN/DSNR Dijon)
9 Nicolas Chantrenne (DSNR Orléans)
10 Philippe Bordarier (Senior executive for organization)
11 Charles-Antoine Louët (DSNR Lyon)
12 Alain Schmitt (Deputy director general)
13 François Godin (DSNR Douai)
14 André-Claude Lacoste (Director general)
15 Marc Stoltz (SD4)
16 Michel Bourguignon (Deputy director general)
17 Laurent Jacques (DSNR Paris)
18 Jean-Luc Lachaume (Deputy director general)
19 Jacques Aguilar (SD1)
20 Cyril Pinel (SD6)
21 Alain Delmestre (Secretary general)
22 Romain Cailleton (SD3)
23 Henri Legrand (Advisor)
24 Pierre Siefridt (DSNR Nantes)
25 Julien Collet (DSNR Bordeaux)
26 Olivier Gupta (SD2)

Decree 2002-255 of 22 February 2002 creating the Directorate General for Nuclear Safety and Radiation Protection.

Article 2:

(…)

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

1. For preparing and implementing all measures concerning the safety of basic nuclear installations, in particular by drafting the corresponding technical regulations and supervising their application;

2. For preparing and implementing all measures concerning the safe transport of radioactive and fissile materials for civil purposes, in particular by drafting the corresponding technical regulations, jointly with the Minister for Transports, and supervising their application;

3. For preparing and implementing - jointly with the other competent administrations - all measures such as to prevent or limit the health risks linked to exposure to ionising radiation, in particular by drafting technical regulations concerning radiation protection, except with respect to the protection of workers against ionising radiation, and supervising their application;

4. For organising safety inspections of basic nuclear installations and, together with the competent departments of the Minister for Transport, of transports of radioactive and fissile material for civil purposes;

5. Notwithstanding the inspections stipulated by the Labour Code and the Environment Code, for organising the radiation protection inspections laid down in the Public Health Code and in the above-mentioned law of 2 August 1961 and its implementing texts, and for coordinating all inspections involved in the supervision of industrial, medical and research radiation protection, including by monitoring sources of ionising radiation used in these fields;

6. For organising a permanent radiation protection watch, in particular through radiological monitoring of the environment nationwide;

7. For supervising gaseous and liquid effluents discharges and waste from basic nuclear installations;

8. For proposing, coordinating and implementing government policy concerning the regulation and supervision of radioactive waste management;

9. For collecting all information concerning R&D work done in the field of nuclear safety and radiation protection;

10. For participating - jointly with the other competent administrations, in particular the departments responsible for civil security - in defining and implementing a technical emergency response organisation to deal with an accident in a nuclear facility or during transport of radioactive materials, or more generally, an accident of any type likely to harm human health through exposure to ionising radiation, occurring in France or likely to affect French territory;

11. For collecting all information in the field of nuclear safety and radiation protection and about the steps taken in this field in France and abroad, and for distributing this information to the administrations concerned;

12. For contributing to informing the public about subjects concerning nuclear safety and radiation protection.

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

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

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

(…)

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

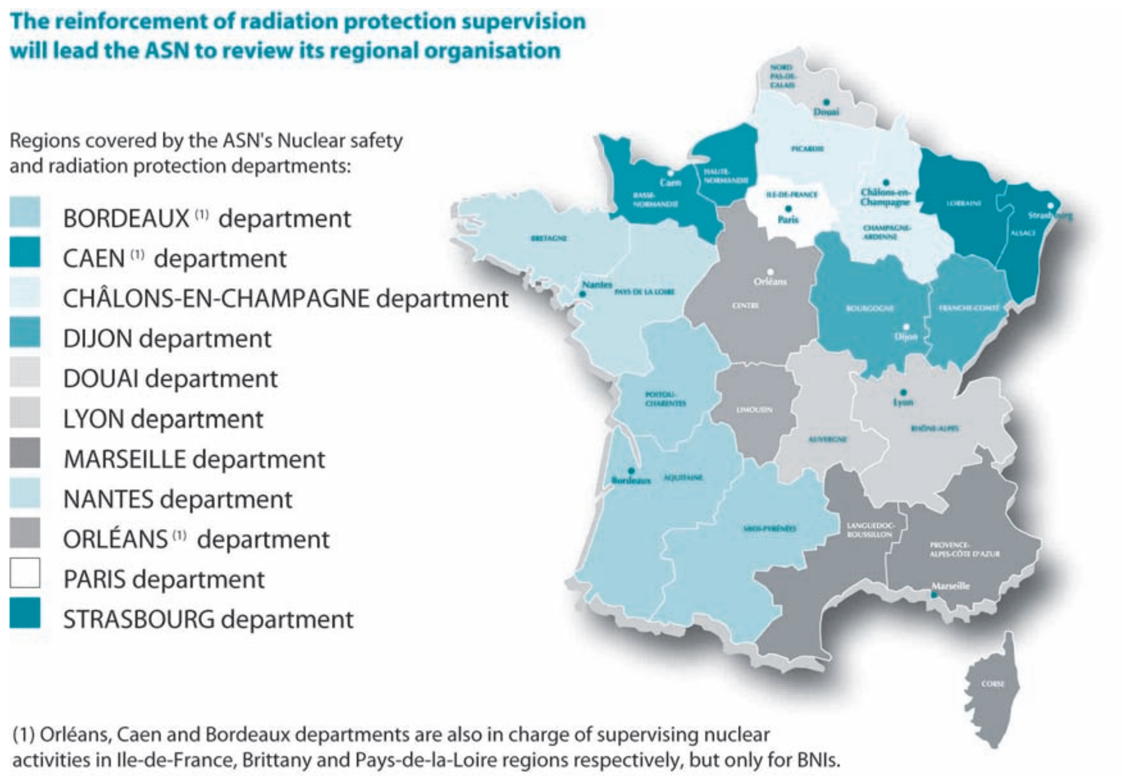
- field checks and inspections;
- review of incidents and accidents which occur in their regions;
- supervision of nuclear power plant unit outages in their regions.

The DSNRs take part in examining licence applications submitted by the operators of nuclear activities (BNI licensees, industrial users of ionising radiation, researchers, physicians, etc.):
- creation, major or minor modification, or final shutdown of BNIs;
- water intake and effluent discharge by BNIs;
- licensing of activities using ionising radiation.

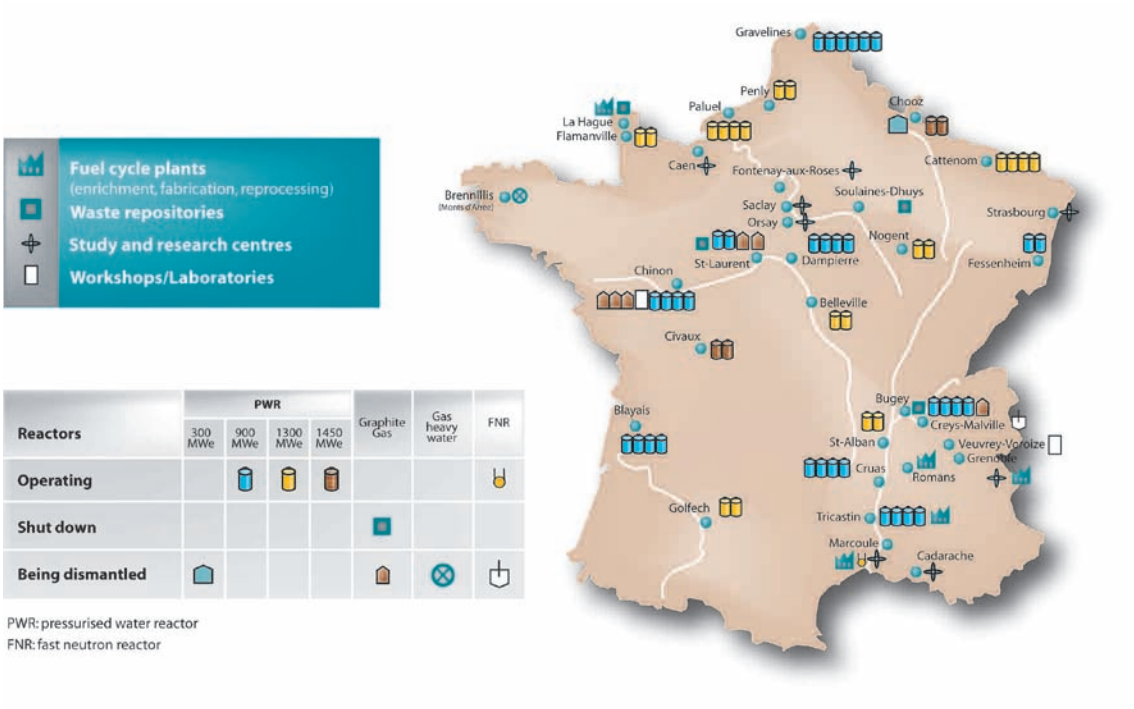
Coordinating examination of these applications is the responsibility of the DGSNR. Issue of the licences is the responsibility of the ministers.

In BNIs, 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 (ICPEs) and pressure-vessels (ESPs). In the local nuclear field, this supervision is carried out without prejudice to the other inspections, in particular that of the inspectorates for labour and for classified installations.

In emergency situations, the DSNRs have a two-fold role to support the département Prefect, who is responsible for protection of the populations, and to monitor the site, if it is accessible and repre-



DSNR map of France



The main nuclear sites

sents no danger. To ensure preparedness for these situations, they take part in drawing up the emergency plans drafted by the prefects and in periodic emergency exercises.

Finally, the DSNRs take part in informing the public in the regions about BNI nuclear safety and radiation protection, by contributing to the ASN's publications, its website and its *Contrôle* magazine, by participating in the local information committees (CLIs), by their information and communication activities - in particular through regular presentations to the media - and via their links with local associations and media.

b) The Regional and Departmental Health and Social Action Directorates (DRASSs and DDASSs)

The DRASSs and DDASSs operate in a given geographical area, either a département or administrative region.

In 2004, on the basis of the conclusions of the DDASS-DRASS-DRIRE working group, a circular to the prefects clarified the duties of the DRIREs, DDASSs and DRASSs with regard to supervision of radiation protection (Circular DGSNR/SD7 04-663 of 29 July 2004 concerning the duties of the regional and departmental directorates of health and social affairs in the field of radiation protection).

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

The DRASSs and DDASSs 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 emergency exercices.

The DRASSs and DDASSs will no longer be required to take part in radiation protection licensing or notification procedures for medical nuclear activities, which have been transferred to the DSNRs, nor to take environmental samples. Their role in supervising the radiation protection of patients has yet to be clarified.

2 | 1 | 3

The working of the ASN

a) Human resources

Workforce

As at 31 December 2005, the ASN total workforce stood at 378 people.

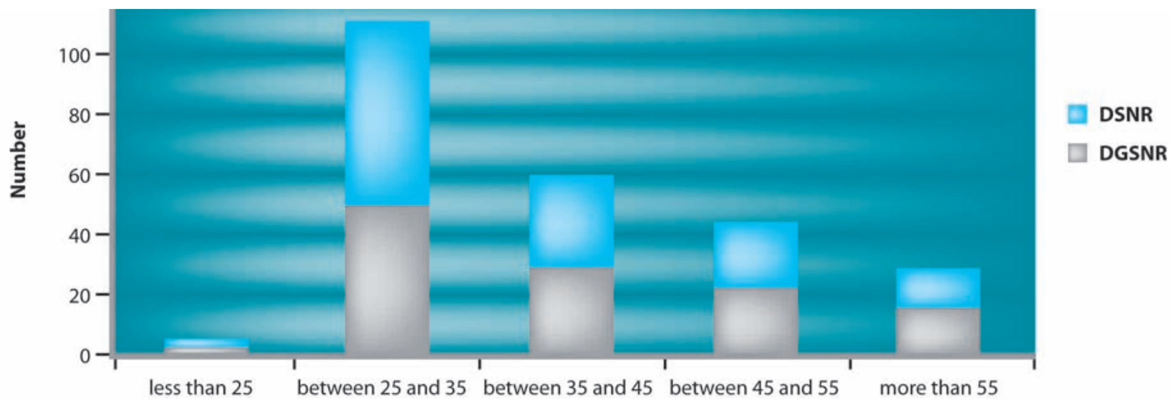
This workforce can be broken down as follows:
- 268 civil servants or contractual State employees;
- 110 staff on assignment from the Ministry of Infrastructure or other public institutions (Assistance publique - Hôpitaux de Paris, CEA, IRSN, ANDRA).

75% of the ASN workforce are executive. Most of these managers come from State technical schools (mining school engineers, State engineering school graduates, industry and mining engineers, State public works engineers, inspector-doctors from the public health service, pharmacists, health engineering specialists) who often have prior experience of supervisory activities (in the nuclear or other fields). This also concerns management staff on assignment from public institutions who have experience of nuclear or radiological activities, as well as contractual engineers specialising in radiation protection.

Workforce as at 31 December 2005

Paris (Bourgoin)	Fontenay-aux-Roses	DSNR	TOTAL
110	84	184	378

The average age of ASN personnel is 40 years and 8 months. Sixty-four percent (64%) of them are under 45 years old. This well-balanced age pyramid enables the ASN to carry out active supervision of nuclear safety and radiation protection, avoiding the pitfalls of habits and routine, while stimulating use of the tutor system with the younger members and the transmission of know-how.



Breakdown of the ASN inspector's ages

Personnel training

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

• Training in nuclear technologies

An official technical training scheme is one of the key elements in managing the qualification levels within the ASN. This training scheme comprises two levels:
- basic training: technical training in the nuclear industry or activities employing ionising radiation, plus training in the regulatory and supervisory procedures of the ASN;
- advanced training.

The ASN has defined a reference framework of basic training to be followed before achieving qualification as an inspector. Inspectors become senior inspectors on the basis of a reference system which includes advanced training and the experience of the inspector (see below "Inspector Qualifications").

In 2005, 2773 days of technical training were given to ASN personnel. The financial cost of the training courses given by organisations other than the ASN, or its technical support organisation the IRSN, amounted to € 437,000 (or an average training cost of € 2,800 per person trained).

• 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 (constitutional bylaw on budget acts, project management, public procurement, public finances, secretarial skills, etc.);
- help with preparation for State competitions and exams.

• Communication training

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

Inspector qualifications

Since 1997, the ASN has followed a program of qualification of its inspectors, based on recognition of their technical competence. This was paralleled by the 25 April 1997 creation of a Safety Authority Accreditation Committee. This is a consultative committee whose role is to rule on the entire qualification system. It examines the training courses and the qualification reference systems applicable to the various units within the ASN. 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 as senior inspector to the Director General of the ASN, who is then responsible for making the decision.

Chaired by Mr Yves Lecointe, the Accreditation Committee is made up half of senior inspectors belonging to the ASN and half of persons with competence in the field of nuclear safety supervision, assessment and teaching, and supervision of classified installations.

The Accreditation Committee met twice in 2005 and proposed that eight BNI inspectors become senior inspectors.

As at 31 December 2005, 40 of the ASN BNI inspectors were senior inspectors, or about 25% of all BNI inspectors.

b) Financial resources

Since 2000, all the personnel and operating resources involved in the performance of the duties entrusted to the ASN have been covered by the State's general budget.

The ASN budget is contained within the "Economic development and regulation" mission, in particular its programme No. 127 "Supervision and prevention of technological risks and industrial development". The combination of the DGSNR and the eleven DSNRs is budgeted in action No. 3 of programme No. 127, "Supervision of nuclear safety and radiation protection".

The budget for action No. 3 of programme No. 127 in 2006 amounts to € 34.17 million. The ASN complete cost budget, excluding financing of the IRSN expertise (see below) must be increased by the budget for management of the DSNRs in the DRIREs and a fraction of the budget for the Personnel, Modernisation and Administration Directorate (DPMA) at the Ministry of the Economy, Finance and Industry. In 2006, the ASN complete cost budget therefore amounted to € 48.5 million, after consolidation of the management budgets.

On behalf of the State, the ASN is responsible for issuing collection notices for the annual tax payable by the nuclear licensees and introduced by article 43 of the 2000 budget act. In 2005, the revenue from this tax amounted to 347 million. It is paid into the general budget.

In order to encourage rapid dismantling of nuclear installations, article 77 of the supplementary budget act for 2005, set this tax at a lower rate of 50% for installations shut down and undergoing dismantling. The tax ceases to be due on delicensing of the installation.

The revenue from this tax amounted to € 213 million in 2003, € 346 million in 2004, and € 347 million in 2005. The breakdown of contributions is shown in the following table:

LICENSEE	BNI tax for 2005 in thousands euros
EDF	307 668
COGEMA	18 867
CEA	8 531
ANDRA	6 403
EURODIF	1 829
FBFC	1 220
OTHERS	2 729
TOTAL	**347 247**

c) The ASN information system

The ASN information system (ASN IS) is now used throughout the ASN. In 2005, various adaptations and ergonomic improvements were made to its professional applications, accessible from the Oasis intranet. Extension of the ASN IS to the ASN's new duties, in particular those specific to the medical field, will continue in 2006.

d) ASN internal communications

Oasis, the ASN intranet, remains the primary means of sending out information within the ASN.
In-house actions in recent years concerning internal communications continued in 2005:
- presentation of each subject in the *Contrôle* magazine to the DGSNR staff and exchanges with the management prior to presentation of the publication to the media;
- organisation of introductory sessions for new recruits in May and October;
- regular visits by DGSNR officials to each of its component entities (general secretariat, sub-directorates, DSNRs).

e) quality organisation and management

To guarantee and improve the quality and effectiveness of its actions, the ASN defined and implemented a quality management system inspired by the ISO and IAEA international standards and based on:
- listening to the needs of all parties involved (the public, elected representatives, associations, media, trade unions, industry) within the context of procedures stipulated by the regulations (public enquiry) or less formal frameworks (opinion polls, hearings, internal consultations, etc);
- action plans setting ASN targets and annual priorities, adjusted during the course of the year 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 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 monitoring and improving the quality and effectiveness of the actions taken by the ASN.

2 | 2

The Institute for Radiation Protection and Nuclear Safety (IRSN, www.irsn.fr)

When preparing its decisions, the ASN calls on the expertise of technical support organisations, mainly the Institute for Radiation Protection and Nuclear Safety (IRSN). For a number of years now, the ASN has been following a policy of technical support diversification, both nationally and internationally.

Role of the IRSN

The Institute For Radiation Protection and Nuclear Safety, an industrial and commercial public establishment created by law 2001-398 of 9 May 2001, carries out research and assessment duties in the following fields, although with no responsibility as nuclear licensee:
- nuclear safety;
- safe transport of radioactive and fissile materials;
- protection of man and the environment against ionising radiation;
- protection and supervision of nuclear materials;
- protection of nuclear installations and transports of radioactive and fissile materials against malicious acts.

Activities of the IRSN

The duties of the Institute for Radiation Protection and Nuclear Safety include:
- assessments, research and other work, in particular analyses, measurements and dose-taking, on behalf of French and foreign, public and private organisations;
- defining research programmes, either carried out in-house or entrusted to other French or foreign research organisations, in order to maintain and develop the skills required for expertise in its fields of activity;
- contributing to radiation protection training of health professionals and persons exposed as a result of their professional activities;
- providing technical support for the ASN, the Delegate for Nuclear Safety and Radiation Protection for National Defence Installations and Activities (DSND) and for any State authorities and services as may request it;
- in the event of an incident or accident involving sources of ionising radiation, proposing to the ASN or the DSND measures of a technical, health and medical nature to ensure protection of the population, workers and the environment and to return the installations to a safe condition;
- participating in a permanent radiation protection watch, particularly by contributing to radiological monitoring of the environment and managing and analysing dosimetric data concerning workers exposed to ionising radiation and managing the inventory of ionising radiation sources.

The IRSN provides technical assistance to the Defence High Official at the Ministry for the Economy, Finance and Industry, in particular concerning implementation of the legislative requirements of the Defence Code as applicable to protection and supervision of nuclear materials.

Finally, the IRSN manages a number of radiation protection monitoring tools under the responsibility of the ASN, acting on behalf of the State. This in particular includes the national network of environmental radioactivity measurements, the SISERI database for monitoring and analysing worker exposure or the SIGIS database for monitoring radioactive source licences.

Organisation and budget of the IRSN

The IRSN is under the joint supervision of the ministers for Defence, the Environment, Industry, Research and Health. The ASN has direct responsibility for the institute on behalf of the Minister for Health. Furthermore, the Director General of the ASN is automatically a member of the institute's Board.

The general budget subsidy granted to the IRSN is consolidated in action No. 3, "Evaluation and prevention of nuclear risks" of programme No. 189 "Research in the field of risks and pollution" of the "Research and higher education" interministerial mission.

The IRSN's state subsidy amounted in 2006 to € 236.8 million. Action No. 3 is split into three subactions. Sub-action 3.2 contains the assessment budgets for public authorities, including the ASN. These budgets amount to a total of € 81.3 million (annual performance project No. 189), of which € 71.1 million (staff and operation) is earmarked for the assessment activities carried out on behalf of the ASN (revenue and spending forecast for 2006, Board decision of 6 December 2005). For information, before 2002, the share of the subsidy allocated to the IPSN for work on behalf of the ASN (article 20 of chapter 44-40 of part IV, Minister for the Environment budget subsidies) stood at € 54 million.

Communication of IRSN works

Subject to the legislation concerning limitations on the right of free access to information, the IRSN releases the scientific data resulting from the research programmes under its initiative, except for those concerning defence.

The nature and results of the research programmes conducted by the Institute are communicated to the relevant authorities in charge of supervising nuclear safety and radiation protection, as well as to the High Council for Nuclear Safety and Information, the French High Public Health Council and to the High Council for Prevention of Professional Risks.

The IRSN contributes to information of the public, in particular by drafting and - after advice from its scientific council - publishing an annual activity report. The report is sent to the supervisory ministers and is presented to the High Council for Nuclear Safety and Information, to the French High Public Health Council and to the High Council for Prevention of Professional Risks.

2 | 3

Expert groups

When preparing its decisions, the ASN asks for opinions and recommendations from expert groups:
- the Advisory Committees;
- the Standing Nuclear Section of the Central Committee for Pressure Vessels;
- the radiation protection section of the French High Public Health Council.

2 | 3 | 1

Advisory Committees

Four Advisory Committees (GPs) comprising experts and representatives of the French administration were created to assist the Director General of the ASN by ministerial decision of 27 March 1973, amended in particular by a decision of 1 December 1998. They analyse 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.

Meetings of the "Advisory Committee for Nuclear Reactors" in 2005

Theme	Date
PWR – Review of commissioning of two NPP units at Civaux	20/01
PWR – Review of the results of level 1 and 2 probabilistic safety studies	03/02
PWR – Review of the behaviour of the 900 MWe reactor containments	03/03
PWR – Review of the state of knowledge on the fire risk and the protection of installations against explosions occurring within the site	10/03
PWR – Periodic safety review concerning the third ten-yearly outages of the 900 MWe reactors (1st and 2nd sessions)	24/03
PWR – Periodic safety review concerning the third ten-yearly outages of the 900 MWe reactors (3rd session devoted to the fuel building pit)	21/04
PWR – Review of operating experience from French and foreign pressurised water reactors during the period 2000 to 2002 (2nd session)	16/06
EPR – Review of draft preliminary safety analysis report (3rd session)	05/07
Awareness-raising day dealing with human and organisational factors impacting high-risk systems	20/10
PWR – Review of equipment qualification for accident conditions (2nd meeting)	17/11
EPR – Review of draft preliminary safety analysis report (4th meeting)	01/12
Periodic safety review of the MASURCA experimental reactor (BNI no. 39) and review of the orientations adopted by the licensee for the renovation work	08/12
PWR – Periodic safety review concerning the second ten-yearly outages for the 1300 MWe reactors	22/12

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

Advisory Committee for laboratories and plants

In 2005, the Advisory Committee for laboratories and plants met on five occasions.

Meetings of the "Advisory Committee for laboratories and plants" in 2005

Theme	Date
Romans-FBFC – Increase in the annual production capacity of the BNI 98 installations on the Romans-sur-Isère site and review of the corresponding preliminary safety analysis report	16/03/2005
Pierrelatte – Review of the preliminary safety analysis report on the centrifugal uranium enrichment plant (Georges Besse II)	20/04/2005
Visit to the COGEMA/La Hague installations in the run-up to the 28/09/2005 meetings	21/09/2005
La Hague (COGEMA) – Review of waste management policy	28/09/2005
Awareness-raising day dealing with human and organisational factors impacting high-risk systems	20/10/2005

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

Advisory Committee for waste

In 2005, the Advisory Committee for waste held five meetings.

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

Meetings of the "Advisory Committee for waste" in 2005

Theme	Date
Summary concerning deep geological disposal	01/02 and 01/07
Recovery of former waste from Cogema La Hague (with the Advisory Committee for laboratories and plants)	16/11
ANDRA's "Clay 2005" dossier	13/12 and 14/12

Advisory Committee for transport

The Advisory Committee for transport did not meet in 2005.

Chaired by Mr François Barthélemy, the Advisory Committee for transport comprises representatives of the French administration and the French committee for certification of contractors 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.

2 | 3 | 2

Standing Nuclear Section of the Central Committee for Pressure Vessels

The Central Committee for Pressure Vessels (CCAP, article 26 of decree 99-1046 of 13 December 1999 concerning pressure vessels) is a consultative organisation reporting to the Minister for Industry.

It comprises members of the various administrations concerned, persons chosen for their particular competence and representatives of the manufacturers and users of pressure vessels and of the technical and professional organisations concerned. It is chaired by Mr Rémi Guillet.

It may be referred to by the Director for Regional Action, Quality and Industrial Safety or the Director General of the ASN for all matters affecting implementation of the laws and regulations on pressure vessels. Pressure vessel accident reports are also forwarded to it.

For particular supervision of the more important pressure vessels in nuclear installations, it set up a Standing Nuclear Section (SPN), the role of which is to issue recommendations on application of pressure vessel regulations to the main nuclear steam supply systems.

On 13 January, a plenary session of the CCAP reviewed the draft order concerning nuclear pressure vessels.

On 1 March, the SPN reviewed:

- EDF strategy for in-service supervision of main secondary system protection valves on pressurised water reactors;
- the request for a waiver to the order of 10 November 1999 presented by EDF and concerning performance of a detailed inspection 30 months after replacement of the steam generators at Fessenheim 1.

On 26 April, the SPN reviewed the design options for the EPR reactor control cluster mechanisms.

On 24 May, the SPN reviewed:

- the request for a waiver to the order of 10 November 1999 presented by EDF and concerning early performance of certain checks in the complete inspection carried out for post-maintenance testing of the main secondary systems;
- the first part of the reference files produced by EDF under article 4 of the order of 10 November 1999.

On 21 June, the SPN reviewed the demonstration designed to show that a main primary and secondary pipe break in the EPR reactor is ruled out.

On 27 September, the members of the SPN held a working meeting to review the workings of the SPN and its relations with the rapporteur for the subjects brought before the section.On 18 October, the SPN reviewed:

- the justifications provided by EDF concerning the in-service behaviour of the 900 MWe reactor vessels;
- the second part of the EDF reference files, in application of article 4 of the order of 10 November 1999.

On 13 December, the SPN reviewed the design choices for the EPR vessel, vessel head and steam generators.

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

2 | 4

The other leading supervisory players

2 | 4 | 1

Parliamentary Office for the Assessment of Scientific and Technological Options (OPECST)

The Parliamentary Office for the Assessment of Scientific and Technological Options was created by law 83-609 of 8 July 1983. It is a parliamentary delegation comprising 18 deputies and 18 senators. Its composition is proportional to the political groups in each parliamentary assembly and was renewed followign the senatorial elections of 26 September 2004.

The role of the Parliamentary Office is to inform Parliament of the consequences of the scientific or technological options chosen, in particular so that it can make its decision in full possession of the facts. The Parliamentary Office is assisted by a Scientific Council comprising 24 members, with the composition of the Council reflecting the diversity of scientific and technical disciplines.

Since it was first set up, the Parliamentary Office has issued 23 reports on nuclear issues, including 11 dealing with supervision of the security and safety of nuclear installations.

In 1990, the highest instances of the *Assemblée Nationale* and the Senate, that is their respective Bureaux, commissioned a study from the Parliamentary Office into supervision of the security and safety of nuclear installations. Since then, Mr Claude Birraux, member of the *Assemblée Nationale* for the Haute-Savoie *département*, has been confirmed in this role, year after year, and has prepared 11 reports on the supervision of safety and security in nuclear installations, adopted by the Parliamentary Office between 1990 and 2001. Mr Henri Revol, Senator for the Côte-d'Or *département* and Chairman of the Office, published a report jointly with the Chairman Christian Bataille, member of the *Assemblée Nationale* for the Nord *département* concerning the environmental and health impacts of the nuclear tests carried out by France between 1960 and 1996.

In the field of nuclear safety, the Parliamentary Office concentrates on the organisation of safety and radiation protection within the French administration and by the licensees, on the structures adopted in other countries, on the adequacy of the resources given to the ASN for the performance of its duties and on the leading nuclear safety and radiation protection issues. The studies carried out by the Office have also concerned the working of the administrative structures, technical subjects such as management of radioactive waste, the life of nuclear reactors, as well as socio-political issues such as the conditions in which information about nuclear matters is disseminated and perceived.

The report by Mr Christian Bataille, member of the *Assemblée Nationale* for the Nord *département*, and Mr Claude Birraux, member of the *Assemblée Nationale* for the Haute-Savoie *département*, entitled "The long-term view: a radioactive waste sustainable management law in 2006", was drafted in response to the request from the Chairmen of the four political groups in the *Assemblée Nationale* for "a statement on the progress of and prospects for research into radioactive waste management". The report was adopted by the Parliamentary Office on 15 March 2005, unanimously minus one vote.

The report by Messrs Bataille and Birraux follows on from the 10 reports published by the Parliamentary Office dealing with radioactive waste, the first of which - adopted in December 1990 - heavily influenced the law of 30 December 1991 concerning research into radioactive waste management.

The preparation of this report mobilised the full resources of the Parliamentary Office. Missions to the United States, Finland, Sweden, Switzerland, Belgium and Germany, during the course of which the rapporteurs had discussions with 180 people, painted a picture of the research and actual implementation situation in these six major nuclear countries. In France, the rapporteurs visited research installations and during these visits, and a number of private hearings, met more than 70 scientists and officials. The rapporteurs also met elected officials from the Haute-Marne and Meuse *départements* as well as from the Champagne-Ardenne and Lorraine regions.

Three full days of public hearings were held in late January - early February 2005, each of which was devoted to one of the three areas of the 1991 law. 73 speakers, including 15 international experts and two Nobel prize-winners, presented the results of the research in detail, during sessions that were open to the press and broadcast live over the Internet. The audience was nothing if not eclectic, with all trade unions, environmental protection associations and consumer associations being invited.

The March 2005 report from Messrs Bataille and Birraux was based on a full and detailed survey and was sent out in several thousand copies. It presented an overview of the available research results and a set of recommendations paving the way for a 2006 law on sustainable management of radioactive waste.

The Parliamentary Office recommends an overall approach dealing with information, research, spin-offs, management methods, the principles underpinning the radioactive waste management policy, financing and ANDRA.

The Parliamentary Office therefore proposes seven objectives for the 2006 law. Information about the results of research into radioactive waste management must be improved at all levels, whether local, national or international. Research into the three areas of the 1991 law must continue under the impetus of Parliament and in preparation for the assessments scheduled at regular intervals. Local and national exploitation of the research resulting from the 1991 law is a valuable source of data for scientific, university and industrial use. Three decisions of principle concerning the use of transmutation, geological disposal and long-term storage must be taken by the law, along with a schedule of decisions required of the public authorities. The national plan for management of radioactive waste and reusable materials, an essential general framework, must be enshrined in law. The very long-term guaranteed financing of research and industrial management of radioactive waste could be strengthened by the creation of a dedicated fund. Finally, ANDRA will have to be strengthened to deal with its new duties.

Following the adoption of their report in March 2005, Messrs Bataille and Birraux took part in numerous meetings in France and abroad (United Kingdom and United States), during which they presented the recommendations from the Office in this field.

The Parliamentary Office will be present during the debate on the bill announced by the Government for early 2006, with the rapporteurs attending hearings with the competent commission(s). The MPs who are members of the Office will personally propose amendments, as necessary, as was already the case during the Parliamentary debate on the energy bill, based on other work by the Office, which led to the law of 13 July 2005, setting energy policy guidelines.

Similarly, on the basis of work done on the subject of nuclear safety, the Parliamentary Office will be closely involved in the debate on the bill concerning nuclear safety and transparency. Its chairman, Mr Henri Revol, Senator for Côte-d'Or, has already been appointed rapporteur to the Senate for this bill. The text will then be examined by the *Assemblée Nationale*.

2 | 4 | 2

Consultative bodies

a) The High Council for Nuclear Safety and Information (CSSIN)

The High Council for Nuclear Safety and Information (CSSIN) created by decree 87-137 of 2 March 1987 amending decree 73-278 of 13 March 1973 provides the ministers responsible for nuclear safety with a highly competent consultative organisation for all issues concerning nuclear safety and information of the 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 licensees and members of the governmental departments concerned (Prime Minister, ministries for Defence, the Environment, Industry, the Interior, Health, Labour).

The Council provides the ministers responsible for nuclear safety 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 ASN keeps the CSSIN informed of its actions, in particular those concerning nuclear information, sends it its annual nuclear safety and radiation protection report and provides it with secretarial services.

The interministerial order of 27 May 2005 appointed Mr Michel Van der Rest as Chairman of the CSSIN. He was formerly assistant director of the École Normale Supérieure in Lyons and is currently director of the Life Sciences department at the CNRS. The CSSIN met in its new configuration on 28 September 2005.

b) The Interministerial Commission for Basic Nuclear Installations (CIINB)

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 responsible for nuclear safety on the applications for BNI authorisation, modification or final shutdown decrees and on the individual requirements applicable to each of these installations. It is also required to give its opinion on the drafting and application of general BNI regulations. An internal Standing Section has full competence in the name of the Commission to issue the opinions specified in article 3 bis of above-mentioned decree 63-1228 and opinions on the authorisation applications required under article 6 of the same decree, in the event of a change in licensee, modifications likely to lead to non-compliance with the requirements, or a modification of the boundary of the installation.

In 2005, the Commission, which is required to meet regularly and at least once a year, held five sessions under the chairmanship of Mr Yves Galmot, Honorary section chairman of the Council of State. These sessions discussed 16 draft regulations.

The CIINB is chaired by Mr Yves Galmot and at the end of 2005 comprised representatives of the French administration, the CEA, the CNRS, EDF, the IRSN, and personalities chosen for their particular competence in the nuclear field. In order to increase its efficiency, reorganisation of the CIINB was initiated in 2005 when decree 63-1228 of 11 December 1963 was revised.

Secretarial services are provided by the ASN.

c) The French High Public Health Council (CSHPF)

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 membership 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 web site.

A standing committee ("Ionising radiation sources" committee) reporting to the radiation protection section, was also created by the order of 27 January 2004 creating a "Ionising radiation sources" committee within the radiation protection section of the French High Public Health Council. Its main role is to propose opinions or recommendations on all subjects dealing with radiation protection and linked to the use of ionising radiation sources, with the exception of questions concerning the protection of persons exposed for medical purposes, and to take part in drafting regulations and technical instructions on this subject.

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

Secretarial services are provided by the ASN.

In the first quarter of 2006, the CSHPF will be replaced by the High Council for Public Health, created by law 2004-806 of 9 August 2004 concerning public health policy. During the last two years of operation, the radiation protection section will have examined most regulatory texts prepared by the ASN for transposition of community directives and published four opinions and a report that can be accessed on the CSHPF website (sante.gouv.fr).

2 | 4 | 3

High Health Authority (HAS)

The High Health Authority, which is a key element in the new French public health landscape, is an independent scientific public organisation. It was created by law 2004-810 of 13 August 2004 concerning health insurance. The High Health Authority is responsible for:

Meetings of the CIINB in 2005

29 April	• Draft decree authorising the Société industrielle de combustible nucléaire to carry out decommissioning and dismantling of basic nuclear installation No. 65 known as the nuclear fuel fabrication plant at Veurey-Voroize (Isère *département*) • Draft decree authorising the Société industrielle de combustible nucléaire to carry out decommissioning and dismantling of basic nuclear installation No. 90 known as the pellet fabrication shop at Veurey-Voroize (Isère *département*). • Draft decree authorising the Commissariat à l'énergie atomique to carry out decommissioning and dismantling of basic nuclear installation No. 52 known as the enriched uranium shop at Saint-Paul-Lez-Durance (Bouches-du-Rhône *département*). • Draft decree authorising la Compagnie générale des matières nucléaires to carry out decommissioning and dismantling of basic nuclear installation No.134 known as the uranium store at Istres (Bouches-du-Rhône). • Draft decree modifying decree 63-1228 of 11 December 1963, as modified, concerning nuclear installations.
11 May	• Draft decree concerning the final stage in decommissioning and complete dismantling of basic nuclear installation No. 91, known as the 1200 MWe fast neutron nuclear reactor at Creys-Malville, referred to as Superphénix, in Creys-Meypieu (Isère *department*). • Draft decree modifying the decree of 24 July 1985 authorising the creation by the Société centrale à neutrons rapides S.A. (Nersa) of the shop for removal of fuel from the Creys-Malville nuclear power plant (Apec). • Draft decree authorising the Commissariat à l'énergie atomique to create a basic nuclear installation No. 165, called Procédé, to replace basic nuclear installations No. 57 and 59, and to carry out decommissioning and dismantling of this installation in Fontenay-aux-Roses (Hauts-de-Seine *département*). • Draft decree authorising the Commissariat à l'énergie atomique to create a basic nuclear installation No. 166, called Support, to replace basic nuclear installations No. 34, 57 and 73, and to carry out decommissioning and dismantling of this installation in Fontenay-aux-Roses (Hauts-de-Seine *département*).
2 June	Session of the standing section: • Draft decree modifying the decree of 2 March 1978 authorising the creation by the Société franco-belge de fabrication de combustibles of a nuclear fuel fabrication unit (BNI No. 98) on the Romans-sur-Isère site (Drôme *département*). Plenary session: • Draft order concerning nuclear pressure vessels.
6 July	Session of the standing session: • Draft decree modifying the decree of 4 September 1989 authorising the Commissariat à l'énergie atomique (i.e. ANDRA) to create a radioactive waste disposal facility at Soulaines-Dhuys and La Ville aux Bois (Aube *département*) • Draft decree modifying decree 96-761 of 27 August 1996 authorising the Société pour le conditionnement des déchets et des effluents industriels to create a basic nuclear installation, known as Centraco (BNI no. 160), in Codolet (Gard *département*) Plenary session: • Draft decree authorising Louis Pasteur University in Strasbourg to carry out decommissioning and dismantling of basic nuclear installation No. 44, known as the Strasbourg university reactor, located in Schiltigheim (Bas-Rhin *département*). • Draft decree authorising Electricité de France to carry out decommissioning and dismantling of basic nuclear installation No. 162, known as EL4-D, an installation for interim storage of equipment from the monts d'Arrée nuclear power plant.
10 November	• Draft order modifying the order from the Minister for the Economy, Finance and Industry and the Minister for Regional Planning and the Environment of 31 December 1999 setting the general technical regulations designed to prevent and limit detrimental effects and external risks resulting from the operation of basic nuclear installations.

- assessing the medical usefulness of all health procedures, services and products covered by the social security health insurance;
- carrying out health institution certification;
- promoting good practices and good use of care among health professionals and the general public.

The High Health Authority takes over the duties of the National Health Accreditation and Evaluation Agency (Anaes), the Transparency Commission and the Products and Services Assessment Commission, and has been assigned new functions.

2 | 4 | 4

Public health and safety agencies

a) The French Health Monitoring Institute (InVs, www.invs.sante.fr)

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

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

b) The French Health Product Safety Agency (AFSSAPS – www.afssasp.sante.fr)

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

With regard to health products generating radiation, the AFSSAPS issues radiation protection authorisations for distribution of radio-pharmaceuticals and medical devices emitting ionising radiation (radioactive sources, electric equipment generating X-rays, and so on). It is also responsible for organising supervision of medical devices and in particular issues certification for the organisations in charge of this supervision and defines the corresponding reference frameworks for each equipment category.

In 2005, the AFSSAPS and the ASN collaborated in particular on technical analysis and public communication concerning the medical incidents which occurred in the Joliot-Curie hospital in Orsay (Ile-de-France region) and the Grenoble university hospital).

c) The French Food Product Safety Agency (AFSSA, www.afssa.fr)

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

d) The French Agency for Environment and Labour Health Safety (AFSSET, www.afsset.fr)

The French Environmental Safety Agency became the French Agency for Environment and Labour Health Safety in 2005 (ordinance 2005-1087 of 1 September 2005).

The French Agency for Environment and Labour Health Safety 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 AFSSET's contribution to appraisal work in the field of ionising radiation, as well as the links to be created with the IRSN and the InVS, has yet to be clarified.

2 | 4 | 5

Other consultative bodies

In application of the regulations, the ASN is either Chairman or Secretary for several consultative committees:
- the national Committee responsible for examining certification applications by organisations carrying out radon measurements in premises open to the public;
- the national Committee responsible for examining certification applications by organisations measuring radioactivity in the environment;
- the national consultative committee for radiological monitoring of the environment.

3 OUTLOOK

The 2002 institutional reform led to nuclear safety and radiation protection being combined within the ASN. The ASN scope was extended to include, besides nuclear installations, local nuclear facilities, including the research and medical sectors.

The inventory of equipment now supervised by the ASN is one of the world's largest and most diverse. It in particular comprises standardised nuclear reactors which produce most of the electricity consumed in France, all the fuel cycle installations, research installations and plants that are virtually without equivalent in the world.

The ASN also aims to develop a broad vision of its scope of supervision: in the field of nuclear safety, it takes account of material aspects and organisational and human factors. In radiation protection, it monitors the impact of activities on both people and the environment and ensures that there is clear, exhaustive and safe management of radioactive waste.

The ASN's role is to provide effective, relevant and transparent nuclear supervision, ensuring continuous progress. The ASN thus bears responsibility for the major issues facing the population and the environment. Nationally, it is responsible for protecting and informing the citizens, while internationally it is required to act as one of the world's leading nuclear safety authorities, sharing its work with its peers and taking account of nuclear safety and radiation protection principles employed world-wide.

The ASN's goal is to offer effective, legitimate, credible nuclear supervision that is recognised by the citizens and constitutes an international reference.

In 2006, the ASN will continue its radiation protection organisation work, which has been in progress since 2002. It will in particular take part in setting up the specialist committees of the High Council for Public Health which are to examine the questions of health and ionising radiation. At the same time, the ASN envisages creating a radiation protection advisory committee similar to those created in the field of nuclear safety.

With the aim of ensuring permanent progress of its nuclear safety and radiation protection supervision work, the ASN will at the end of 2006 submit to an international audit by its peers, run by the IAEA. The conclusions of this audit will be made public.

Finally, the ASN will play an active role in the government's work to modify its status, leading to the creation of an independent administrative authority responsible for supervising nuclear safety and radiation protection.

REGULATIONS

CHAPTER 3

1 THE REGULATION OF RADIATION PROTECTION

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

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

1|3 Protection of persons exposed for medical and medico-legal purposes
1|3|1 Procedures justification
1|3|2 Exposure optimisation
1|3|3 Medico-legal applications of ionising radiation

1|4 Protection of persons exposed to TENORM
1|4|1 Protection of persons exposed to radon
1|4|2 Other sources of exposure to TENORM

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

2 BNI REGULATORY PROVISIONS

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

2|2 General technical regulations
2|2|1 Ministerial and interministerial orders
2|2|2 Basic safety rules and ASN guides
2|2|3 French nuclear industry codes and standards

2|3 Installations classified on environmental protection grounds

3 OUTLOOK

APPENDIX 1 – VALUES AND UNITS USED IN RADIATION PROTECTION

APPENDIX 2 – LIMITS AND DOSE LEVELS

The French regulations applicable to nuclear activities are not the product of a general framework law, but have evolved gradually, to keep pace with changes in the nuclear activities themselves. Many of the texts governing these activities are therefore based on legislation of a general nature, particularly the Environment Code, which codifies law 76-629 of 10 July 1976 concerning nature protection, law 92-3 of 3 January 1992 on water and law 96-1236 of 30 December 1996 on air and the rational use of energy, the Public Health Code and the Labour Code.

The legislative provisions applicable to radiation protection and nuclear safety can be found on the one hand in chapter III of section III of book III of the first part of the Public Health Code, the provisions of which were mainly taken from ordinance 2001-270 of 28 March 2001 concerning the transposition of community directives in the field of protection against ionising radiation and, on the other, in law 61-842 of 2 August 1961 concerning the reduction of atmospheric pollution and offensive odours.

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

Finally, the legal framework for nuclear activities also stems from a variety of international norms, standards and recommendations. The following in particular should be mentioned:

- the recommendations of the ICRP (International Commission on Radiological Protection), in particular the ICRP 60 currently under revision;
- the standards of the International Atomic Energy Agency (IAEA) dealing with nuclear safety and radiation protection, particularly the International Basic Safety Standards for Protection against Ionising Radiation and for the Safety of Radiation Sources (Safety Series no. 115);
- the work of the Western European Nuclear Regulators' Association (WENRA).

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

1 THE REGULATION OF RADIATION PROTECTION

Since publication of Council directive 96/29/Euratom dated 13 May 1996 laying down basic safety standards for the protection of the health of workers and the general public against the dangers arising from ionising radiation and Council directive 97/43/Euratom dated 30 June of 1997 on health protection of individuals against the dangers of ionising radiation in relation to medical exposure, a complete update has been undertaken of the legislative and regulatory provisions concerning radiation protection contained in the Public Health Code and the Labour Code.

Updating of the legislative part was completed with publication of the above-mentioned ordinance of 28 March 2001 and law 2004-806 of 9 August 2004 concerning public health policy, with the introduction of new articles concerning radiation protection inspections.

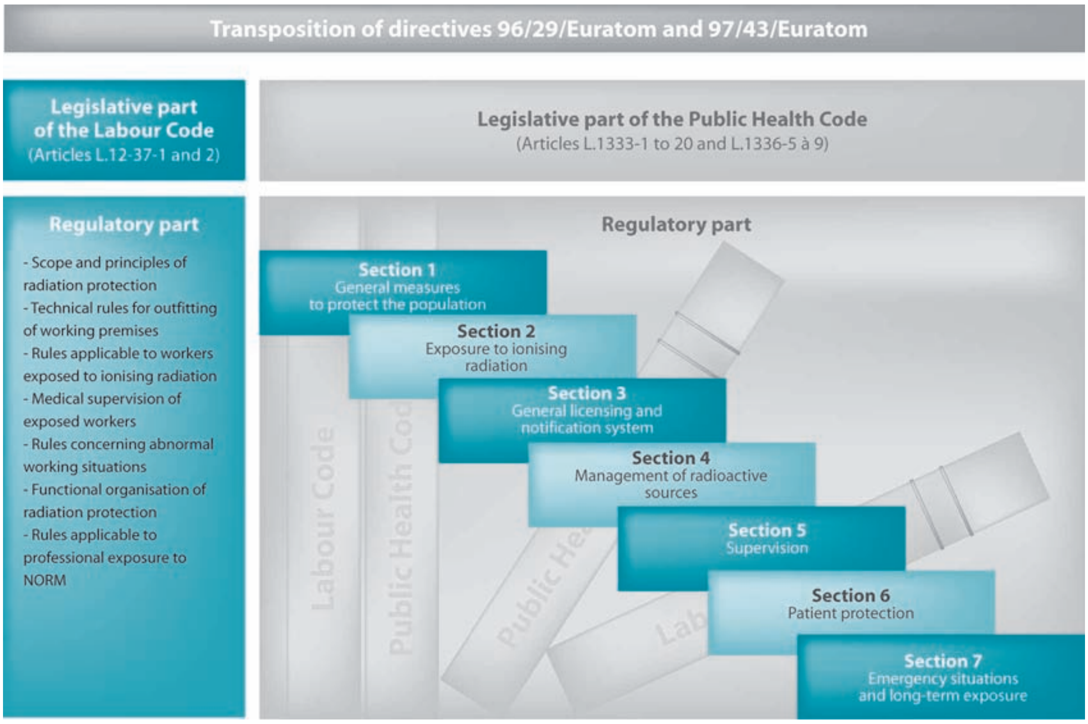
Updating of the regulatory part is currently being completed. The following were published in turn:

- decree 2001-1154 of 5 December 2001 concerning mandatory maintenance and quality control of medical devices;
- decree 2002-460 of 4 April 2002 concerning the protection of individuals against the dangers arising from ionising radiation;

•decree 2003-270 of 24 March 2003 concerning the protection of persons exposed to ionising radiation for medical and medico-legal purposes;
•decree 2003-295 of 31 March 2003 concerning intervention in a radiological emergency and in the event of long-term exposure;
•decree 2003-296 of 31 March 2003 concerning worker protection against the hazards of ionising radiation.

The decrees of 4 April 2002, 24 March 2003 and 2003-295 of 31 March, mentioned above, are codified in chapter III "Ionising Radiation" of part III of book III of the new regulatory part of the Public Health Code (art. R.1333-1 to R.1333-92). Decree 2003-296 of 31 March 2003 is codified in section 8 "Prevention of the risk of exposure to ionising radiation" in chapter I of part III of book II of the second part of the Labour Code.

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



Structure of the legislative and regulatory radiation protection framework

Section 7 "Emergency situations and long-term exposure" of chapter III of part III of book III of the Public Health Code was supplemented by decree 2005-1179 of 13 September 2005 concerning radiological emergency situations, in order to complete transposition of Council directive 89/618/Euratom of 27 November 1989 on informing the general public about health protection measures to be applied and steps to be taken in the event of a radiological emergency.

Effective implementation of the new regulatory provisions remains dependent on the publication of numerous orders: 25 were published between July 2003 and December 2005, and 7 are still to be published in 2006. However, transposition of the above-mentioned directives 96/29/Euratom, 97/43/Euratom and 89/618/Euratom is considered to be complete. Completion of transposition of these three directives in 2005 was accompanied by work to update the provisions of chapter III "Ionising radiation" of part III of book III of the Public Health Code, with the following goals:

- to transpose Council directive 2003/122/Euratom of 22 December 2003 on the control of high-activity sealed radioactive sources and orphan sources;
- to introduce administrative simplification measures, particularly with regard to the ionising radiation source licensing and notification procedures, incorporating the experience acquired in application of the new regulations;
- to supplement requirements concerning supervision of radiation protection;
- to provide clarifications and additional data in the wording of a number of provisions already in force.

A draft decree, subject to extensive discussion with the various parties concerned, as well as the general public (consultation on the ASN's website in September 2005), was produced and notified for information to the European Commission (under the terms of article 33 of the Euratom treaty). Its publication is scheduled for the second half of 2006.

Stamp bearing the picture of H. Becquerel, commemorating the discovery of radioactivity in 1896

1 | 1 The legislative bases of radiation protection

1 | 1 | 1 The Public Health Code

The principles of radiation protection

The new chapter III "Ionising Radiation" of part III of book III of the legislative part of the Public Health Code aims to cover all "nuclear activities", that is all activities involving 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 the natural radionuclides are or have been treated 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), established internationally (ICRP) and incorporated in the above-mentioned directive 96/29/Euratom, are enshrined in the Public Health Code (article L. 1333-1). They constitute guidelines for the regulatory action for which the ASN is responsible.

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

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 ASN in the case of sources used for medical, industrial and research purposes, it is the competence of AFSSAPS when authorising use of a new irradiating medical device and is the responsibility of the doctors when prescribing and carrying out diagnostic or therapeutic procedures.

Assessment of the expected benefit of a nuclear activity and the corresponding health drawbacks may lead to prohibition of an activity for which the benefit would not seem to outweigh the risk.

This prohibition is either generic (for example: ban on the intentional addition of radioactive substances in consumer goods), or the licence 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 a nuclear activity or medical procedure must be kept as low as reasonably achievable, given the current technological, 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 discharge licences of the quantities of radionuclides present in radioactive effluent from nuclear installations, to mandatory monitoring of exposure at the workstation in order to reduce it to the strict minimum necessary, or to supervision to ensure that medical exposure resulting from diagnostic procedures remains close to the predetermined reference levels.

3°) The principle of limitation – "Exposure of an individual to ionising radiation resulting from a nuclear activity may not raise the sum of the doses received beyond the limits set by the regulations, unless this person is being exposed for medical or biomedical research purposes."

The exposure of the general population or of workers as a result of nuclear activities is subject to strict limits. These limits comprise significant safety margins to prevent the appearance of deterministic effects. They are also far below the doses at which probabilistic effects (cancers) have begun to be observed (100 to 200 mSv). Exceeding these limits is considered to be unacceptable and in France, can lead to administrative or legal sanctions.

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

The notification and licensing system

The new legislative base introduced into the Public Health Code means that decrees passed after advice of the Council of State can be used to lay down general rules concerning the conditions for prohibition, licensing and notification of use of ionising radiation (art. L.1333-2 and 4), as well as rules for artificial or natural radionuclides management (art. L.1333-6 to L.1333-9). These licences and notifications concern all applications of ionising radiation generated by radionuclides or by electrical X-ray generators, whether for medical, industrial or research purposes. Some may however benefit from exemptions.

Exposure to TENORM

The transposition of above-mentioned directive 96/29/Euratom also led to new provisions being defined to assess and reduce exposure to naturally-occurring ionising radiation (NORM), in particular exposure to radon, when human activities contribute to enhancing this exposure (article L.1333-10 of the Public Health Code).

Inspection of radiation protection

In 2004, new provisions were introduced, creating the new radiation protection inspectorate (art. L.1333-17 to L.1333-19), oversight of which is entrusted to the ASN. An implementing decree setting the procedures for designating, qualifying and swearing-in the radiation protection inspectors is currently being finalised. The radiation protection inspectors, designated by the ministers for Health and Labour, on proposals from the DGSNR, will mainly be chosen from among ASN staff, but also from among inspectors of installations classified on environmental protection grounds working in the DRIREs. The administrative and judicial police powers of the radiation protection inspectors were also defined (art. L.1337-1-1).

Finally, a new system of legal sanctions accompanies these provisions (articles L. 1337-5 to L. 1337-9).

1 | 1 | 2

The Labour Code

The new provisions of the Labour Code (articles L. 230-7-1 and L. 230-7-2) introduce a legislative base specific to the protection of workers, whether or not salaried employees, with a view to transposition of Council directive 90/641/Euratom of 4 December 1990 on the operational protection of outside workers exposed to the risk of ionizing radiation during their activities in controlled areas , and the above-mentioned Council directive 96/29/Euratom. They bring French legislation into line with directive 90/641/Euratom concerning non-salaried workers exposed to ionising radiation.

A link with the three radiation protection principles in the Public Health Code is established in the Labour Code, and the rules concerning worker protection are the subject of a specific decree (decree 2003-296 of 31 March 2003).

1 | 2

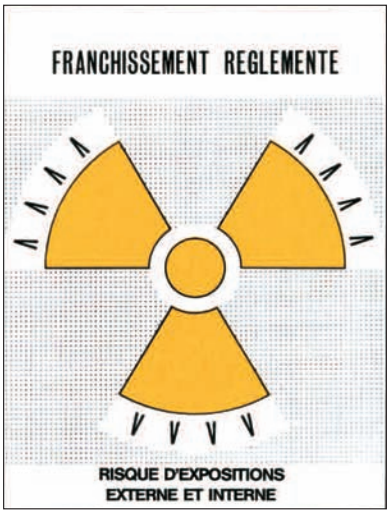
Protection of individuals against the dangers of ionising radiation from nuclear activities

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 above-mentioned decree 2003-296 of 31 March 2003, create a single radiation protection system for all workers (whether or not salaried) likely to be exposed to ionising radiation during their professional activities. Of these requirements, the following should be mentioned:
- application of the optimisation principle to the equipment, processes and work organisation (art. R. 231-75), which will lead to clarification of where responsibilities lie and how information is circulated between the head of the facility, the employer, in particular when he or she is not the head of the facility, and the person with competence for radiation protection;
- the dose limits (art. R. 231-76) were reduced to 20 mSv for 12 consecutive months, barring waivers resulting from exceptional exposure levels justified in advance, or emergency occupational exposure levels;



Signs indicating areas in which radioactive work is in progress

– the dose limits for pregnant women (art. R. 231-77) or more accurately for the child to be born (1 mSv for the period from the declaration of pregnancy up until birth).

The publication of six implementing orders since March 2003 has provided the clarification necessary for these new measures to be put into practice.

Zoning

New stipulations concerning the definition of controlled areas, monitored zones and specially regulated zones are yet to be published (planned for 2006), in order to take account of the new dose limits. The monitored zone is required to cover potential exposure of workers in excess of 1 mSv per year, and the controlled area is required to cover exposure likely to exceed 6 mSv per year. This order will also give the necessary additional information for defining signalling rules and health and safety rules within these zones.

The person with competence for radiation protection (PCR)

The duties of the person with competence for radiation protection (PCR) were extended to marking out the areas in which radiation work is being carried out, to studying the exposed workstations and to taking measures such as to reduce exposure (optimisation). For the performance of these duties, the PCR will have access to passive dosimetry and operational dosimetry data (art. R. 231-106). The instructor must be certified by an organisation accredited by the COFRAC.

The new order of 26 October 2005 concerning training of the person with competence for radiation protection and certification of the instructor, which abrogated the previous order of 29 December 2003, now makes a distinction between three sectors of activity:

a) the "medical" sector, comprising nuclear and radiological activities intended for preventive and curative medicine - including medico-legal examinations - dentistry, medical biology and biomedical research, as well as veterinary medicine;

b) the "BNI - ICPE" sector, covering establishments containing one or more basic nuclear installations and those which comprise an installation subject to licensing as a classified facility, with the exception of the nuclear activities in the medical sector defined above;

c) the "industry and research" sector, covering the nuclear activities defined in article R. 231-73 of the Labour Code, with the exception of the activities in the "medical" and "BNI - ICPE" sectors defined above.

Training comprises a theory module - common to all the options - and a practical module specific to each sector, comprising two options ("sealed sources and electric generators of ionising radiation" and "unsealed sources"). The duration and content of the PCR training programme therefore differ according to the activity sector in which the person is to work and the type of sources used.

Dosimetry

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

Radiation protection supervision

Technical supervision of sources and devices emitting ionising radiation, protection and alarm devices and measuring instruments, as well as ambient environment checks, can be entrusted to IRSN, to the department with competence for radiation protection or to organisations approved under application of article R. 1333-44 of the Public Health Code. The supervision procedures were published in the order of 26 October 2005.

In application of articles R. 231-84 of the Labour Code and R. 1333-44 of the Public Health Code, this order defines the type and frequency of radiation protection technical supervision inspections. These concern sources and devices emitting ionising radiation, the ambient environment, measuring instruments and protection and alarm devices, management of sources and of any waste and effluent produced. This supervision is partly carried out as part of the operator's in-house inspection processes and partly by outside organisations (the outside checks must be performed by the IRSN or an organisation approved under article R. 1333-44 of the Public Health Code). The approval procedures for these organisations were defined in the order of 9 January 2004. ASN is now responsible for examining accreditation applications submitted by the organisations. A new list of approved organisations was published by orders dated 17 March and 18 July 2005.

Radon in the working environment (see point 1|4|1 below)

1|2|2

General protection of the population

Apart from the special radiation protection measures included in individual nuclear activity licences for the benefit of the population as a whole and the workers, a number of general measures included in the Public Health Code help to protect the public against the dangers of ionising radiation.

The intentional addition of natural or artificial radionuclides in all consumer goods and construction materials is prohibited (art. R. 1333-2 of the Public Health Code). Waivers may however be granted by the Minister for Health after receiving the opinion of the French High Public Health Council, except with respect to foodstuffs and materials placed in contact with them, cosmetic products, toys and personal ornaments. This new range of prohibitions does not concern the radionuclides naturally present in the initial components or in the additives used to prepare foodstuffs (for example potassium 40 in milk) or for the manufacture of materials used in the production of consumer goods or construction materials.

Furthermore, the use of materials or waste from a nuclear activity is also in principle prohibited, when they are contaminated or likely to have been contaminated by radionuclides as a result of this activity.

The annual effective dose limit (article R. 1333-8 of the Public Health Code) received by a member of the public as a result of nuclear activities, is set at 1mSv; the equivalent dose limits for the lens of the eye and the skin are set at 15 mSv/year and 50 mSv/year respectively (average value for any 1 cm surface of skin). The calculation method for the effective and equivalent dose rates and the methods used to estimate the dosimetric impact on a population are defined by ministerial order of 1 September 2003.

A national network for collection of environmental radioactivity measurements is currently being set up (art. R. 1333-11 of the Public Health Code) and the data collected will help estimate the doses received by the population. This network collates the results of the various environmental impact assessments required by the regulations, and those of analyses performed by the various government departments and its public institutions, by local authorities and by associations who so request. These results will be made available to the public. Management of this monitoring network has been entrusted to the IRSN, with guidelines being defined by the ASN (order of 27 June 2005 organising

Sun lotion advertisement

the national network for environmental radioactivity measurements and setting the procedures for laboratory accreditation).

So that the quality of the measurements taken can be guaranteed, the laboratories in this network must meet approval criteria, which in particular include intercomparison tests.

Management of waste and effluent from BNIs and ICPEs is subject to the provisions of the special arrangements concerning these installations (see point 2 of this chapter). For management of waste and effluent from other facilities, including hospitals (art R. 1333-12 of the Public Health Code), general rules will be specified by an interministerial order (not yet published). These waste and effluent must be eliminated of in duly authorised facilities, unless there are special provisions for on-site organisation and monitoring of their radioactive decay (this concerns radionuclides with a radioactive half-life of less than 100 days).

Although above-mentioned directive 96/29/Euratom so allows, French regulations have not adopted the notion of discharge threshold, in other words the generic level of radioactivity below which the effluent and waste from a nuclear activity can be disposed of without supervision. In practice, waste and effluent disposal is monitored on a case by case basis when the activities which generate them are subject to licensing (as is the case of BNIs and installations classified on environmental protection grounds). The regulations also do not include the notion of "trivial dose", in other words the dose below which no radiation protection action is felt to be necessary. This notion appears however in above-mentioned directive 96/29/Euratom (10 µSv/year).

1 | 2 | 3

The licensing and notification procedures for sources of ionising radiation

The new system of licensing or notification, which covers all sources of ionising radiation, is now described in full in section 3 of chapter III of part III of book III of the Public Health Code. All medical, industrial and research applications are concerned by these measures. This more specifically concerns the manufacture, possession, distribution - including import and export, and use of radionuclides or products and devices containing them. The use of X-ray equipment is subject to notification for medical radio-diagnostic (except for very large systems) or to licensing in all other cases.

It should be noted that the licensing system applies irrespectively to companies or facilities which have radionuclides on-site, as well as to those which trade in them without directly possessing them. This is in conformity with directive 96/29/Euratom which explicitly mentions both 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 remembered that, in accordance with article L. 1333-4 of the Public Health Code, licences for industries subject to the Mining Code, for BNIs and for ICPEs, replace the radiation protection licence. However, this exception does not concern ionising radiation applications for medical purposes or for biomedical research.

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

a) the medical, biomedical research and medico-legal fields

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

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

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

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

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

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

b) the industrial and non-medical research fields

The ASN 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, products or devices containing them, the use of devices emitting X-rays or of radioactive sources, the use of accelerators other than electron microscopes and the irradiation of products of whatsoever nature, including foodstuffs, with the exception of activities which are licensed under the terms of the Mining Code, the BNI system or that applicable to ICPEs.

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 replace those given in decree 66-450 of 20 June 1966 concerning the general principles of protection against ionising radiation. 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/Euratom which does not introduce this mass limit. Introduction of this restrictive criterion should avoid the risk of the radioactive material being diluted in order to fall below the exemption threshold.

The way this system of licences, issued according to the Public Health Code, interfaces with the system of classified installations was clarified by a circular from the Minister for Ecology and Sustainable Development on 19 January 2004.

c) technical supervision of radiation protection

Technical supervision of the radiation protection organisation, including supervision of the management of radioactive sources and any associated waste, is entrusted to approved organisations (R. 1333-44 of the Public Health Code). The type and frequency of the inspections were defined by the order of 26 October 2005, mentioned in point 1|2|1.

1 | 2 | 4

Radioactive source management rules

The general radioactive source management rules are contained in section 4 of chapter III of part III of book III of the Public Health Code. They were drafted on the basis of rules laid down by CIREA (Interministerial commission on artificial radioelements) and their supervision is now the responsibility of the ASN. However, CIREA's radioactive source inventory duties have been transferred to IRSN (article L.1333-9 of the Public Health Code). These general rules are as follows:
- sources may only be transferred to or acquired from someone in possession of a licence;
- prior registration with IRSN is mandatory for the acquisition, distribution, import and export of radionuclides in the form of sealed or unsealed sources, or products or devices containing them. This prior registration is necessary so that monitoring of the sources and control by the customs services can be organised;
- traceability of radionuclides in the form of sealed or unsealed sources, or products or devices containing them, is required in each institution, and a quarterly record of deliveries must be sent to IRSN by the suppliers;
- any loss or theft of radioactive sources must be declared;
- validity of the formalities required for the import and export of radioactive sources, products or devices, defined by CIREA and the customs services, is renewed.

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

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

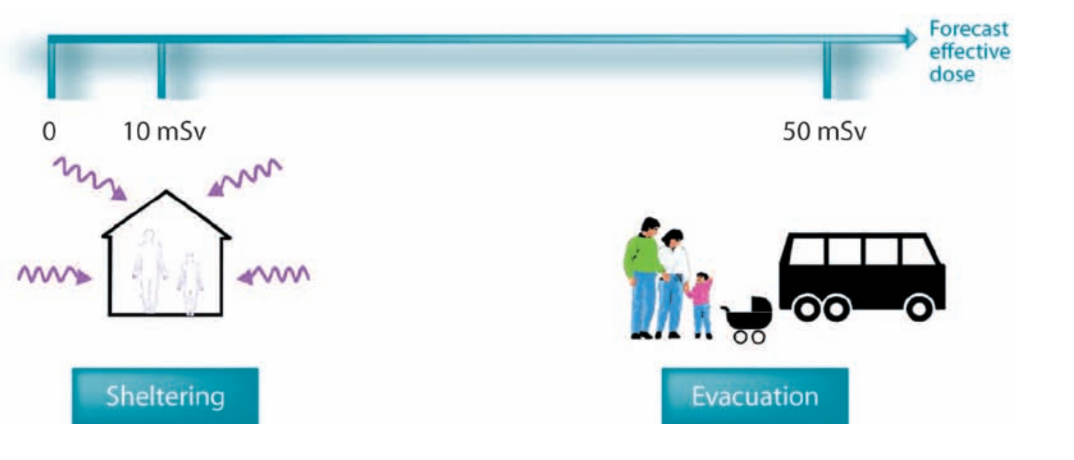
The question of financial guarantees will be dealt with in a decree implementing article L. 1333-7 of the Public Health Code which introduces the principle of source recovery by the supplier and the principle of financial guarantees. This new decree should also take account of the requirements of the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

1 | 2 | 5

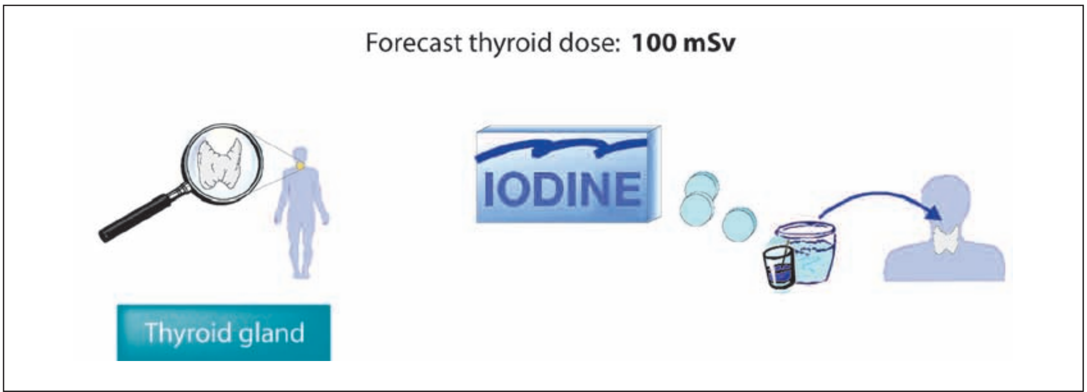
Protection of persons in a radiological emergency situation

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

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



Response levels for population protection: sheltering and evacuation



Response levels for population protection: absorption of iodine

These response levels were included in the order of 13 October 2003 concerning response levels in a radiological emergency situation, 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 regulations (article R. 1333-86 of the Public Health Code) and two groups of response personnel are thus defined:

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

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

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

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

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

Information of the population in a radiological emergency

The procedures for informing the population of a radiological emergency are detailed in a specific directive (directive 89/618/Euratom of 27 November 1989 on informing the general public about health protection measures to be applied and steps to be taken in the event of a radiological emergency). This directive was transposed into French law by:

- decree 2001-470 of 28 May 2001 concerning information of the population and amending decree 88-622 of 6 May 1988 concerning emergency plans and two implementing orders (order of 30 November 2001 concerning the creation of an emergency alert system around a basic nuclear installation with an off-site emergency plan and the order of 21 February 2002 concerning information of the population);
- decree 2005-1179 of 13 September 2005 concerning radiological emergency situations.

Definition of a radiological emergency situation (article R. 1333-76 of the Public Health Code)

"There is a radiological emergency when an event is likely to lead to the emission of radioactive materials or to a level of radioactivity such as to constitute a hazard for public health, in particular with reference to the limits and response levels set in articles R. 1333-8 and R. 1333-80 respectively. This event may be the result of:

1°) an incident or accident occurring during the performance of a nuclear activity defined in article L. 1333-1, including the transport of radioactive substances;

2°) a malicious act;

3°) environmental contamination detected by the environmental radioactivity measurement network mentioned in article R. 1333-11;

4°) environmental contamination made known to the competent authority under the terms of international conventions or agreements, or decisions made by the European Community for information in the event of a radiological emergency."

Two implementing orders were published:

- the order of 4 November 2005 concerning information of the population in the event of a radiological emergency situation;
- the order of 8 December 2005 concerning the medical aptitude check-up, radiological surveillance and training or information of the personnel involved in managing a radiological emergency situation.

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 (Ministry 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 set for each case.

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

1 | 3 Protection of persons exposed for medical and medico-legal purposes

Stamp commemorating the discovery of radium by Pierre and Marie Curie

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

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

1 | 3 | 1 Procedures justification

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

As an example, under the principle of justification, the use of radioscopy appliances without image intensification was prohibited in 2003 (article R. 1333-58 of the Public Health Code); the procedures for decommissioning these appliances were specified in the order of 17 July 2003. Establishments operating a total number of 35 installations of this type have confirmed that their equipment is no longer in use and has been scrapped.

Prescription and procedure guides for the performance of medical procedures involving exposure to ionising radiation

Articles R. 1333-70 and R. 1333-71 of the Public Health Code respectively refer to the publication of "prescription of routine procedures and examinations" guides (also called "indication guides") and "performance of procedures involving exposure to ionising radiation" guides (called "procedure guides"). Under the impetus of the departments reporting to the Ministry for Health (DGSNR since 2002), the professionals represented by their learned societies, including the French radiotherapy and oncology society (SFRO), the French radiology society (SFR), the French biophysics and nuclear medicine society (SFBMN), the French medical radio-physics society (SFPM), have set up the necessary working frameworks for drafting these guides. As applicable, DGSNR coordinates or supports this work, or is simply kept informed. The progress of the various guides is presented in the following table.

Specialty	Medical radiology		Nuclear medicine	Radiotherapy	Dental radiology
Documents	Procedure guide	Indication guide	Indication and procedure guides	Good practices	Indication and procedure guides
Start	09.1999	06.2001	09.1999	04.2004	01.2004
Interim reports	07.2000	03.2004	06.2004	10.2005	08.2005
Finalisation	10.2001* (JFR 2001)	10.2004 (JFR 2004)		Scheduled for 2006	Scheduled for 12.2006
Availability	SFR and IRSN website	SFR publication website	SFBMN website	–	–

*Currently being updated

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

1 | 3 | 2

Exposure optimisation

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

Diagnostic reference levels

New statutory concepts specific to radiation protecting for patients have been introduced for this very purpose and reference diagnostic levels were set in the order of 12 February 2004. For radiology, this consists of dose values, while for nuclear medicine it consists of activity levels administered in the course of the most common or most heavily irradiating examinations. These reference levels will be updated by conducting regular measurements or readings in line with the type of examination in each radiology and nuclear medicine department and centralizing them at the IRSN. Therefore, since June 2004, any new radiology appliances which enter service must be fitted with a device for estimating the dose delivered during an examination (article R. 5211-22 of the Public Health Code).

Dose constraints

In the field of biomedical research, where exposure to ionising radiation entails no direct benefit for the persons exposed, dose constraints designed to encompass the doses delivered must be established by the practitioner. An order currently being drafted will specify the methods for validating these dose constraints.

Medical radiological physics

Special medical physics skills are called for in optimising the dose delivered to patients. The employment of a specialised medical radiological physicist, formerly called a "radiophysicist", has been extended to radiology having already been compulsory in radiotherapy and nuclear medicine. Qualification of such specialists involves obtaining a master's degree (the list of which was published in the order of 7 February 2005), followed by specialist training including clinical work placements.

The duties of this specialist have been specified and expanded (order of 19 November 2004). Thus medical radiological physics specialists must ensure the appropriateness of the equipment, data and computing processes for determining and delivering the doses and activity levels administered to the patient in any procedure involving ionising radiation. In the field of radiotherapy they guarantee that the radiation dose received by the tissues due to be irradiated matches that prescribed by the prescribing physician.

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

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

Maintenance and quality control of medical devices

Maintenance and quality control, both internal and external, of medical devices using ionising radiation (articles R. 5211-5 to R. 5211-35 of the Public Health Code) have been mandatory since publication of the order of 3 March 2003. Outside quality control is entrusted to organisations approved by the Director General of the AFSSAPS who is responsible for issuing a decision to define the acceptability criteria, the monitoring parameters and the frequency of the inspections on the medical devices concerned.

Four decisions were published:
- decision of 2 March 2004 concerning outside quality control of external radiotherapy installations;
- decision of 2 March 2004 concerning electron accelerators for medical uses and tele-cobalt therapy devices.
- decision of 20 April 2005 setting the quality control procedures for bone mineral density test devices using ionising radiation;

– decision of 7 October 2005 concerning monitoring of mammography installations, modified by a decision of 16 December 2005.

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

Training and information

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

Thus the objectives and content of training programmes for practitioners conducting procedures using ionising radiation, or who assist in these procedures, were defined in the order of 18 May 2004. This patients radiation protection training is already part of initial medical training programmes and extends to other medical professions involved in these procedures; on-the-job training, currently being devised by learned societies and professional bodies, will also be offered to working practitioners.

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

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

1 | 3 | 3

Medico-legal applications of ionising radiation

In the medico-legal field, ionising radiation is used in a wide variety of sectors such as occupational medicine, sports medicine or for investigative procedures required by the courts or insurance companies. The principles of justification and optimisation defined apply both to the person requesting the examinations and to the person performing them.

In occupational medicine, ionising radiation is used for medical supervision of workers (whether or not professionally exposed to ionising radiation, for example workers exposed to asbestos). A working group set up by the ASN is examining the justification and optimisation of various procedures currently conducted, some of which are required by the regulations. The conclusions of this work will be available during the course of 2006.

For medical supervision of high-level athletes, radiographic examinations are stipulated in the regulations (order of 11 February 2004). On the basis of the work of an expert group, tasked jointly by the Minister for Sport, the Directorate-General for Health and the ASN with evaluating the justification for these examinations, a modification to this order is planned for 2006.

1 | 4

Protection of persons exposed to TENORM

1 | 4 | 1

Protection of persons exposed to radon

The regulatory framework applicable to management of the radon-related risk in premises open to the public (article R. 1333-15 of the Public Health Code) 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.

Stamp commemorating the centenary of the discovery of radium

In addition to introducing action trigger levels of 400 and 1000 Bq/m^3, the implementing order of 22 July 2004 concerning management of the radon risk in premises open to the public defined geographical areas and premises open to the public for which radon measurements are now mandatory: the geographical areas correspond to the 31 departments classified as having priority for radon measurement (see map enclosed); the categories of premises open to the public cover teaching institutions, health and social institutions, spas and penitentiaries.

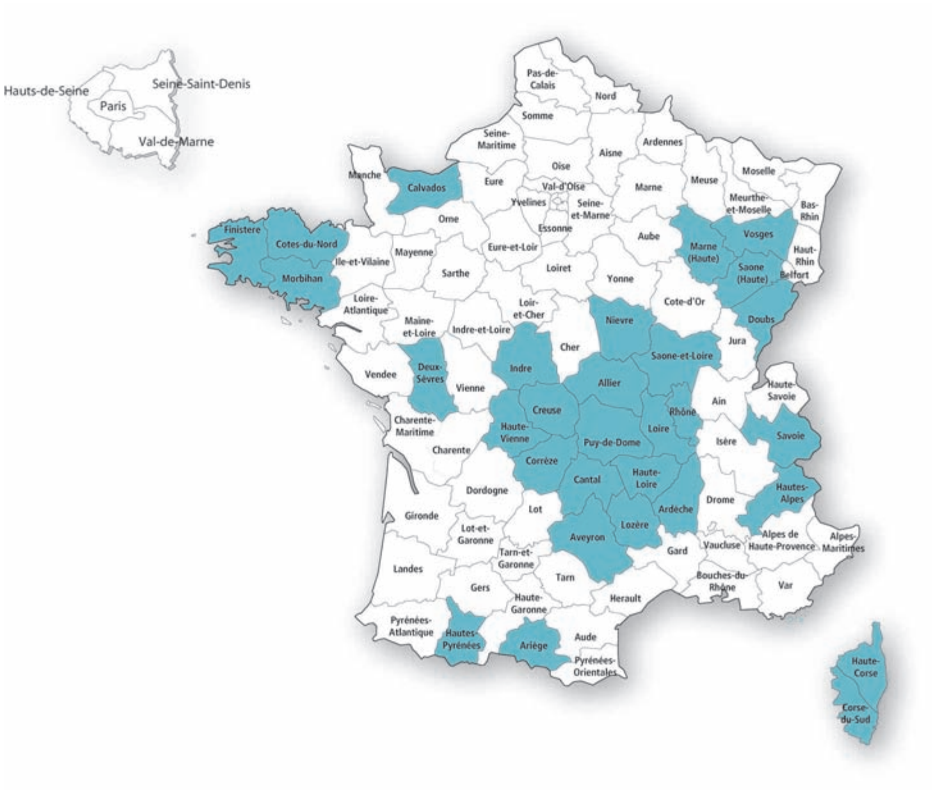
The obligations of the owner of the facility are also specified when the action trigger levels are found to have been exceeded.

The conditions for accreditation of the organisations authorised to carry out activity concentration measurements were defined in the order of 15 July 2003 concerning the accreditation of organisations responsible for measuring radon. The list of accredited organisations was updated by three orders published in 2005, on the opinion of the accreditation committee comprising representatives of the ministries concerned, of technical bodies (IRSN, Building industry's scientific and technical centre, French higher public health council), construction professionals and professionals concerned by radon measurement.

The order of 22 July 2004 was accompanied by publication in the Official Gazette of a notice defining the applicable standards for radon measurement (Official Gazette of 12 August 2004) and another notice concerning definition of the actions and work to be carried out in the event of these 400 and 1000 Bq/m^3 action trigger levels being exceeded (Official Gazette of 22 February 2005).

In the residential field, the National health and environment plan has defined a number of priorities which include regulatory action to deal with the radon risk:
- setting up a radon diagnosis to improve information made available to future real estate buyers and tenants;
- definition of construction rules for newly built accommodation located in the priority areas.

Finally, in the working environment, the new article R. 231-115 of the Labour Code requires the head of the facility to take radon activity measurements and take the steps needed to reduce exposure when the measurement results reveal an average radon concentration of more than 400 Bq/m^3. An order defining the workplaces in which these measurements are required should be published in 2006.



Map of 31 departments with radon measurement priority

1 | 4 | 2

Other sources of exposure to TENORM

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 of the Labour Code) and the Public Health Code (art. R. 1333-13 of the Public Health Code).

The order of 25 May 2005 defines the list of professional activities using raw materials naturally containing radioelements, the handling of which can lead to significant exposure of the population or of workers. The following are therefore concerned:

1. coal combustion in thermal power plants;

2. processing of tin, aluminium, copper, titanium, niobium, bismuth and thorium ores;

3. the production of refractory ceramics as well as glassmaking, foundry, steelmaking and metallurgical activities employing them;

4. the production or use of compounds comprising thorium;

5. the production of zircon and baddeleyite, and foundry and metallurgical activities employing them;

6. the production of phosphated fertilisers and the manufacture of phosphoric acid;

7. processing of titanium dioxide;

8. processing of rare earths and production of pigments containing them;

9. treatment of underground water by filtration intended for the production of:
- water intended for human consumption
- mineral waters;

10. Spas.

For these activities, the Public Health Code now contains an obligation to proceed with a study to estimate the doses to which the population is subjected. The Minister for Health may also implement measures to protect the public against ionising radiation, should this prove necessary in the light of the estimations made. When these activities fall into the category of classified installations, these measures will be defined by the corresponding applicable regulations.

Stamp illustrating uranium ore mining in the Limousin region

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 of the Public Health Code). This measure complements the ban on the intentional addition of radioactive substances to consumer goods.

For professional exposure resulting from these activities, a dose evaluation process, under the responsibility of the head of the facility, was introduced into the Labour Code. Should the dose limit of 1 mSv/year be exceeded, steps to reduce exposure should be taken. The abovementioned order of 25 May 2005 offers clarification of the technical measurement procedures for evaluating the doses received by the workers.

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

1 | 5

Radiological quality of water intended for human consumption and foodstuffs

• Council directive 98/83/CE of 3 November 1998 concerning the quality of water intended for human consumption, transposed into national law by decree 2001-1220 of 20 December 2001 on water intended for human consumption, with the exception of natural mineral waters, set radiological quality criteria for waters 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 above-mentioned directive 98/83/EC should shortly be completed to clarify the radiological analyses strategy associated with TID. The document which should soon be adopted by the committee composed of representatives of the Member States created by directive 98/83/EC recommends introducing the measurement of gross alpha and beta activity indicators and the corresponding values adopted by the World Health Organisation (0.1 Bq/l and 1 Bq/l respectively), and a search for specific natural and artificial radionuclides, when one or other of these gross activity values is not met.

On this basis, the order of 12 May 2004 setting radiological quality control procedures for water intended for human consumption, implementing the above-mentioned decree of 20 December 2001, defines the new radiological monitoring programmes for public mains water and non-mineral bottled waters.

• Several European regulations (Council Regulations n° 3954/87 of 22 December 1987 laying down maximum permitted levels of radioactive contamination of foodstuffs and of feedstuffs following a nuclear accident or in any other case of radiological emergency, CouncilRegulation n° 2219/89/EEC of 18 July 1989 on the special conditions for exporting foodstuffs and feedingstuffs following a nuclear accident or any other case of radiological emergency) were adopted subsequent to the Chernobyl accident, to establish the maximum allowable levels of radioactivity in contaminated foodstuffs. These levels, along with the values of the Codex alimentarius for international trade, are appended to this chapter.

At the end of 2004, as soon as it became aware of the issue, the ASN made known its opposition to the project to revise the indicative limits for radionuclides in foodstuffs applicable to international trade, as established by the FAO/WHO/IAEA[1] expert group.

The ASN in particular criticised the approach taken by the expert group, which deals with the long-term consequences of an accident (or malicious act) in the same way as those resulting from authorised discharges of radioactive effluent from the installations into the environment. In environmental terms, it would seem preferable to limit and control releases at source rather than after their dilution in the environment through the food chain. During normal operation of the installations, the radiological impact of releases via foodstuffs must remain as low as possible.

Apart from in accident situations, the adoption of foodstuff contamination standards is not an effective means of limiting and controlling nuclear installation discharges, because a very slight rise in the contamination of foodstuffs would be indicative of a serious and totally unacceptable malfunction of the installations, which should in any case be detected by the alert systems.

The concerns of the French authorities were similar to those expressed by the departments of the European Commission. Through their mouthpiece, the ASN, the French authorities therefore expressed their support for the Commission's position during the meeting of the Member States of the European Union on 31 January 2005 in Brussels. During the Codex meeting at The Hague (Netherlands) from 25 to 29 April 2005, intervention by the Commission, supported in particular by France, Belgium, Germany and the United Kingdom, enabled the process to adopt the project drafted by the FAO/WHO/IAEA expert group to be blocked. The decision was finally taken to revise the project, with the contribution of experts from the European countries which opposed its adoption. The ASN is taking part in this revision work.

1. FAO : Food and Agriculture Organisation, WHO: World Health Organisation, IAEA: International Atomic Energy Agency.

2 BNI REGULATORY PROVISIONS

Without prejudice to application of the general regulations, such as those dealing with radiation protection described in the first part of this section, and pending a law specific to nuclear activities, BNIs are governed by amended decree 63-1228 of 11 December 1963 concerning nuclear facilities, which determines their licensing procedures. This system is supplemented by technical rules.

2 | 1

Licensing

The unlicensed operation of a basic nuclear installation is prohibited by French law and the relevant regulations. Therefore, the above-mentioned decree of 11 December 1963, implementing law 61-842 of 2 August 1961, as modified, on the abatment of atmospheric pollution and offensive odours, in particular provides for an authorisation decree procedure followed by a series of licences issued at key stages in the life of these facilities: loading with fuel or pre-commissioning, commissioning, possible modification of the installation, final shutdown and dismantling. The ministers in charge of nuclear safety (at present the ministers for the Environment and for Industry) may also at all times ask the operator to review the safety of its installation.

BNIs are also subject to the requirements of decree 95-540 of 4 May 1995 concerning discharges of liquid and gaseous effluent from and water intake by basic nuclear installations implementing on the one hand the above-mentioned law of 2 August 1961 and, on the other, the law 92-3 of 3 January 1992 on water, as modified, which is codified in articles L. 210-1 to L. 217-1 of the Environment Code. This decree, modified in particular by article 3 of decree 2002-460 of 4 April 2002 concerning the general protection of individuals against the dangers arising from ionising radiation, sets the licensing procedure for liquid and gaseous effluent discharge and water intake for these installations.

A person operating a BNI without the required licences, or in breach of the provisions of these licences, is liable to administrative and legal sanctions. These are primarily stipulated in articles 5 to 7-1 of the above-mentioned law of 2 August 1961 and articles 12 and 13 of the above-mentioned decree of 11 December 1963 regarding breaches of the requirements of these texts or the authorisation decree, and by articles L. 216-6 to L. 216-13 of the Environment Code, which codify articles 22 to 30 of the above-mentioned law of 3 January 1992, concerning violations of the regulations on effluent discharge and water intake.

Application of these various procedures starts with siting and plant design and ends with ultimate dismantling of the installation. The installation must first have been identified as a BNI as defined in article 2 of the above mentioned decree of 11 December 1963 and its implementing texts, that is the order of 27 April 1982 setting the characteristics of particle accelerators as basic nuclear installations and the order of 11 March 1996 setting the limits above which plants preparing, manufacturing or transforming radioactive substances, and facilities designed for the disposal, storage or use of radioactive substances, including waste, are to be considered basic nuclear installations.

2 | 1 | 1

Siting

Well before applying for a BNI authorisation decree, the operator informs the administration of the site(s) on which it plans to build this installation.

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

In application of part IV of law 2002-276 of 27 February 2002 on local democracy (codified in articles L. 121-1 to L. 121-15 of the Environment Code), decree 2002-1275 of 22 October 2002 on the organisation of public debates and the National Public Debates Commission (codified in articles R. 121-1 to R. 121-16 of the Environment Code) specifies that creation of a BNI is subject to the public debate procedure:
- systematically, when dealing with a new nuclear electricity generating site or a new site not generating electricity and costing more than € 300 million;
- possibly, when dealing with a new site not generating electricity from nuclear power and costing between € 150 million and € 300 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 ASN generally asks the competent Advisory Committee (GP) to examine the project and then informs the operator of issues to be covered 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

The application for a BNI authorisation decree is sent to the ministers in charge of nuclear safety, who forward it to the other ministers concerned (Interior, Health, Agriculture, Town Planning, Transport, Labour, etc.). Each application file comprises a preliminary safety analysis report.

Processing of this application includes a public inquiry (unless the installation has already been through an enquiry prior to a declaration of public interest and is in conformity with the project subjected to this inquiry) and a technical assessment.

• Consultation of the public and the local authorities

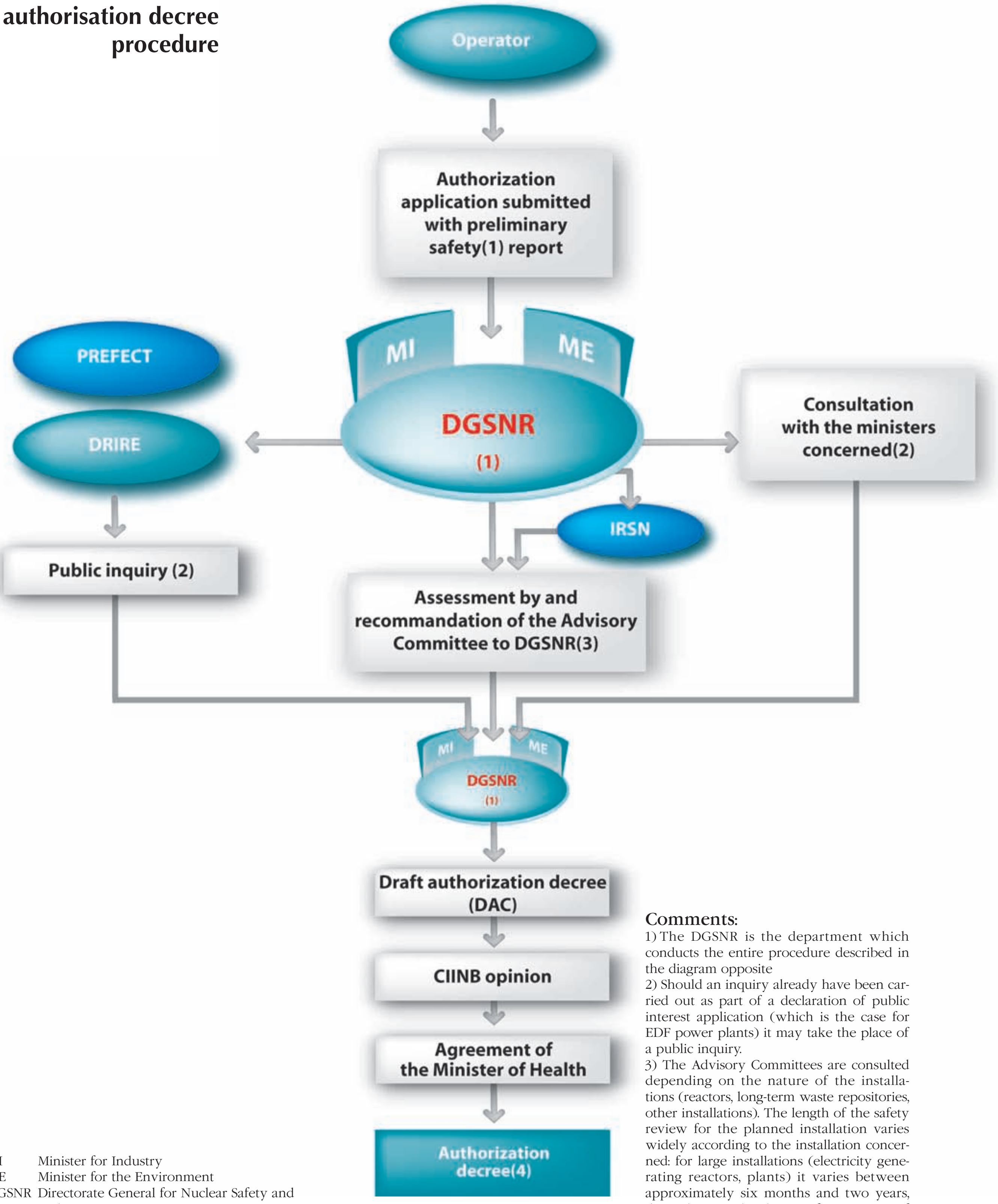
The public inquiry is opened by the Prefect of the department where the installation is to be built. The documents submitted to the inquiry must notably include the authorisation application, specify the identity of the applicant, the purpose of the inquiry, the nature and basic characteristics of the 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*[1] 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

1. Smallest administrative subdivision administrated by a mayor and a municipal council.

Basic nuclear installations authorisation decree procedure



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

Comments:

1) The DGSNR is the department which conducts the entire procedure described in the diagram opposite

2) Should an inquiry already have been carried out as part of a declaration of public interest application (which is the case for EDF power plants) it may take the place of a public inquiry.

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 between approximately 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 requirements of the authorisation decree, the MI and the ME may notify particular technical specifications

Commissioner. Furthermore, a specific provision introduced by decree 93-816 of 12 May 1993, enables the government to issue a decree to extend the BNI inquiry period by a maximum of one month.

The purpose of the inquiry is to inform the public and collect opinions, suggestions and counter-proposals, in such a way as to provide the competent authority with all the elements necessary for its own information. So any interested person, whatever his nationality or place of residence, is invited to express his opinion.

An Inquiry Commissioner (or an Inquiry Committee, depending on the nature or extent of the operations) is nominated by the President of the competent Administrative Court. He may receive any document, visit the site, arrange to meet all people wishing to make statements, organise public meetings and request extension of the inquiry period.

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

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

Finally, within a period of one month from the date on which the documents were submitted to him, the Prefect submits the report and conclusions of the Inquiry Commissioner, accompanied by his recommendation, and the results of the administrative conference, to the ministers in charge of nuclear safety.

• Consultation of technical organisations

The preliminary safety analysis report appended to the authorisation decree application is transmitted to the ASN, which submits it for examination to one of the advisory committees reporting to it.

On the basis of recommendations of the Advisory Committee, and taking account of the results of the public inquiry and any observations by the other ministers consulted, the ASN will - if there is nothing to oppose it - prepare a draft decree authorising creation of the installation.

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.

Once this assent is given, the draft decree is presented to the Prime Minister for signature, by the ministers in charge of nuclear safety.

• Authorisation decree

The authorisation decree, issued on the basis of the report from the ministers in charge of nuclear safety, sets the perimeter and characteristics of the installation and any particular requirements with which the operator is required to comply. It also specifies the particular justifications the operator will have to present prior to:
- the various pre-commissioning stages;
- commissioning of its installation;
- the subsequent final shutdown and dismantling.

The authorisation decree includes an obligation on the part of the operator, at least six months before the date scheduled for initial loading with nuclear fuel in installations containing a reactor, or use of a particle beam or radioactive substances in other installations, to submit the following to the Director General for Nuclear Safety and Radiation Protection:

- a provisional safety report, in particular containing data guaranteeing the conformity of the installation with the technical construction requirements of the authorisation decree;
- the general operating rules to be followed during the period prior to commissioning, to guarantee safe operation;
- an onsite emergency plan specifying the response organisation and resources to be deployed on the site in the event of an accident in the installation.

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

Before commissioning, the operator will present the Director General for Nuclear Safety and Radiation Protection with a final safety report and the site's updated operating rules and on-site emergency plan.

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

The specific requirements imposed for the installation shall under no circumstances be detrimental to compliance with the general technical regulations, regulations concerning discharge of effluent or any other texts applicable in particular with regard to environmental protection or worker health and safety issues.

These requirements may in particular concern the quality of the design, construction and operation of the installation, its protection and security systems, emergency resources, the ventilation and discharge systems, protection against earthquakes, radiological protection of the environment and workers, transport of radioactive products, installation modifications, final shutdown and dismantling.

• Installation modifications

The operator notifies the Director General for Nuclear Safety and Radiation Protection of all modifications to the installation leading to updating of the safety reports, the general operating rules or the on-site emergency plan.

A new authorisation decree, examined in exactly the same way as before, must be obtained when a BNI is to undergo modifications likely to lead to non-compliance with the above-mentioned requirements, if there is a change in the operator or a modification in the perimeter of the installation, or when, owing to a fire, explosion or any other accident occurring in a BNI, it is destroyed or is closed for a period in excess of two years.

In the case of modifications made to an existing or planned installation which has already undergone a public inquiry, and if these modifications do not appreciably alter the scale or purpose of the installation and do not increase its risks, examination of the application may omit the public inquiry.

No authorisation decree was issued for a basic nuclear installation in 2005.

Modification decree issued in 2005

REACTOR (Chinon – Indre-et-Loire)	25 November 2005	Decree modifying the decree of 27 August 1996 authorising EDF to modify the BNI known as Chinon A3, to keep it under surveillance

2 | 1 | 4

Operating licences

• **Power reactor commissioning**

The first load of new fuel elements may only be delivered to the reactor's storage building after authorisation by the ministers in charge of nuclear safety. This authorisation is given after examination by the ASN:

- 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.

Furthermore, six months prior to loading of the reactor, the operator must send the ministers in charge of nuclear safety a provisional safety analysis report, together with provisional general operating rules (RGE) and an on-site emergency plan (PUI) specifying the organisation and measures to be implemented on the site in the event of an accident. The ASN consults the Advisory Committee for nuclear reactors on these documents, and then drafts its own recommendation. Upon receipt of the latter, the ministers can authorise fuel loading and pre-commissioning tests.

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

- a fuel loading licence, authorising fissile fuel elements to be installed in the reactor vessel, enabling fuelled testing to start (pre-critical cold tests);
- a licence for pre-critical hot testing, prior to first criticality. These tests are dependent on the satisfactory outcome of the pre-critical cold tests. They are carried out while the primary system is at nominal temperature and pressure, after heating of the primary fluid by starting up the primary pumps. They may only be initiated after issue of the primary system hydrotest report by the director of the Burgundy region DRIRE, under application of an order of 26 February 1974 (see below in chapter 4);
- a licence for first criticality and power build-up to 90% of nominal power;
- a licence for power build-up to 100% of nominal power.

After first startup, within a time limit set in the authorisation decree, the operator must request authorisation for final commissioning from the ministers in charge of nuclear safety. His request is substantiated by a final safety analysis report, final general operating rules and a revised version of the on-site emergency plan. These documents must reflect the experience acquired during the operating period since the initial startup.

• **Commissioning of basic nuclear installations other than power reactors**

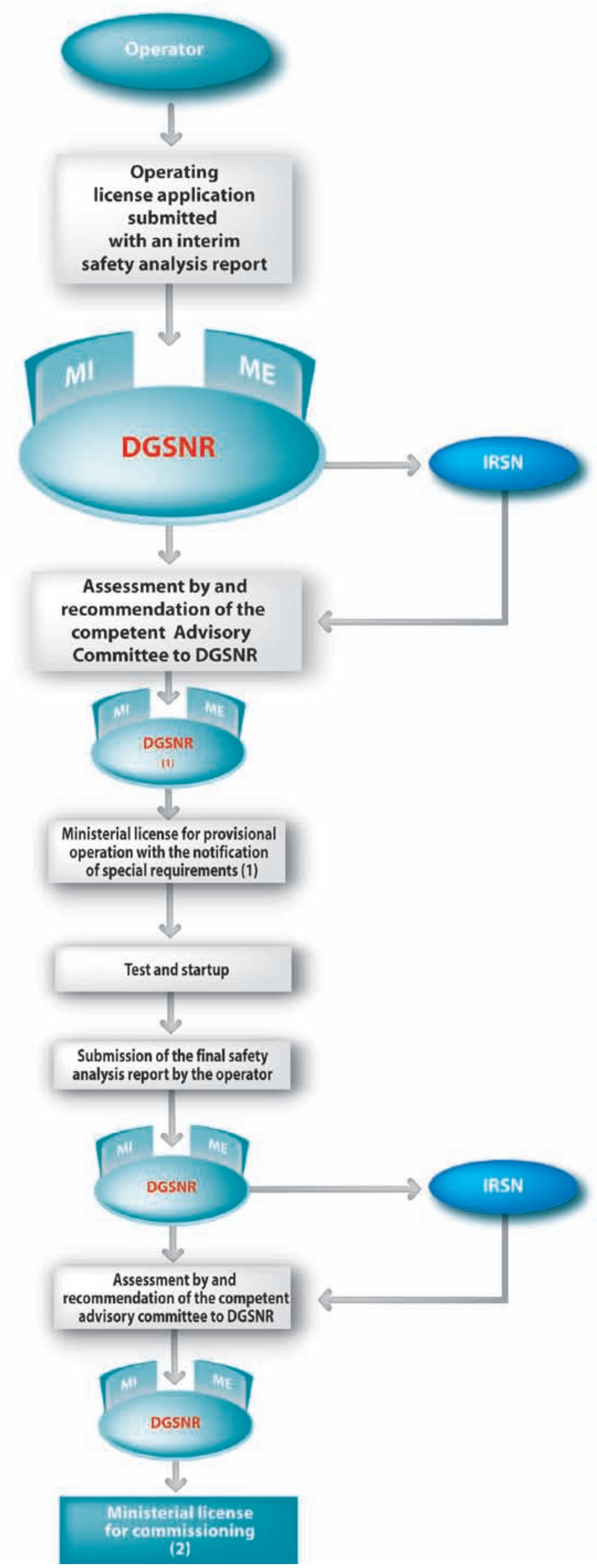
The authorisation decrees for BNIs other than power reactors stipulate that commissioning is dependent on authorisation by the ministers in charge of nuclear safety.

This pre-commissioning authorisation is accompanied by notification of technical requirements. It is granted after examination by the ASN and its technical support organisations, particularly the competent Advisory Committee, of the documents prepared by the operator. These documents include the provisional safety analysis report, the installation's general operating rules and the on-site emergency plan.

Moreover, before final commissioning of the installation, which must take place within a time set in the authorisation decree, the operator must submit a final safety analysis report to the ministers in charge of nuclear safety. 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.

No BNI commissioning licence was issued in 2005.

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

2 | 1 | 5

Final shutdown and dismantling licenses

• The final shutdown and dismantling licensing procedure

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

– a document justifying the selected configuration in which the installation will be left after final shutdown, and indicating the various stages of subsequent dismantling;

– a safety analysis report covering the final shutdown procedures and indicating subsequent plant safety provisions;

– the general surveillance and servicing rules to ensure that a satisfactory level of safety is maintained;

– an updated on-site emergency plan for the installation concerned.

In accordance with articles R. 122-1 to R. 122-16 of the Environment Code, the operator must also submit an environmental impact assessment of the proposed measures.

The above-mentioned decree of 11 December 1963 does not require a public inquiry as part of the examination of these applications. However, in the light of France's new international obligations under the Convention on access to information, public participation in decision-making and access to justice in environmental matters of 25 June 1998 (known as the Aarhus Convention), and of environmental protection regulations, the ASN requires that a public inquiry be conducted on BNI final shutdown and dismantling licence applications when the investigating department feels that the final shutdown and dismantling operations substantially affect the scope or purpose of the installation and that the risk presented by the BNI during the dismantling phase is appreciably greater than that which existed during its operating phase.

Performance of the final shutdown and dismantling operations as presented in the documents accompanying the licence application is dependent on their approval by decree countersigned by the ministers in charge of nuclear safety, further to assent by the Minister for Health, after prior consultation of the CIINB.

• Performance of final shutdown and dismantling operations

The final shutdown and dismantling operations, which only begin after any decommissioning operations, comprise two successive sets of operations:

– final shutdown operations, which mainly consist of disassembly of the equipment outside the nuclear island and not required for continued monitoring of nuclear island safety, maintaining or reinforcing of the containment barriers or establishing a radioactivity balance;

– 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.

In some cases, operations such as the unloading and removal of nuclear material, the disposal of fluids, or decontamination and clean-up operations can be performed under the provisions of the authorisation decree for the plant considered. To do so, these operations must involve compliance with previously imposed requirements and with the safety analysis report and general operating rules currently in force. In all other cases, such operations come under the provisions of the final shutdown and dismantling decree.

• Installation declassification and contractual easements

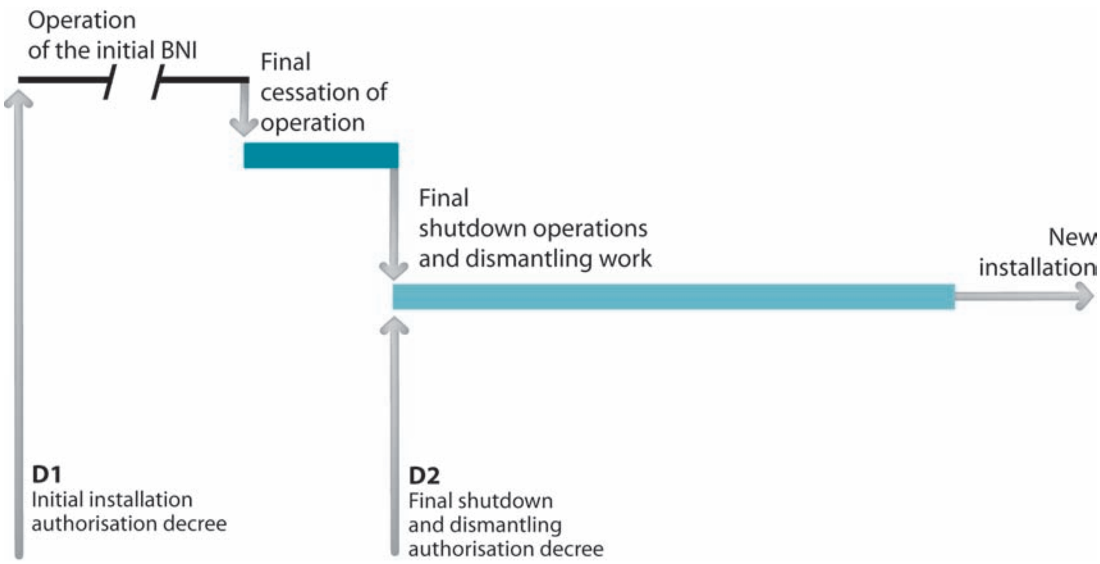
If dismantling work reaches the stage where the total radioactivity of the remaining radioactive substances is below the minimum level necessitating classification as a Basic Nuclear Installation, the plant can be declassified and removed from the list of BNIs in accordance with the procedure laid down in its final shutdown and dismantling decree.

Depending on the residual level of radioactivity, the installation may then be subject to the legislation applicable to ICPEs (articles L. 511-1 to L. 517-2 of the Environment Code) and therefore subject to a registration or licensing procedure.

In order to retain a trace of the past existence of a BNI on a site, and provide for any possible future restrictions on use of the installation, the ASN may consider establishment of an easement as a precondition for declassification of the installation.

The final shutdown and dismantling decree for an installation therefore requires that after the dismantling operations and to support its installation declassification application, the operator submit an updated study of the impact of the installation on its environment, in order to assess the need for any restrictions on the future use of the installation and/or site. If this does prove necessary, a contractual easement on behalf of the State may be established by the ASN, after discussion with the local State services concerned, proposed to the landowner and, as applicable, the owner of the remaining buildings. This proposed easement may comprise general precautionary easements (minimum inspections required when earthworks are carried out on the land, ban on construction of buildings housing vulnerable persons, inclusion of the easement in the land registry) and may, as required, provide for procedures specific to the site concerned, according to its state after dismantling.

When such a contractual easement is put in place, it is communicated by the ASN when the ministerial decision is made to declassify the installation from its BNI status.



Final shutdown and dismantling of basic nuclear installations

Final shutdown and dismantling decrees issued in 2005		
SILOÉ RESEARCH REACTOR (Grenoble – Isère)	26 January 2005	Decree authorising the CEA to proceed with final shutdown and dismantling of BNI n° 20
SILOETTE RESEARCH REACTOR (Grenoble – Isère)	26 January 2005	Decree authorising the CEA to proceed with final shutdown and dismantling of BNI n° 21
Contractual easements on behalf of the State established in 2005		
SATURNE SYNCHROTRON (Saclay – Essonne)	6 Octobre 2005	Instrument creating an contractual easement on behalf of the State concluded between the department Prefect, the ASN and the CEA

2 | 1 | 6

Liquid and gaseous effluent discharge and water intakes licences

The normal operation of nuclear plants produces radioactive effluent, for which discharge 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 effluent, 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 discharge of non-radioactive liquid and gaseous effluent.

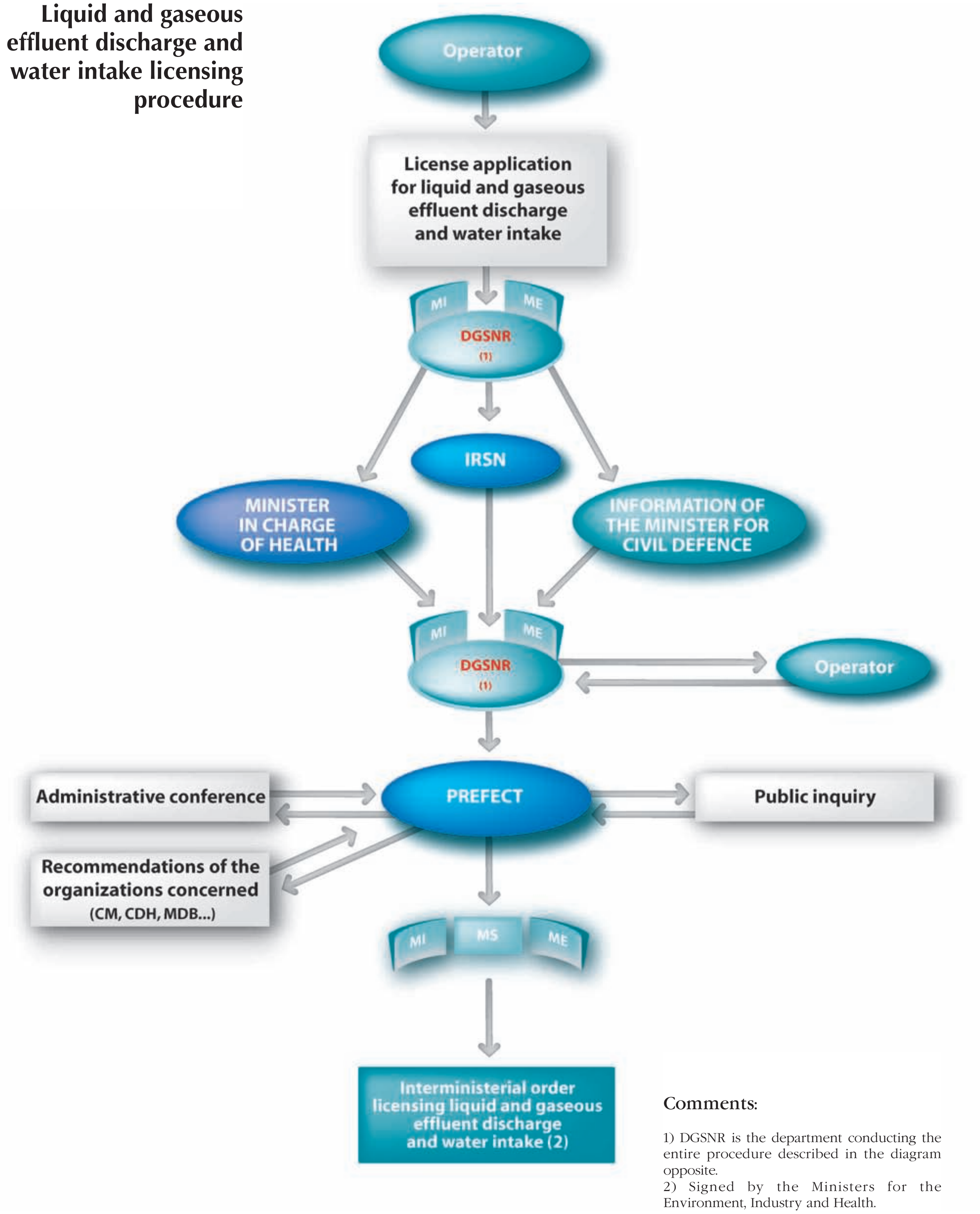
In application of decree 95-540 of 4 May 1995, as modified, on BNI liquid and gaseous effluent discharge and water intake, the same licence, issued at ministerial level, can where necessary cover both radioactive and non-radioactive liquid and gaseous discharge and water intake for a given BNI. The procedure, explained in two interministerial circulars (Health, Industry and Environment) of 6 November 1995 and 20 May 1998, is carried out on the basis of a single application drafted accordingly, with the investigating department in any case being the ASN.

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

• Submission of the plant authorisation

The effluent discharge and water intake licence application covers all such operations for which authorisation is required. It is sent to the ministers in charge of nuclear safety. 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 discharge and water intake licensing procedure



Comments:

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

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

· Recommendations of the ministers concerned

After asking the operator for additional data or for modifications to the documents, whenever necessary, the application is sent for their opinion to the ministers for Health (Directorate General for Health) and Civil Security (Nuclear risk management support delegation - MARN).

· Consultation of the public and local authorities and organisations

The ministers in charge of nuclear safety transmit the application and the recommendations of the ministers to the Prefect of the department concerned, for his opinion.

The Prefect organises an administrative conference between various regional offices which he feels should be consulted and subjects the application to a public inquiry under conditions similar to those described in point 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.

Furthermore, the Prefect consults the town councils concerned and, if necessary, the person with responsibility for managing the public domain and the departmental health council, as well as the local river authority (Mission déléguée de bassin) if necessary. He also sends the application file, for information, to the local water commission.

The Prefect then transmits the results of the administrative conference, consultations and inquiry, with his recommendation, to the ministers in charge of nuclear safety.

In application of article 37 of the Treaty instituting the European Atomic Energy Community, known as “Euratom”, France provides the European Commission with general data about any plans for discharge of radioactive effluent, so that it can be determined whether implementation of this project is likely to lead to radioactive contamination of the water, soil or airspace of another Member State. This transmission is required for any new project or any project leading to a rise in radioactive discharges and takes place at least six months before the licence is granted. France is bound by the opinion issued by the European Commission.

· Interministerial authorisation

Authorisation is granted by a joint 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 has been further clarified by a circular sent out to the prefects, signed by the same ministers on 17 January 2002 (see below in point 2|2|1) this document stipulates:
- the intake and discharge limits for which the operator is authorised;
- the approved methods of analysis, measurement and monitoring of the installation, work or activity and of surveillance of environmental effects;
- 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 discharges it has performed together with environmental impact surveillance results;
- the methods to be used for public information.

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

Finally, any modification made by the operator to the installation or its operating procedures, such as to have consequences on effluent discharges or water intake, must be notified beforehand to the ministers in charge of nuclear safety, who 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 2005

Nuclear maintenance shop (SOMANU), Maubeuge – Nord)	16 February 2005	Modification of the liquid radioactive effluent discharge licence for the nuclear maintenance shop
Nuclear site (Tricastin – Drôme)	16 August 2005	Order authorising EURODIF Production to continue with water intake and discharge of liquid and gaseous effluent for operation of a uranium isotope separating plant using gaseous diffusion on the Tricastin site
Nuclear site (Tricastin – Drôme)	16 August 2005	Order authorising SOCATRI to carry-out water intake and make liquid and gaseous effluent discharges for operation of a purification and uranium recovery installation on the Tricastin site
Nuclear site (Tricastin – Drôme)	17 August 2005	Order authorising COMURHEX to continue with liquid and gaseous effluent discharges for operation of a uranium hexafluoride preparation plant on the Tricastin site
Nuclear site (Chinon – Indre-et-Loire)	17 August 2005	Modification of the order authorising water intake and liquid and gaseous effluent discharge on the Chinon nuclear site

2 | 2

General technical regulations

The general technical regulations comprise all texts of a general nature establishing the technical rules applicable to nuclear safety, whether regulatory (orders) or related (circulars, basic safety rules, guides). However, texts defining the administrative and procedural rules applicable to BNIs and individual letters to the operators are not considered to be a part of the general technical regulations.

In 2005, the ASN began to look at ways of clarifying the structure of the general technical regulations as applicable to BNI safety. With a view to harmonising and simplifying access by professionals and the public to the stipulations and recommendations issued concerning nuclear safety, the ASN proposed that the general technical regulations henceforth comprise only two categories of texts:
- ministerial or interministerial orders, containing legally binding requirements specifying long-term safety objectives;
- guides, containing non-legally binding provisions on how to apply a regulatory text by stipulating recommended resources or procedures considered to be acceptable for achieving the safety objectives.

On this basis, the current body of general technical regulations will need to evolve and the ASN aims to broaden the scope of application.

All the texts making up the general technical regulations for the safety of basic nuclear installations are available in the Texts part of the ASN's website (asn.gouv.fr).

2 | 2 | 1

Ministerial and interministerial orders

These orders, based on article 10 bis of the above-mentioned decree of 11 December 1963, currently deal with four important subjects: pressure vessels, quality organisation, BNI water intake and effluent discharges, off-site detrimental effects and hazards resulting from BNI operation.

· Pressure vessels

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

The applicable regulations are detailed in the following table:

<table>
<tr><th rowspan="2"></th><th colspan="3">Nuclear</th><th rowspan="2">Conventional</th></tr>
<tr><th>Main primary system of pressurised water reactors</th><th>Main secondary systems of pressurised water reactors</th><th>Other equipment</th></tr>
<tr><td>Construction</td><td>• Decree of 2 April 1926
• Order of 26 February 1974 (1)</td><td>• Decree of 2 April 1926
• RFS II.3.8 of 8 June 1990 (1)</td><td rowspan="2">• Decree of 2 April 1926
• Decree of 18 January 1943
or
• Decree of 13 December 1999 (1)</td><td>• Decree of 13 December 1999</td></tr>
<tr><td>Operation</td><td colspan="2">• Order of 10 November 1999</td><td>• Decree of 13 December 1999
• Order of 15 March 2000</td></tr>
</table>

(1) The ASN has prepared a new regulatory text which, for nuclear pressure vessels, specifies construction and inspection procedures similar to those of decree 99-1046 of 13 December 1999 concerning pressure vessels, with the addition of aspects specific to nuclear facilities. This order concerning nuclear pressure vessels, dated 12 December 2005, will apply as of 2006 to the construction of pressure vessels for use in the nuclear field.

· Quality organisation

The order of 10 August 1984 concerning the quality of the design, construction and operation of basic nuclear installations specifies the steps to be taken by a BNI operator for defining, obtaining and maintaining the necessary quality of its installations and operating conditions, in order to guarantee safety.

It thus stipulates that the operator must define quality requirements for each activity concerned, employ the appropriate skills and methods for meeting these quality requirements and finally, guarantee quality by checking appropriate compliance with these requirements.

It also specifies:
- that detected discrepancies and incidents be thoroughly corrected and that preventive action be taken;
- that suitable documents testify to results obtained;
- that the operator supervise the service companies used and check compliance with procedures adopted to guarantee quality.

Experience feedback from incidents and accidents occurring in BNIs and the findings of the inspections conducted, enable the ASN to analyse the various problems in order to assess the application of the above-mentioned order of 10 August 1984.

• Water intake and effluent discharge by BNIs

BNI water intake and effluent discharges which - under application of the decree of 4 May 1995 mentioned above in point 2.1.6 - are subject to joint licensing by the ministers for Health, Industry and the Environment, are managed by technical rules defined in an order signed by the same ministers on 26 November 1999, setting the general technical rules concerning the limits and procedures for these BNI intakes and discharges subject to licensing. This text, which abrogates and replaces a number of orders dated 10 August 1976, comprises requirements which in particular concern proactive reduction of water intake and effluent discharge, enhancement of analysis resources and reinforcement of inspections, information of the various government services and of the public. Its implementation is explained in an interministerial circular of 17 January 2002, in particular with regard to the objectives and to application of the new regulations, depending on whether one is dealing with an initial application or a modification.

• Prevention of off-site detrimental effects and hazards resulting from BNI operation

BNI operation can entail detrimental effects and hazards for the environment in the broadest sense, that is for the surrounding installations and their workers, but also for the public and the environment off the site. The policy conducted by the ASN with respect to environmental protection is described in Chapter 5. It primarily aims to prevent and minimise the risks for the installations by ensuring that the following are applied:

- the above-mentioned decree of 11 December 1963, clarified by its implementing order of 31 December 1999 setting the general technical regulations designed to prevent and mitigate off-site detrimental effects and hazards resulting from operation of basic nuclear installations;
- ICPE legislation for installations of this type within the BNI perimeter.

The above-mentioned order by the ministers for the Environment and Industry of 31 December 1999 sets the general technical regulations for preventing and mitigating off-site detrimental effects and hazards resulting from BNI operation, with the exception of water intake and discharge of effluent. It introduces principles concerning waste management, prevention of accidental pollution, fire, lightning, criticality and radiolysis applicable to all nuclear equipment, including that which is situated outside the sensitive parts of the BNIs. Application of this text ensures that environmental protection concerns are taken into account by the operators at a level comparable with that required for non-nuclear industrial installations.

A revision of this order was finalised in 2005, clarifying fire risk management and introducing general technical rules concerning cooling installations, to prevent the risk of the spread of legionella. At the same time, work carried out with the DSND and the main nuclear operators led to preparation of a fire risk management guide specifying the corresponding goals defined in the amended version of the order of 31 December 1999 (see below in point 2|2|2).

2 | 2 | 2

Basic safety rules and ASN guides

• Nature and legal value of the RFS and ASN guides

On a variety of technical subjects, concerning both PWRs and other BNIs, the ASN has drafted basic safety rules (RFS). These are recommendations which specify safety objectives and describe practices the ASN considers to be adequate for compliance with them.

They are not, strictly speaking, regulatory documents. An operator may decide not to follow the specifications of an RFS if it can demonstrate that the alternatives it proposes employing enable the stipulated safety objectives to be met.

The flexibility of this type of text enables the technical requirements to evolve in line with changing technology and knowledge.

Given the restructuring of the general technical regulations described in point 2.2 above, the RFS will be gradually replaced by guides.

There are currently about forty RFS and other technical rules issued by the ASN, which can be consulted in the Texts part of the ASN's website (asn.gouv.fr).

• The RFS and guides currently being revised or drafted

RFS revision work is currently in progress, in particular concerning:

– RFS III.2.e of 31 October 1986, revised on 29 May 1995, concerning the preconditions for approval of encapsulated solid waste packages intended for surface disposal: changes to the rule should enable experience feedback from the first ten years of operation of the Aube repository to be taken into account. The ASN will ensure that the Advisory Committee for waste's examination of the revised RFS leads to conclusions that are consistent with the information obtained from examination of the safety analysis report on the Aube repository submitted by the ANDRA in October 2004.

– RFS I.4.a of 28 February 1985 on fire protection of BNIs other than reactors: a guide concerning management of the fire risk explaining the requirements of the above-mentioned order of 31 December 1999 and setting fire risk prevention goals, was drafted by the ASN in 2005.

2 | 2 | 3

French nuclear industry codes and standards

In the industrial field, the rules of industrial and professional good practice are codified in standards by standardisation bodies or in industrial codes by professional associations. The codes and standards allow concrete transposition of the requirements of the general technical regulations, while reflecting good industrial practice, thus facilitating contractual relations between customers and suppliers.

In the particular field of nuclear safety, the industrial codes used by the manufacturers and nuclear operators are drafted by the *Association française pour les règles de conception, de construction, et de surveillance en exploitation des matériels des chaudières électronucléaires* (AFCEN), of which EDF and Framatome ANP are members. The RCC codes of design and construction rules were drafted for the design, manufacture and commissioning of electrical equipment (RCC-E, 4th edition), civil engineering (RCC-G) and mechanical equipment (RCC-M, 2000 edition). As of 1990, a code of mechanical equipment in-service monitoring rules (RSE-M) was drafted to deal with this subject.

Production of these documents is the responsibility of industry and not the ASN, which is nonetheless tasked with examining them to ensure their conformity with the general technical regulations, in most cases leading to drafting of RFS, a guide or a decision, recognising the overall acceptability on the date of the edition concerned.

The new version of the RCC-E code was accepted by the ASN in 2003. The ASN in particular checked that this fourth edition of the code was consistent with RFS II.4.1.a of 15 May 2000 concerning software in PWR safety-classified electrical systems.

The 2000 edition of the RCC-M code was accepted with reserves by the ASN in a decision of 10 July 2001 (available in the Texts part of the ASN's website: asn.gouv.fr). A modification of the code is currently being examined in order to lift the reserves expressed at its acceptance in 2001 and take account of some of the new technical rules applicable to nuclear steam supply system construction.

The 2000 edition of the RSE-M code was accepted by the ASN in June 2002 and has been applicable to all nuclear power plants since January 2003. A modification to this code is also being examined in order to deal with the discrepancies observed at its acceptance in 2002, with respect to the order of 10 November 1999 concerning monitoring of operation of the main primary system and the main secondary systems of pressurised water reactors.

Until such time as it issues a position on the proposed changes to these codes, the ASN considers that the accepted versions of these codes, supplemented by any particular restrictions and measures imposed, remain in force.

2 | 3

Installations classified on environmental protection grounds

Installations liable to entail hazards and detrimental effects on the environment are governed by part I of book V of the Environment Code (which codified law 76-663 of 19 July 1976, as modified, concerning installations classified on environmental protection grounds). The installations concerned, mentioned in a list regularly updated by the Ministry for the Environment, and recently modified by decree 2005-989 of 10 August 2005, are subject to special conditions when located within a BNI perimeter.

The above-mentioned decree of 11 December 1963 in effect makes the following distinction, clarified by an opinion of the Council of State on 4 October 1983:
- "equipment which is part of a basic nuclear installation" is that which, within the perimeter of the BNI, constitutes an element of this installation which is necessary for it to operate; depending on its type, this equipment can in technical terms be compared to classified installations but, as a part of the BNI, it is subject to articles 2 and 3 of the above-mentioned decree of 11 December 1963 and to 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;
- the classified installations included within the perimeter of a BNI but which are not necessarily linked to it, are covered by the legislation concerning installations classified on environmental protection grounds, with the exception of three particular points specified in article 6 bis of the above-mentioned decree of 11 December 1963:

• the ministers in charge of nuclear safety take the place of the Prefects in granting licences and registering the notifications required by ICPE regulations;

• 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.

Furthermore, as mentioned in point 2|1|6 above, effluent discharges from ICPEs located within the perimeter of a BNI are regulated by the above-mentioned decree of 4 May 1995.

The ASN examines the relevant documents and the BNI inspectors are responsible for the supervision specified in the ICPE legislation, with regard to the relevant installations.

3 OUTLOOK

In the field of radiation protection in 2005, the ASN completed transposition of three Euratom directives (89/618, 96/29 and 97/43) and continued with work to transpose Council directive 2003/122/Euratom of 22 December 2003 on the control of high-level sealed radioactive sources and orphan sources. This work should be completed during the first half of 2006. At the same time, based on the experience acquired since 2002, it has already begun to update the regulatory part of the Public Health Code dealing with ionising radiation, in order to simplify it. The proposed simplifications are aimed at greater accountability on the part of the users of sources of ionising radiation, but also reinforcement of supervision by approved organisations.

Updating of the new ICRP recommendations will be very closely monitored by the ASN. At the same time, it will play an active part in the international work of the IAEA and the European Commission, which have already announced their desire to coordinate updating of the international standards constituting the reference for radiation protection regulations, in particular by using the new ICRP recommendations as a basis.

The WENRA working groups have finalised their preparatory work for setting reference nuclear safety levels for power reactors and management of radioactive waste. The reports from the two working groups will be presented at a seminar in February 2006 in Brussels, bringing together representatives of the nuclear safety authority members of WENRA, the representatives of the European Commission, the IAEA, the NEA and the nuclear operators.

These reference levels will be debated during the course of 2006 and will be formalised at the end of the year, so that the WENRA members can initiate work to revise their national regulations, leading to harmonisation of nuclear safety supervisory practices in 2010.

The bill on nuclear transparency and safety should also be brought before Parliament at the beginning of 2006. This bill, tabled before the Senate on 18 June 2002, completes the general legislative framework for nuclear activities as defined by the Public Health Code. The bill has three key goals:

- it defines the main principles applicable to nuclear activities;
- it organises operator transparency in the field of nuclear activities;
- it overhauls the legislative basis concerning regulation and supervision of the safety of BNIs and radioactive material transport.

In accordance with law 91-1381 of 30 December 1991 concerning research into radioactive waste management, a parliamentary debate is scheduled for 2006 on a radioactive waste management bill. This bill could incorporate the main orientations of the national radioactive waste and reusable materials management plan (PNGDR-MV), the preparation of which was entrusted to the ASN in 2003 (see below chapter 16, point 1|6).

2006 will also be devoted to regulatory work aimed at:

- completing the simplification of licensing procedures for activities covered both by the list of installations classified on environmental protection grounds (ICPE) and the Public Health Code;
- redefining the procedures for BNI classification following abrogation of decree 66-450 of 20 June 1966, as modified, concerning the general principles of protection against ionising radiation and the subsequent disappearance of all reference to the radiotoxicity groups used to defined the activity levels above which an installation is considered to be a basic nuclear installation.

APPENDIX 1

VALUES AND UNITS USED IN RADIATION PROTECTION

1 The main values used in radiation protection

It is impossible to apply radiation protection rules without metrology, as the most important exposure indicators for radiation protection are the doses received by man. Transposition of Council directive 96/29/Euratom of 13 May 1996 laying down the basic safety standards for the protection of the health of workers and the general public against the dangers arising from ionising radiation enabled the definitions of the main values used in radiation protection to be updated (appendix 13-7, regulatory part of the Public Health Code).

Activity and becquerel

Activity (A): the activity A of an amount of a radionuclide in a particular energy state at a given time is the quotient of dN by dt, where dN is the expectation value of the number of spontaneous nuclear transitions with emission of ionising radiation from that energy state in the time interval dt.

$$A = \frac{dN}{dt}$$

The unit of activity of a radioactive source is the becquerel (Bq).

Absorbed dose and gray

Absorbed dose (D): energy absorbed per unit mass

$$D = \frac{dE}{dm}$$

where:
dE is the mean energy communicated by the ionising radiation to the matter in a volume element;
dm is the mass of the matter in this volume element.
The term "absorbed dose" designates the mean dose received by a tissue or an organ.

The absorbed dose unit is the gray (Gy).

The absorbed dose D represents the quantity of energy absorbed per unit mass of tissue. 1 gray (Gy) corresponds to the absorption of 1 joule per kilogram. This quantity designates the mean dose absorbed by a tissue, organ or the whole body. However, the absorbed dose cannot be directly used in radiation protection because it does not take account of the fact that the biological effects of the energy intake depend on a number of parameters:
- the quality of the radiation, in other words how it loses its energy in the micro-volumes along its path. This depends on its nature, whether electromagnetic (X or gamma rays) or electrically charged or uncharged particle (alpha, beta or neutrons);
- the characteristics of the organ or tissue into which the energy is 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 radiation R.

When the radiation field comprises radiation of types and energies corresponding to different values of w_R the total equivalent dose H_T is given by the formula:

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

The equivalent dose unit is the sievert (Sv).

The ICRP's w_R values, published in the order of 1 September 2003, are given in the following table. For the types of radiation which do not appear in the table, an approximate w_R value 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.

Dans $H_T(\tau)$, 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:

$$E = \Sigma_T \, w_T \, H_T = \Sigma_T w_T \, \Sigma_T \, w_R \, D_{T,R}$$

where:

$D_{T,R}$ is the mean for 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 [$H_T(\tau)$] following intake, each multiplied by the appropriate weighting factor w_T. It is given by the formula:

$$E(\tau) = \Sigma_T w_T H_T(\tau)$$

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 belated 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
Œsophagus	0.05
Thyroid	0.05
Liver	0.05
Skin	0.01
Bone surface	0.01
Others[1]	0.05

Comments - The choice of the same unit to express the equivalent dose, defined in an organ, and the effective dose which takes account of all irradiated organs, is frequently a source of confusion.

1. For the calculations, the "other" organs are represented by a list of 12 organs for which selective irradiation is possible by internal contamination. If one of them concentrates most of the radionuclides, a w_T of 0.025 is given to it and a factor of 0.025 assigned to the mean dose received by the other 11 organs.
The sum of the different w_T values is equal to 1, which corresponds to uniform irradiation of the whole body. The w_T values are adapted to the expression of internal contamination.

The effective dose can be used to compare irradiations of different types, with regard to both the nature of the radiation and whether irradiation is overall or partial. On the other hand, the effective dose comprises a weakness: that of not being a measurable value. In the case of external exposure, measurable operational values are defined (ambient equivalent dose, directional equivalent dose, etc.), which will be used to calculate the dose in variable volumes, according to whether or not the radiation is penetrating and according to the effects (dose on the eye, dose on the skin).

The means of calculating the effective dose also has the drawback of having varied with time, in line with the changes made by the ICRP to the w_R and w_T coefficients, which were reviewed in the light of fresh data as it became available. Comparing the effective doses calculated at intervals of several years means that the weighting coefficients used in the calculations must be known for each period.

In the case of internal contamination from a long-lived radionuclide, we use the committed dose (committed equivalent dose or committed effective dose). At the time of contamination, it expresses integration of all the tissue doses, up to complete elimination of the radionuclide or for 50 years in workers and 70 years in children. The committed effective dose is calculated using the dose coefficients of directive 96/29/Euratom published in France in the order of 1 September 2003 defining the methods for calculating effective and equivalent doses resulting from exposure of persons to ionising radiation. 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:

$$S = \Sigma H_i P_i$$

H_i is the mean of the total doses or the doses in a given organ of the P_i members of the ith subgroup of the population or group.

The collective dose unit is the man.sievert.

Comment - For the ICRP, the advantage of the collective dose is to allow optimisation of exposure to the lowest possible collective level, which contributes to the advancement of society as a whole, with the exception of the cost generated, which was not taken into account. This value, little used in France, was not included in the European and national regulations.

2 Uncertainties

The values recognised for the various weighting factors (w_R and w_T) were chosen from a relatively wide range of values. These are approximations designed to provide a tool for risk management.

The w_R values are taken from physical measurements describing the intensity of ionisation per unit volume, a value which varies with the residual energy along the path. When choosing a single value for a given radiation, account is therefore only taken of the direct biological observations, comparing the effects of this radiation with those of a reference radiation. Depending on the dose level and the biological effects considered, the relative biological effectiveness (RBE) can vary widely.

The w_T were also chosen with a view to compromise and simplification. A few numerical values alone characterise them. Some are of debatable scientific value. Thus, the value of 0.2 for the gonads implies the existence of genetic effects which have not been observed and the animal experimentation data used are probably highly over-valued. Finally, the breakdown of the risk between the various organs is primarily the result of epidemiological observations in Hiroshima and Nagasaki and we do not know exactly on what bases these risks should be transposed to a human group with significantly different ways of life.

APPENDIX 2

LIMITS AND DOSE LEVELS

Annual exposure limits contained in the Public Health Code (CSP) and in the Labour Code (CT)

	Definition	Values	Observation
Annual limits for the population Art. R.1333-8 of the CSP	• Effective whole-body doses • Equivalent doses for the lens of the eye • Equivalent doses for the skin (average dose over any area of 1 cm² of skin, regardless of the area exposed)	1 mSv/year 15 mSv/year 50 mSv/year	☞ These limits comprise the sum of effective or equivalent doses received as a result of nuclear activities. These are limits that must not be exceeded.
Limits for workers over 12 consecutive months Art. R.231-77 of the CT	Adults: • Effective whole-body doses • Equivalent doses for the hands, forearms, feet and ankles • Equivalent doses for the skin (average dose over any area of 1 cm² 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 whole-body doses • 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. ☞ Exceptional waivers are accepted: • when justified beforehand, they are scheduled in certain working areas and for a limited period, subject to special authorisation. These individual exposure levels are planned according to a upper limit which is no more than twice the annual exposure limit value; • emergency occupational exposure is possible in an emergency situation, in particular to save human

* Only if covered by waivers, such as for apprentices.

Optimisation levels for patient protection (Public Health Code)

	Definition	Values	Observation
Diagnostic examinations Diagnostic reference level Art. R.1333-68, order of 16 February 2004	Dose levels for standard diagnostic examinations	e.g., 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 employ 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 2006	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 cases of radiological emergencies (Public Health Code)

	Definition	Values	Observation
Protection of the general public Intervention levels Art. R.1333-80, order of 14 October 2003, circular of 10 March 2000	Expressed in effective dose (except for iodine), these levels are designed to assist 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 adjustements to take account of local factors.
Protection of participants 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 participants	 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	Observation
Long-term 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	Undefined	☞ 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 R.1333-16 of the CSP, order of 22 July 2004 **Protection des travailleurs** Article R.231-115 du CT	Premises open to the public Working environments	400 Bq/m³ 1000 Bq/m³ 400 Bq/m³	☞ See notice published in Official Gazette of 11 August 2004 defining radon measurement methods. ☞ See notice published in Official Gazette of 22 February 2005 defining the corrective measures to be taken in the event of overshoot.
Enhanced natural exposure (excluding radon) **Protection of the general public** Art. R.1333-13 and R.1333-14 of the CSP **Worker protection** Art. R.231-114 of the CT	Effective dose	N/A 1 mSv/an	☞ Any population protection action to be taken will be defined on a case by case basis.
Water intended for human consumption Decree n° 2001-1220 of 20 December 2001, order of 12 May 2004	Annual total indicative dose (TID) calculated based on the radioelements present in the water, except for tritium, potassium 40, radon and daughter products Tritium	0,1 mSv 100 Bq/L	☞ The TID can be used to estimate the exposure attributable to the radiological quality of the water. Any corrective measures to be taken if the TID is exceeded depend on the value of the TID and the radioelements in question. ☞ Tritium is a contamination indicator.
Foodstuffs (emergency situation) European regulations *Codex alimentarius*, etc.	Saleability limits		See following table.

Consumption restrictions on contaminated foodstuffs

In the event of an accident or any other radiological emergency situation, the restrictions on the consumption or sale of foodstuffs are determined in Europe by two regulations: Council regulation N° 3954/87/Euratom of 22 December 1987 laying down maximum permitted levels of radioactive contamination of foodstuffs and of feedstuffs following a nuclear accident or in any other case of radiological emergency, and Council Regulation 2219/89/EEC of 18 July 1989 on the special conditions for exporting foodstuffs and feedstuffs following a nuclear accident or any other case of radiological emergency. 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 feedstuffs).

A list of foodstuffs of “lesser importance” was drawn up (foodstuffs for which consumption does not exceed 10 kg/year). Levels ten times higher are set for these items, such as thyme, garlic, cocoa paste, truffles, caviar, etc.

Foodstuffs or feedstuffs in which contamination exceeds these levels, may not be sold or exported. Nonetheless, in the event of an accident, “automatic” application of this regulation may not exceed a period of three months, after which time it would be replaced by more specific provisions.

MAXIMUM ALLOWABLE LEVELS FOR FOODSTUFFS (Bq/kg or Bq/L)	**Baby foods**	**Dairy products**	**Other foodstuffs** except those of lesser importance	**Liquids** intended for consumption
Isotopes of strontium, in particular ^{90}Sr	75	125	750	125
Isotopes of iodine, in particular ^{131}I	150	500	2,000	500
Isotopes of plutonium and alpha-emitting transuranic elements, in particular ^{239}Pu and ^{241}Am	1	20	80	20
Any other element with a half-life of more than 10 days, in particular ^{134}Cs and ^{137}Cs	400	1,000	1,250	1,000

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

Pork: 1,250 Bq/kg
Poultry, lamb, veal: 2,500 Bq/kg
Others: 2,500 Bq/kg.

The WHO also proposed indicative values to facilitate international trade. The national authorities may use these values as the basis for determining their own thresholds, thus helping to harmonise these intervention criteria.

Indicative values of the *Codex alimentarius* for foodstuffs offered for sale (FA91) Bq/kg

FOODSTUFFS INTENDED FOR GENERAL CONSUMPTION	
Americium 241, plutonium 239	10
Strontium 90	100
Iodine 131, caesium 134, caesium 137	1,000
BABY FOODS AND MILK	
Americium 241, plutonium 239	1
Iodine 131, strontium 90	100
Caesium 134, caesium 137	1,000

SUPERVISION OF NUCLEAR ACTIVITIES AND EXPOSURE TO IONISING RADIATION

CHAPTER 4

1 SUPERVISION OF BNIS AND RADIOACTIVE MATERIAL TRANSPORTS

1|1 Scope of supervision
1|1|1 Supervision of nuclear safety
1|1|2 Pressure vessels
1|1|3 BNI working conditions

1|2 BNI and radioactive material transport supervision procedures
1|2|1 Technical investigation of operator files
1|2|2 Using experience feedback
1|2|3 ASN decisions and formal notices
1|2|4 Inspection
1|2|5 Internal authorizations

1|3 The ASN organisation for BNI supervision
1|3|1 BNI inspectorate
1|3|2 Supervision of pressure vessels
1|3|3 Examination of significant events

2 "LOCAL" NUCLEAR SUPERVISION

2|1 Scope of supervision

2|2 Supervision procedures for activities using ionising radiation
2|2|1 Internal supervision of radiation protection by the users of ionising radiation
2|2|2 ASN examination of the procedures laid down by the Public Health Code
2|2|3 Growth in radiation protection supervision by the ASN
2|2|4 Supervision procedures by organisations approved by the ASN
2|2|5 Openness and discussion

3 MONITORING OF EXPOSURE TO TENORM

3|1 Monitoring of exposure to radon

3|2 Monitoring of exposure to NORM in non-nuclear industries

3|3 Monitoring of natural radioactivity in drinking water

4 OUTLOOK

SUPERVISION OF NUCLEAR ACTIVITIES AND EXPOSURE TO IONISING RADIATION

The supervision of nuclear activities by the ASN aims to check that all users of ionising radiation exercise in full their responsibilities and their obligations with regard to radiation protection. In the case of basic nuclear installations (BNIs), this supervision is extended to cover nuclear safety and environmental protection and applies to all stages of the life of the installations: design, creation, commissioning, operation, final shutdown, dismantling. This supervision also includes visits, inspections of all or part of an installation, and examination and analysis of files, documents and data supplied by the operator to justify its actions. Although traditionally more focused on verifying the technical conformity of installations and activities with regulations and standards, this supervision today encompasses a broader dimension taking in human and organisational factors that are harder to assess; it thus includes an examination of individual and collective behaviour, of management, organisation and procedures, based on a variety of indicators (such as events, inspections or relations with the stakeholders (personnel, operators, contractors, trade unions, occupational physicians, inspectorates, and so on)). This supervision by the ASN does not relieve the user of ionising radiation of the need to organise its own in-house supervision of its activities.

The ASN also carries out supervision in premises where exposure of persons to natural radiation can be enhanced owing to the underlying geological context (radon in premises open to the public) or the characteristics of the materials used in industrial processes (non-nuclear industries).

This chapter present the procedures involved in the supervision conducted by the ASN, on the one hand of BNI operators and transporters of radioactive materials, and on the other of users of ionising radiation. It also presents the procedures for monitoring exposure to Technologically Enhanced Naturally Occurring Radioactive Materials (TENORM).

1 SUPERVISION OF BNIS AND RADIOACTIVE MATERIAL TRANSPORTS

Although prime responsibility for safety lies with the operator, the regulatory body is responsible for authorization, inspection and formal notice. In France, under application of decree 2002-255 of 22 February 2002 which created the Directorate General for Nuclear Safety and Radiation Protection (DGSNR), the regulatory body is the ASN: this body is in particular tasked with preparing and implementing all measures concerning the safety of BNIs and transports of radioactive and fissile materials for civil purposes (TMR), in particular by checking application of technical regulations and organising BNI and TMR safety inspections. For the ASN, this responsibility covers safety, radiation protection and pressure vessels.

1 | 1 Scope of supervision

1 | 1 | 1 Supervision of nuclear safety

BNI safety, the principles of which are recalled in chapter 2, covers all technical and organisational measures taken at all stages in the design, construction, operation, shutdown and dismantling of nuclear installations in order to ensure normal operation, prevent accidents and limit their effects, in order to protect workers, the population and the environment against the effects of ionising radiation. It also comprises technical measures to optimise management of waste and radioactive discharges.

The safe transport of radioactive materials depends 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.

The ASN's supervisory activities cover all elements contributing to BNI and TMR safety. It is thus required to look at the equipment constituting the installations and the persons in charge of operating it, at the working and organisational methods from the initial design phases up to dismantling. It examines on the one hand the steps taken concerning safety or the monitoring and limitation of the doses received by the persons working in the installations, and on the other waste management, effluent control and environmental protection procedures.

In-depth inspection at Pierrelatte

1|1|2

Pressure vessels

A large number of nuclear plant systems contain pressurised fluids and are consequently subjected to general pressure vessel regulations (see chapter 3, point 2|2|1).

At central government level, responsibility for supervising application of the regulations lies with the ASN for nuclear pressure vessels containing radioactive products inside BNIs, and the Directorate for Regional Action, Quality and Industrial Safety (DARQSI) for other pressure vessels.

Of the BNI pressure vessels subject to ASN supervision, the main primary and secondary systems of EDF's 58 pressurised water reactors are particularly important systems. 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.

1. Transports includes all operations and conditions associated with the movement of radioactive materials, such as packaging design, manufacture, maintenance and repair, and the preparation, shipment, loading, routing, including interim storage in transit, unloading and reception at the final destination of the radioactive material loads and packages.

ASN supervision of these systems is consequently very specific. It is based:
- with regard to the design and construction phase, on the order of 26 February 1974 for the main primary system (CPP) and on basic safety rule II.3.8 of 8 June 1990 for the main secondary systems (CSP);
- with regard to the operations phase, on the order of 10 November 1999 concerning supervision of the operation of the main primary system and the main secondary systems of pressurised water nuclear reactors, which gives the requirements for these two types of systems.

The ASN has prepared a new regulatory text, the order of 12 December 2005 concerning nuclear pressure vessels, which was published at the end of 2005. It will apply as of 2006 to the construction of nuclear pressure vessels, in particular reactor main primary and secondary systems (see chapter 3 point 2|2|1).

Pressure vessel operation is supervised. This supervision in particular applies to the in-service surveillance programmes, non-destructive testing, maintenance work, disposition of nonconformities affecting the systems and periodic post-maintenance testing of the systems. The principal PWR main and secondary system files currently being dealt with are discussed below in chapter 12.

1|1|3

BNI working conditions

In BNIs, as in any industrial firm, compliance with regulations concerning health and safety in the workplace is the responsibility of labour inspectors. In the case of EDF's nuclear power plants, supervision is carried out by DRIRE agents under the authority of the Directorate for Energy Demand and Energy Markets (DIDEME) at the Ministry for the Economy, Finance and Industry, by delegation of the Ministry for Labour. At the DRIREs, the agents carrying out this activity may also be BNI inspectors and could in the future be radiation protection inspectors.

Nuclear safety supervision, radiation protection and labour inspection actions have common concerns, notably the organisation of work sites and the conditions governing use of subcontractors. Whenever necessary, the ASN and the DIDEME therefore aim to co-ordinate their respective actions.

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

1|2

BNI and radioactive material transport supervision procedures

The operator is required to provide the ASN with all data required to enable it to carry out its inspection functions. The volume and quality of this data should enable the technical demonstrations presented by the operator to be analysed and the inspections to be targeted. It should also allow identification and monitoring of the key events marking BNI operation or a TMR.

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 (point 1|2|3).

Finally, to ensure that supervision is as effective as possible, by checking that adequate resources are allocated to its duties, the ASN is developing an approach involving transfer to the operator of certain decisions for which it was hitherto responsible. This is the principle of "internal authorizations" (see point 1|2|5).

1 | 2 | 1

Technical investigation of the operator files

Examination of the justification documents produced by the operators and of the technical meetings organised on the site with the BNI operators or the manufacturers of equipment used in the installations is one of the forms of supervision conducted by the ASN.

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 pressurised water reactor main primary system (CPP) and main secondary system (CSP) equipment. In accordance with the same principles, it supervises the packages intended for the transport of radioactive materials.

Once the nuclear installation has started operating, all safety-related modifications made by the operator are subject to ASN approval. In addition to meetings necessitated by developments in plant equipment or operating procedures, the ASN requires periodic safety reviews from the operators, providing opportunities to reinforce safety requirements according to both technological and policy developments and operating feedback.

Examination of this data may lead the ASN to accept or on the contrary reject the operator's proposals, to ask for additional information or studies or to ask for work to bring the relevant items into conformity. The ASN expresses these requirements in the form of either an authorization, or a decision (see point 1|2|3).

a) Appraisal of the data supplied

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

Whenever it deems necessary, the ASN seeks the advice of technical support organisations, primarily the 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.

b) The main fields concerned

• Nuclear power plant scheduled outages

Nuclear power plants are periodically shut down for refuelling and for maintenance of their main components.

Given the importance for safety of the maintenance work done during the outage and the safety hazards involved in certain outage situations, the ASN requires detailed information from the operator. This information mainly concerns the work programme involved (see chapter 12) and any anomalies observed during the outage. During the "site" inspections, the inspectors will carry out spot checks on the conditions in which the various worksites in progress are conducted, whether for repair or for modification of the installations, and the conditions in which equipment is monitored in-service, or periodic equipment testing is carried out.

Approval of outage programmes has been a DRIRE assignment since 1985. Restart of a reactor requires approval by the Director General for Nuclear Safety and Radiation Protection, on proposals from the competent DSNR.

• Other data submitted by the operators

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

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

1 | 2 | 2

Using experience feedback

A system of nonconformity or significant incident declaration by BNI operators was set up in accordance with the requirements of the order of 10 August 1984 concerning the design, construction and operation of basic nuclear installations (see chapter 3). This safety concept is derived directly from application of the second level of defence in depth, as described in chapter 2, and resulting from the provisions of the international conventions ratified by France (article 9 of the Joint Convention on the Safety of Spent Fuel Management and the Safety of Radioactive Waste Management, of 5 September 1997; article 19 of the Convention on Nuclear Safety of 20 September 1994). This requires implementation of a reliable system for detecting possible nonconformities or deviations, such as equipment failures or errors in application of operating rules. This system should allow early detection of any excursion from the normal operating range and constant improvement is required in BNI and radioactive material transport safety. It is therefore necessary to analyse the events detected in an installation or during a transport operation, in order:
- by taking account of appropriate corrective measures, to ensure that an event which has already occurred will not happen again;
- by analysing the potential consequences of events constituting early-warning signs of more serious incidents, to prevent an aggravated situation from occurring;
- to promote good safety improvement practices.

Analysis of the events detected in this way and implementation of modifications and corrective measures brought to light by this analysis, constitute what is known as experience feedback. It is a fundamental tool in the defence in depth approach. To give an idea, between 100 and 300 deviations are detected and analysed every year for each EDF reactor, and about fifty per year for a research laboratory.

Classification of these events must ensure that the more important ones are given priority treatment. For this purpose and for all the BNIs, the ASN has defined a category of unforeseen events known as "significant events". These are events that are sufficiently important in terms of safety to justify rapid notification, followed by a subsequent and more complete report. This report indicates the operators' conclusions concerning analysis of the events and the steps they are taking to improve safety. This information is extremely valuable for the ASN and its technical support organisation, the IRSN, in particular for the installations' periodic safety reviews. As an illustration, about ten significant events are declared for an EDF reactor every year.

The ASN ensures that the operator has carried out a pertinent analysis of the event and taken appropriate steps to remedy the situation, prevent it happening again and ensure that experience feedback is sent out to the nuclear operators.

Based on twenty years of experience, the ASN felt that it would be a good idea to transpose this safety concept to the fields of radiation protection and environmental protection and therefore updated the safety principles defined in the 1980s, extending them to radiation protection. A guide that can be consulted on the ASN's website, www.asn.gouv.fr, now gives all the provisions applicable to the operators and transporters concerning how to declare safety events affecting BNIs, radioactive material transports, radiation protection or environmental protection.

This declaration system is a means of providing data for the experience feedback data base. Significant events should not however be confused with radiological emergency situations, for which a different organisation is in place (see chapter 8).

The ASN wishes to expand this concept beyond the transporters and BNI operators. A similar approach is in progress for defining significant event declaration criteria concerning radiation protection in all local nuclear activities.

1 | 2 | 3

ASN decisions and formal notices

a) 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, nuclear safety authorities in other countries, etc.

Technical dialogue between the ASN and the operators is a key factor in preparation of the ASN's decisions: the arguments examined must be complete and exhaustive. When all the arguments have been exchanged, the regulatory decisions are imposed.

Ensuing actions include the following:
- granting or refusal of the requested authorization;
- 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.

b) 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 2005, four decisions were signed by the Director General for Nuclear Safety and Radiation Protection:

– decision DGSNR/SD3/ 0698/2005 of 18 November concerning decommissioning of basic nuclear installation no. 48 known as the SATURNE synchrotron, operated by the French Atomic Energy Commission on the Saclay site in Saint-Aubin (Essonne);
– decision DGSNR/SD2/ 298/2005 of 2 August, concerning the primary flow rate of the pressurised water reactors of the 900 MWe plant series: this sets the time-frame for transmission of the studies aimed at reviewing the relevance of the water flow limit value in the primary systems of nuclear reactors and the uncertainties linked to the measurement. In the meantime, and if the flow limit value is exceeded, EDF must ensure that the locating pins on the core lower plate are in good condition;
– decision DGSNR/SD2/ 124/2005 of 18 April 2005 stipulating a one month change in the time-frame for carrying out the conformity work on the lifting and handling cranes in the reactor building and on a number of their components, with respect to their seismic performance, for the 1300 MWe series of reactors. These conformity time-frames had been set by a decision of 22 April 2003;
– decision DGSNR/SD2/ 95/2005 of 1 March concerning prevention and monitoring requirements for insertion of reactor control clusters in pressurised water reactors. It authorises EDF to load fuel assemblies under RCCs for their last burnup cycle and puts an end to the obligation to conduct RCC drop time tests during the course of the cycle. The requirements concerning the RCC drop time tests at the end of the cycle and the particular fuel assembly deformation measurements are however maintained for all reactors in order to consolidate experience feedback.

The formal notices are injunctions addressed to operators, notably further to non-compliance with:
– the general technical regulations;
– requirements defined by order;
– a decision;
– a commitment made to the ASN.

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

In 2005, no formal notice was issued.

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.

1 | 2 | 4

Inspection

a) Principles and objectives

Compliance with the safety reference system by the nuclear operators is monitored through regular supervision. This in particular takes the form of inspections on the nuclear sites, but also in the central or corporate departments (or design offices) of the main nuclear operators or their suppliers, in order to check actual application of the safety requirements.

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

These inspections give rise to factual records, made available to the operator, concerning:
– nonconformities in regard to plant safety or radiation protection, or safety-related points requiring additional justification in the opinion of the inspectors;
– deviations between the situation observed during the inspection and the regulatory texts or the documents produced by the operator under application of the regulations, concerning both safety

and radiation protection and the related fields supervised by the ASN (waste management, effluent discharge, prevention of non-nuclear risks).

A programme of upcoming inspections is produced annually by the ASN. The topics dealt with take account of the inspections already performed, the extent to which the DRIREs and the ASN are familiar with the installations and the progress of the technical subjects under discussion between the ASN and the operators. It is prepared after consultation between the ASN, the DSNRs, 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.

Inspection in a BNI control room by ASN inspectors

b) Action taken in 2005

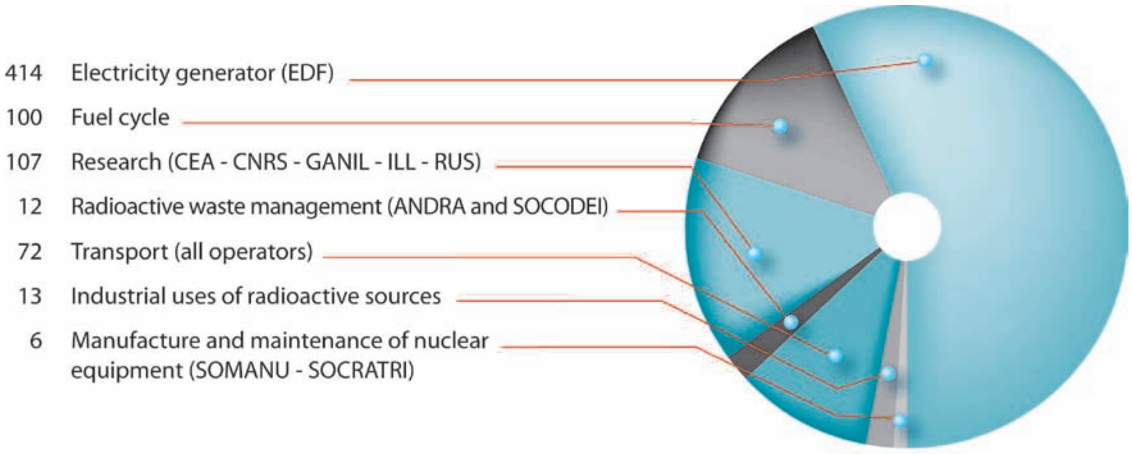
• Inspection practices

The ASN uses six types of inspections:
- standard inspections;
- reinforced inspections, on topics involving particular technical difficulties and normally directed by confirmed inspectors (see chapter 2 point 2|1|3);
- in-depth 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 discharge levels independently of operator measurements;
- reactive inspections, carried out further to a particularly significant event;
- worksite inspections, ensuring a significant ASN presence on the sites on the occasion of PWR unit outages or particular work, especially in the dismantling phase.

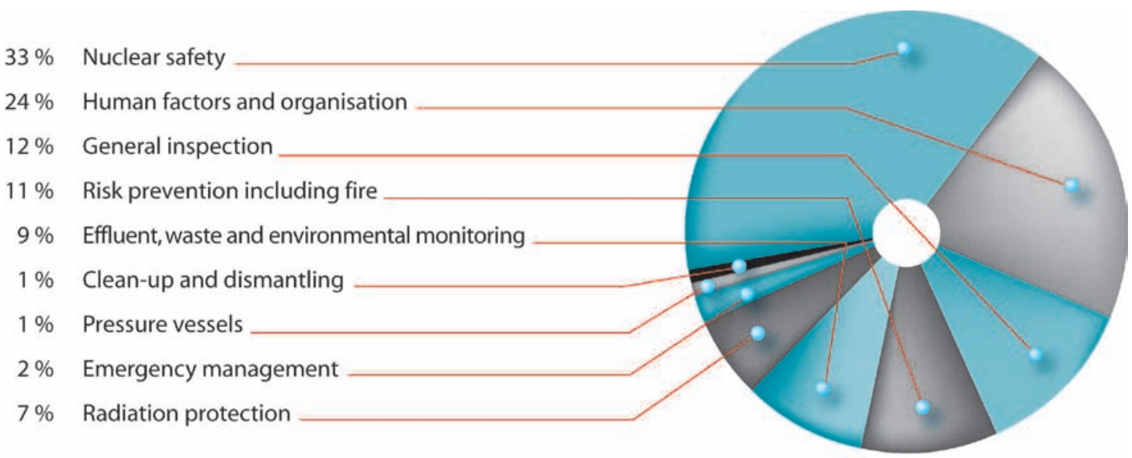
• Inspections in 2005:

In 2005, 724 inspections were conducted, 192 of which were unannounced. The breakdown according to the various installation categories is described in the following graphs.

Breakdown of 2005 inspections per type of operator



Breakdown of BNI inspections in 2005, per topic



The topics dealt with include the following, some of which were priority issues for 2005 and will be the subject of a summary analysis:

BNIs:

- management of radioactive sources at the CEA	2 inspections
- steam generator maintenance	20 inspections
- contracted work (PWR)	23 inspections
- operational diligence	18 inspections
- radiation protection at industrial contractors	2 inspections

Transport:

- non-approved packages	9 inspections
- gammagraphs and gamma-densimeters	23 inspections

1 | 2 | 5

Internal authorizations

The ASN must focus its efforts on topics which contribute to guaranteeing supervision of nuclear safety and radiation protection that is as effective as possible.

Expansion of the scope of supervision by the ASN in recent years, in particular owing to inclusion of supervision of radiation protection in local nuclear activities, is not without risks: the ASN could make operation of all nuclear activities dependent on granting of authorizations that would be issued by itself, without consideration for the overall picture and which could be prejudicial to the overall effectiveness of the ASN. Furthermore, this supervision activity has a degree of influence on the level of responsibility of those persons carrying out nuclear activities. The inspector is sometimes incorrectly seen as being the ultimate line of defence, through his attentive reading of the safety files.

For these two reasons - performance of its actions and operator accountability - the ASN is developing an approach in which certain decisions are devolved to the operator. For those which do not compromise the safety assumptions adopted for operation or dismantling of the installations, the operators may - on the basis of an opinion from an internal commission independent of the operators - directly take decisions which had traditionally been the preserve of the ASN.

These internal authorizations must be planned. The agenda is transmitted to the ASN sufficiently in advance for the ASN to check that the envisaged decisions do indeed correspond to internal authorizations. Once taken, they are declared to the ASN, which may then decide to inspect correct implementation. By means of dedicated inspections, the ASN also ensures the quality of the internal opinions given and assesses the independence of the commission. For decisions which can compromise the safety assumptions or the safety demonstration, the operators must ask the ASN for authorization to implement them.

This approach enables the ASN to concentrate its efforts on those changes which could have the greatest impact on the safety of the installations, while making the operator more accountable for its choices. It also gives greater value to the inspection, as an authorization request, assessed in principle by the ASN, becomes an internal decision checked subsequently by the ASN.

1 | 3

The ASN organisation for BNI supervision

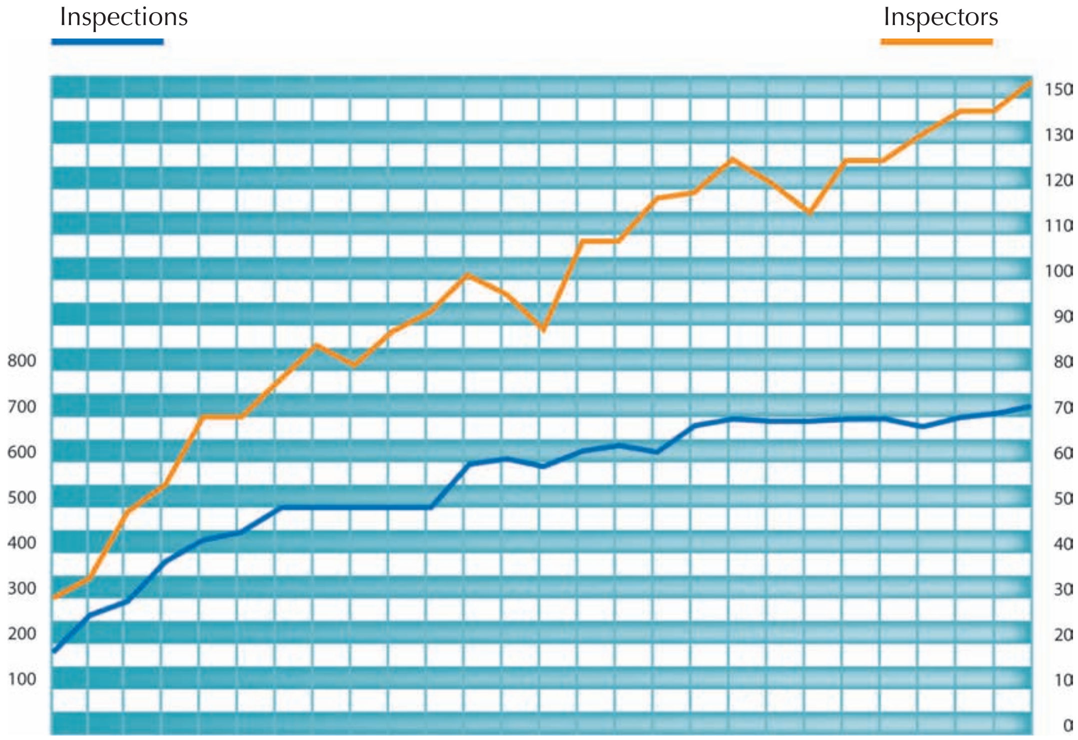
All the tasks involved in supervising nuclear safety are split within the ASN between the DGSNR and the DSNRs. The DSNRs are entrusted with “on the spot” supervision. They are in permanent contact with the nuclear operators, take charge of most of the inspections carried out on the nuclear sites and provide step by step supervision of the various stages in PWR maintenance and refuelling outages, after which authorization for restart will depend on the ASN. The DSNRs are also tasked with examining certain authorization or waiver requests. The DGSNR is responsible for co-ordinating and steering the DSNRs in these areas, deals with all matters of national importance and defines and implements national nuclear safety policy.

1 | 3 | 1

BNI inspectorate

The BNI inspectors are ASN management level staff appointed from among the inspectors for installations classified on environmental protection grounds (ICPEs) by joint order of 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 are sworn in and bound by professional secrecy (see chapter 2 point 2|1|3).

Trends in numbers of inspectors and inspections



Year	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	00	01	02	03	04	05
Number of inspectors	29	34	49	54	68	69	78	85	80	87	91	98	95	89	106	107	114	117	125	118	113	124	124	129	143	143	156
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	692*	724

*erratum : the number of inspection mentioned in the 2004 annual report was incorrect

Note:

This table does not take account of the surveillance inspections carried out by the ASN 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.

On 31 December 2005, the number of BNI inspectors on duty stood at 156, including 78 in the DRIREs and 78 at the DGSNR. For the past 3 years, this number has remained on the whole stable. The list of these inspectors is given in Appendix A.

1 | 3 | 2

Supervision of pressure vessels

Within the ASN, a specific sub-directorate is in charge of monitoring application of regulations concerning the main primary system and the main secondary systems for pressurised water reactors as well as all pressure vessels in the nuclear field.

It directly supervises the construction (design and manufacture) of the main primary and secondary systems (CPP and CSP) (see chapter 12 point 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 | 3 | 3

Examination of significant events

The DSNRs are responsible for immediately investigating significant events in all basic nuclear installations, to check that immediate corrective measures are implemented and, if necessary, to prepare the necessary information of the public. The ASN ensures co-ordination of DSNR action in this field and provides suitable training courses each year for the engineers concerned.

Examination of a significant event by the DSNR involves compliance with the rules in force concerning detection and declaration of significant events, the immediate technical steps taken by the operator to keep the installation in or bring it to a safe condition and finally, the pertinence of the significant event reports provided by the operator.

A subsequent examination of event experience feedback is conducted by the ASN and its technical support organisations, particularly the IRSN. The data supplied by the DSNRs and analysis of significant event 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.

2 “LOCAL” NUCLEAR SUPERVISION

2 | 1

Scope of supervision

The basic international standards for protection against ionising radiation and the safety of radioactive sources issued by the IAEA define the general functions of the regulatory authority (see box on following page).

In France, the ASN performs the role of regulatory authority, through its duty of drafting and monitoring technical regulations in the field of radiation protection. Decree 2002-255 of 22 February 2002 also states that the DGSNR is responsible for organising radiation protection inspections as provided for in the Public Health Code and its implementing texts, and for coordinating all inspections contributing to monitoring of radiation protection in the industrial, medical and research fields, including the monitoring of sources of ionising radiation used in these fields.

The scope of radiation protection supervision by the ASN thus extends to the use of ionising radiation in all nuclear activities defined in article L. 1333-1 of the Public Health Code. This duty is performed jointly with other inspection organisations such as the labour inspectorate, the inspectorate for classified installations and the French Health Products Safety Agency (AFSSAPS).

The basic international standards comprise:

" - the examination of requests for authorization to carry out practices entailing or potentially entailing exposure;
- authorization of these practices and their corresponding sources in certain conditions;
- performance of periodic inspections designed to check that the conditions are met and, as necessary, the application of measures designed to ensure compliance with the regulations and standards.

Mechanisms must therefore be available for declaring, recording and issuing licences for the sources involved in these practices as well making provision, in certain conditions, for exclusion or indeed exemption of sources and practices from the scope of application of the regulations. Steps must also be taken to ensure supervision, radiological monitoring, examination, verification and inspection of sources and ensure that adequate plans are in place to deal with radiological accidents and provide the necessary emergency response (see chapter 8, point 1).

The regulatory authority may need to provide additional information on how to comply with certain regulations applicable to various practices, for example by publishing regulatory guides.

A climate of openness and cooperation must be encouraged between the inspectors and the individuals or corporate bodies subject to the regulations, in particular so that they facilitate inspector access to both premises and information.

The regulatory authority is also responsible for requiring that all parties concerned establish a safety culture consisting in:
- an individual and collective commitment to safety on the part of the workers, managers and regulatory bodies;
- accountability on the part of each and every individual with regard to protection and safety, in particular at management level;
- measures designed to encourage a systematically questioning attitude, the desire to learn and a refusal to take existing safety results for granted.

The regulatory authority and the individuals and corporate bodies subject to the regulations must take due account of general experience and of the most recent innovations in the fields of radiological protection and source safety."

2 | 2

Supervision procedures for activities using ionising radiation

The user of ionising radiation has prime responsibility for radiation protection within the context of its activities. The ASN ensures that it meets its obligations and assumes its responsibilities. In this respect, and as required by the IAEA standard described above, the ASN's supervision of users of ionising radiation involves examination of data, visits prior to commissioning of installations, inspections and finally discussion, in a climate of openness and cooperation, with the professional organisations (trade unions, orders, learned societies, etc.). This action directly concerns either the users of ionising radiation, or organisations approved to carry out technical inspections on these users.

These actions can be summarised as shown in the following table:

Methods of ASN supervision of the various radiation protection players

	Examination/authorization	Inspection	Openness and cooperation
Users of ionising radiation	Files produced in accordance with the authorization procedures laid down in the Public Health Code (articles R. 1333-1 to R. 1333-54) specified in chapter 2 Examination of the file and visit prior to commissioning Leads to registration of the declaration or to issue of an authorization	Radiation Protection Inspectorate (article L. 1333-17)	Jointly with the professional organisations, drafting of a guide of good practices for users of ionising radiation
Organisations approved for radiation protection inspections under article R. 1333-43 of the Public Health Code	Approval application file in accordance with the provisions of article R. 1333-44 of the Public Health Code Examination of the file and audit of the organisation Leads to issue of approval	Second level inspection through: – audit, – in-depth inspection at head office and in the branches of the organisations, – unannounced inspection in the field	Jointly with the professional organisations, drafting of guides of good practices for performance of radiation protection inspections

2 | 2 | 1

Internal supervision of radiation protection by the users of ionising radiation

The purpose of the internal 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. Under application of the current regulations, internal radiation protection checks may be carried out as necessary by the person with competence for radiation protection (PCR), appointed and duly empowered by the head of the establishment, by approved supervisory bodies or by the IRSN. These internal checks do not replace the checks carried out directly by the ASN as part of its inspection activities at renewal or modification of an authorization, or in the event of loss or theft of a source.

The table opposite specifies the various operators likely to be involved on the basis of the requirements of the Public Health and Labour Codes and decree 2001-1154 of 5 December 2001 concerning the obligation of maintenance and quality control for medical appliances as stipulated in article L.5212-1 of the Public Health Code.

Inspection operators for electrical generators and sealed or unsealed radioactive sources

Type of internal checks	Public Health Code (art. R. 1333-7 and R. 1333-43) Organisation and technical arrangements ensuring compliance with radiation protection rules	Labour Code (art. R. 231-84 and R. 231-86) Sources and appliances, protection and alarm systems and instruments measuring ambient environment
Inspection on reception in the establishment[1]		Appliances, protection and alarm systems and measuring instruments: IRSN or OA or PCR
Inspection before first use	OA[2]	
After modification	OA[2]	
After overshoot of public or worker exposure limits		IRSN and OA
Periodic	OA[2]	Appliances[3]: organisation approved by AFSSAPS, Protection and alarm systems and measuring instruments: IRSN or OA Inspection frequency: yearly
Cessation of activity		OA or IRSN or PCR for issue of a certificate of radiological cleanness if unsealed sources are used
Ambient inspection in supervised area		OA or PCR. Inspection frequency: from one month to one year

(1) This is an inspection of the performance of the protection systems.
(2) The installation inspection concerns the premises and all means employed for radiation protection.
(3) In the case of medical appliances, such as radiology or radiotherapy appliances, the above-mentioned decree of 5 December 2001 requires inspection of the internal and external quality of the appliances, performance of which is checked by organisations approved by the AFSSAPS.
OA: Organisation approved by the Director General for Nuclear Safety and Radiation Protection and the DRT, in accordance with article R. 1333-43 of the Public Health Code.
PCR: Personne Compétente en Radioprotection (person with competence for radiation protection).

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. It in particular relies on the inspection reports from the approved organisations and the reports on the steps taken to remedy inadequacies detected during these inspections.

Apart from the internal inspections conducted under the responsibility of the establishments themselves, the ASN carries out its own checks as part of its role to supervise application of radiation protection regulations. In this respect it directly carries out checks during the procedures for issue (pre-commissioning inspections) or renewal (periodic inspections) of the authorizations to possess and use radiation sources granted on the basis of article R. 1333-24 of the Public Health Code. The authorization notifications can only be issued if the requests submitted by the ASN have been taken into account. These checks are in particular designed to compare the data contained in the files with the actual physical reality (sources inventory, check on the conditions of production, distribution and utilisation of the sources and the appliances containing them). They also enable the ASN to ask the establishments to improve their in-house provisions for source management and radiation protection. In 2005, the ASN carried out 69 inspections of this type.

2 | 2 | 3

Growth in radiation protection supervision by the ASN

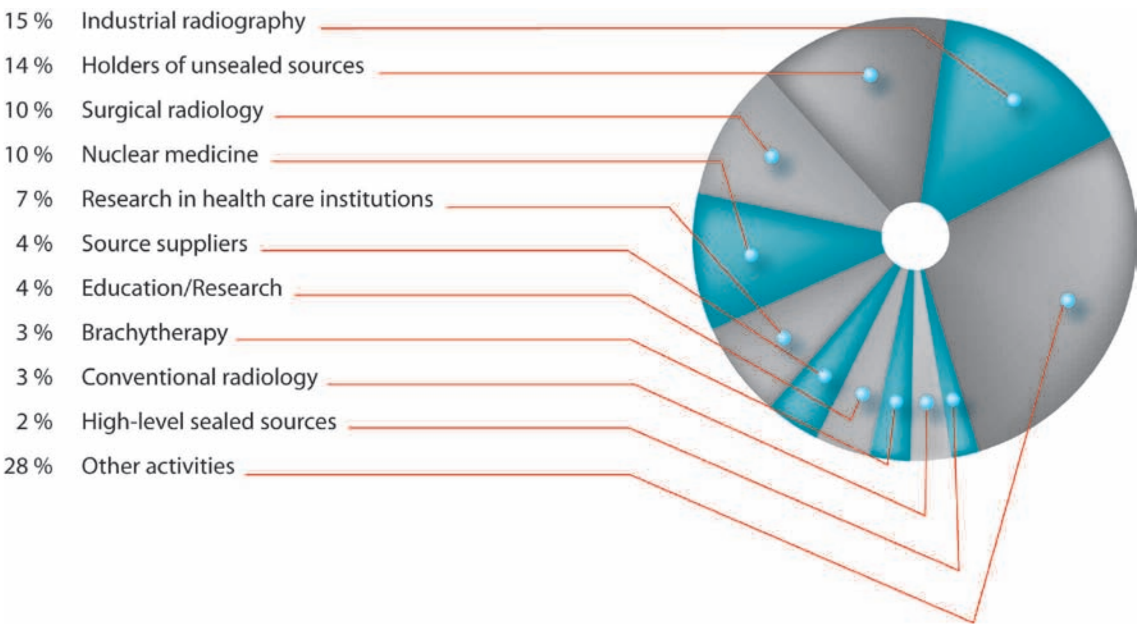
Following the reform of radiation protection supervision which took place in France in 2002, the ASN adapted its management organisation to develop radiation protection supervision in local nuclear fields. It thus focused on identifying supervision priorities, defining intervention procedures for itself and for the approved organisations, and deploying the necessary manpower. Various missions have been carried out along these lines since 2002 (reconnaissance mission, Vroussos mission, DRIRE/DRASS/DDASS working group). 557 visits were also made to ionising radiation users in 2005, with the following breakdown:
- medical field: 215 visits;
- industrial and research fields: 342 visits including 78 devoted to gammagraph operators.

Law 2004-806 of 9 August 2004 concerning public health policy, introduced new requirements into the Public Health Code (articles L. 1333-17 to L. 1333 19, L. 1337-1-1.), creating the radiation protection inspectorate. Under application of these provisions, the ASN in 2005 prepared the decree defining the conditions for appointing and swearing-in the inspectors. Once it is published, the ASN will examine the appointment and clearance applications for the future radiation protection inspectors, so that the manpower required for performance of the supervision tasks can be made rapidly available.

During the course of 2006, inspections will continue and will be reinforced by performance of an initial programme of 521 visits (or inspections once the inspectors are appointed) broken down according to the priorities defined by the ASN on the basis of the health issues represented by the various categories of nuclear activities.

Checking a radiotherapy accelerator

2006 inspection programme schedule: breakdown per type of activity



The ASN will continue with its supervision of ionising radiation uses involving the highest exposure risks. In addition to the action already initiated in supervising radiation protection in nuclear medicine and radiotherapy, a programme will therefore be started in 2006 and targeted on surgical radiology installations. In the industrial fields, action concerning industrial radiography activities will be maintained.

At the same time, the ASN will define its supervisory management organisation on the basis of the principle that its actions must be proportional to the health issues linked to ionising radiation and consistent with the action of the other inspectorates. In the light of the number of installations and nuclear activities concerned (more than 50,000), the ASN will continue its work to identify those activities entailing real radiation protection issues and will define action priorities. To ensure greater efficiency, this action will be organised on the following basis:

- systematic inspections of nuclear activities with high or intermediate level health issues, at a frequency to be determined;
- inspections concerning a small number of users for the other nuclear activities;
- systematic internal checks on the entire fleet by approved organisations.

Thus, for those nuclear activities involving lower-level issues, supervision will primarily be based on technical inspections conducted by the approved organisations. The programme of ASN inspections will concern a limited part of the fleet (principle of spot-checks), particularly targeted on the basis of the results of the inspections performed by the approved organisations or information collected through other channels (experience feedback from reconnaissance visits, incident frequency, major modifications to installations, transmission of dosimetry data, etc.).

Based on these data or recent topical information, national priorities will be defined annually, together with the Directorate for Labour Relations at the Ministry for Labour (DRT) and the Inspectorate General for Social Affairs (IGAS). These priorities will enable action to be targeted on specific nuclear topics or activities, covering a number of installations or activities that is large enough to be representative of this sector (for example: gammagraph work sites, computed tomography, etc.).

Reactive inspections could also be held further to incidents. In 2005, a number of visits were performed in this way, jointly with the inspectorate for classified installations and/or the labour inspectorate.

This organisation of supervision will gradually develop, in particular according to the pace at which the teams of radiation protection inspectors become available.

2 | 2 | 4

Supervision procedures by organisations approved by the ASN

The in-house inspections performed by the approved organisations under application of articles R. 1333-43 of the Public Health Code and R. 231-84 and R. 231-86 of the Labour Code, are used in particular to check the technical conformity of electrical devices emitting ionising radiation and radioactive sources, the radiological environment of the workstations, source, waste and effluent management procedures, and the organisation and technical arrangements in place under application of radiation protection regulations. These approvals are issued by the Director for Labour Relations and the Director General for Nuclear Safety and Radiation Protection. The orders of 17 March 2005 and 18 July 2005 specify the list of organisations approved for performance of technical radiation protection inspections in basic nuclear installations and/or in local nuclear facilities. About 40 organisations had been approved up to 31 December 2005.

The ASN ensures that these organisations conduct their activities in conditions of quality commensurate with their technical, organisational and ethical obligations. This second level supervision comprises:

- examination and monitoring of the approval file;
- approval follow-up or renewal audits;
- in-depth checks to ensure that the organisation's management arrangements are satisfactory;
- unscheduled inspections to ensure that the organisation's staff in the field work in satisfactory conditions.

In order to ensure that the work done by these organisations is consistent and diligent, in a competitive context, but also to obtain access to the results of these internal inspections, which are a valuable source of concise information (in particular, the main deviations observed), the ASN aims to define the following, after discussion with the technical inspector professional bodies:

- the procedures for obtaining data on the actions of the organisations and the state of the fleet inspected;
- the tools used by the organisations to carry out their duties of supervision and information of the administration.

This work was started in 2005 and will continue during the course of 2006.

Most of the approved organisations underwent auditing or in-depth visits during the last quarter of 2005, as part of the approval renewal procedures.

2 | 2 | 5

Openness and discussion

Supervision will be supplemented by awareness programmes designed to ensure familiarity with the regulations and application of them in practical terms appropriate to the various professions. The ASN aims to encourage and support initiatives by the professional organisations who will be implementing this approach by issuing good practice and professional information guides. Initiatives of this type are mentioned in point 1|5 of chapter 9.

Awareness also involves joint action with other administrations and organisations who carry out supervisory duties on the same installations, but with different prerogatives, such as the Labour Inspectorate, inspection of medical appliances by the AFSSAPS or health inspection as entrusted to the technical divisions of the Ministry for Health. Close collaboration with the High Health Authority (HAS) is to be envisaged, with respect to incorporating the conformity of installations and medical practices using ionising radiation into the framework of the assessment and accreditation procedures under its responsibility.

Finally, the ASN envisages joint actions targeted at the administrations and organisations with central responsibility (Directorate for Hospitalisation and Health Care) and decentralised responsibility (regional hospitalisation agencies) for health care institutions.

3 MONITORING OF EXPOSURE TO TENORM

3 | 1

Monitoring of exposure to radon

Since August 2004, the activity concentration of radon in premises open to the public has to be measured, in accordance with the order of 22 July 2004, by organisations approved by the Director General for Nuclear Safety and Radiation Protection. Measurement campaigns are run between 15 September of year n and 30 April of the following year. For the 2004-2005 campaign, 33 organisations were approved to carry out screening (level N1), 9 of which were approved for performance of the subsequent investigations (level N2) necessary for identifying radon transfer channels within a building.

At the request of the ASN (DGSNR circular of 20 December 2004 concerning management of the radon risk in premises open to the public), the DDASS in the 31 priority departments (see chapter 3) acted to inform the property owners of their new obligations to measure radon in teaching, health care and social institutions, spas and penitentiaries. This campaign was launched belatedly and the number of screening operations carried out remained low (a few tens) owing to the time needed to prepare the calls for bids locally.

A fresh campaign began in autumn 2005. For this campaign, 101 organisations were approved for N1 level screening, with 6 of them approved for additional N2 level investigations.

In terms of supervision, the ASN examined the approval applications submitted by the organisations and visited the head offices of several of them (5), with the support of the IRSN. This second level supervision is supplemented by a DDASS examination of the inspection reports produced by the approved organisations, whenever the activity levels measured exceed the supplementary action level of 400 Bq/m^3. Owing to the small number of inspections conducted in 2004-2005, no results summary was produced.

3 | 2

Monitoring of exposure to NORM in non-nuclear industries

In 2005, the list of professional activities (industries, spas and drinking water treatment plants) requiring supervision of human exposure to Naturally Occurring Radioactive Materials (NORM) was published, owing to the fact that the materials used contain natural radionuclides and are likely to generate doses that are significant from the radiation protection standpoint.

Supervision of implementation of these new measures is not yet operational, but should be broken down as follows:

- the labour inspectors and radiation protection inspectors are competent to monitor the steps taken by the head of the establishment to assess the exposure of its workers and reduce it if necessary;
- the inspectors for classified installations and the radiation protection inspectors are competent to monitor the steps taken by the operator to reduce public exposure, if necessary, whenever these industrial activities are subject to authorization under the terms of the regulations applicable to installations classified on environmental protection grounds.

3 | 3

Monitoring of natural radioactivity in drinking water

Monitoring the natural radioactivity in drinking water is now an integral part of the health monitoring activities of the DDASS. The ASN is responsible for overall coordination, jointly with the Directorate General for Health. Implementation of the new monitoring programmes has been under way (see point 1|5 of chapter 3 and point 2|4 of chapter 5) since 2004.

The ASN is preparing a circular clarifying what to do when the reference levels concerning the radiological quality of this water are exceeded.

4 OUTLOOK

2006 will be devoted to implementation of the decree setting the procedures for designating, qualifying and swearing-in the radiation protection inspectors mentioned in articles L. 1333-17, L. 1333-18 and L. 1337-1-1 of the Public Health Code, amending this code (regulatory provisions) and will see the appointment of the first radiation protection inspectors.

Jointly with the Directorate for Labour Relations (DRT), the ASN will begin to look at ways of organising its supervision of the activities of the organisations approved for radiation protection inspections. This work will concern four areas:

- using and managing approvals in conditions such as to avoid any distortion of the practices of these organisations;
- through field inspections conducted by the ASN, checking that the organisations carry out their duties in conditions of quality consistent with their technical and ethical obligations;
- organising feedback to the administration of information concerning the state of the "fleet" of ionising radiation users obtained during the inspections carried out by the organisations;
- encouraging the organisations to produce a professional guide of good practices for radiation protection technical inspections on sources and devices emitting ionising radiation, ambient environment technical checks, source, waste and effluent management checks.

Based on the experience it has acquired with regard to significant event declarations in the BNI and radioactive material transport fields, the ASN aims to develop a similar approach for local nuclear activities.

ENVIRONMENTAL PROTECTION

1 FIELD OF ACTION

2 MONITORING RADIOACTIVITY IN THE ENVIRONMENT

2|1 Laboratory approval

2|2 Deployment of the national network of environmental radioactivity measurement

2|3 Public information

2|4 The radiological quality of water intended for human consumption

3 BNI EFFLUENT DISCHARGES

3|1 The regulatory context of BNI effluent discharges

3|1|1 Examination of discharge licence applications

3|1|2 The ministerial order of 26 November 1999

3|2 ASN policy concerning BNI discharge licences

3|3 The radiological impact of nuclear facilities

3|4 Work programmes initiated by the ASN

3|4|1 Continued revision of the discharge licences

3|4|2 Improvements to application examination conditions

3|5 Accounting and monitoring radioactive discharges

3|6 The other discharges from nuclear installations

4 DISCHARGES FROM OTHER INSTALLATIONS

5 PREVENTION OF DETRIMENTAL EFFECTS FROM BNIS

5|1 Application of the requirements of the order of 31 December 1999 concerning environmental protection

5|2 Prevention of water pollution

5|3 Protection against noise

5|4 Protection against the microbiological risk (legionella, amoebae)

5|4|1 Legionella

5|4|2 Amoebae

6 WASTE STUDIES

7 SIGNIFICANT ENVIRONMENTAL EVENTS

8 OUTLOOK

CHAPTER 5

1 FIELD OF ACTION

Under decree 2002-255 of 22 February 2002, which created the Directorate General for Nuclear Safety and Radiation Protection (DGSNR), the Directorate is in particular responsible for:
- organising a permanent radiation protection watch, in particular through radiological monitoring of the environment nationwide;
- supervising gaseous and liquid effluent discharges and waste from basic nuclear installations.

Nuclear safety, radiation protection and environmental concerns all share the same goal of protecting workers, patients, the public and the environment against the risks linked to nuclear activities and to ionising radiation.

The changes to the regulations introduced by the above-mentioned decree of 22 February 2002, confirms the wider view of nuclear safety. The ASN therefore tackles the issues of nuclear safety, radiation protection and the environment from a general standpoint, using an integrated approach and the same tools - particularly inspections - and the same demands of stringency, competence, transparency and independence.

With regard to the environment, the ASN's actions are primarily focused on 3 areas:
- monitoring radioactivity in the environment with a view to informing the population of the health impact of nuclear activities in France;
- minimising the dispersal into the environment of radioactivity and toxic substances from the nuclear industry. This involves strict control of effluent discharges and waste management. The ASN is responsible for supervision of discharges of radioactive and chemical, liquid and gaseous effluents from basic nuclear installations (BNIs);
- the prevention and limitation of detrimental effects and hazards resulting from the operation of basic nuclear installations (BNIs), and of inconvenience to the neighbourhood or for public health, safety and hygiene, agriculture, nature and environment protection purposes, or for conservation of sites and monuments.

Generally speaking, ASN policy regarding environmental protection tends towards that applied to conventional industrial activities. Thus numerous rules concerning discharges or control of their impacts are comparable to those used in industry. As an illustration, concerning the prevention of risks linked to the spread of legionella, the revised ministerial order of 31 December 1999 refers to the provisions applicable to installations classified on environmental protection grounds.

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 environmental protection measures. In 2005, it also harmonised significant event declaration criteria.

2 MONITORING RADIOACTIVITY IN THE ENVIRONMENT

Article R. 1333-11 of the Public Health Code provides for the creation of a national network of environmental radioactivity measurements, in order to help estimate the doses to which the population is exposed as a result of nuclear activities as a whole.

This network is being deployed for two main reasons:
- to implement a quality policy in the measurement of radioactivity, by setting up a system of approvals;
- to develop transparency in information concerning the health impact of nuclear activities in France.

Revision of this article of the Public Health Code has been initiated, in particular to improve its legibility.

Environmental radioactivity measuring station

This article of the Public Health Code is modified by the order of 27 June 2005 which organises a national network for environmental radioactivity measurements and sets the procedures for laboratory approval. This text abrogates the previous requirements and its preparation entailed wide-ranging discussions with the players in the national network.

These new regulatory provisions led in particular to a separation between the laboratory approval process and the process for transmission of the environmental radioactivity measurements to the national network, as well as the introduction of interim measures giving the laboratories a certain time to bring their practices into conformity with the requirements of standard NF EN ISO/CEI 17025.

After obtaining the opinion of a Steering Committee, the ASN is responsible for defining the orientations of this network, which is managed by the IRSN. It prepares the laboratory approval orders, in particular on the basis of the results of the intercomparison tests organised by the IRSN and on receipt of the opinion of an Approvals Board.

The members of these two bodies (Steering Committee and Approvals Board), appointed by joint order of the ministers for Health and the Environment, are primarily representatives of the Ministries for Health, the Environment, Consumer Affairs, Agriculture, and Defence, representatives of national agencies with responsibility for health and environmental issues, such as the InVS, AFSSET and AFSSA, as well as representatives of measurement laboratories from the industry and from the associative world. Abrogation of the 17 October 2003 order organising a national network of environmental radioactivity measurements led to the renewal on 12 September 2005 of the two orders appointing the members of the Steering Committee and the Approvals Board.

In 2005, the Steering Committee met on 26 May and the Approvals Board met on 12 April and 22 November.

2 | 1

Laboratory approval

In 2003, the ASN took over the laboratory technical qualification duties previously performed by the Ministry for Health, with the technical support of the OPRI, and in 2004, it set up measures for laboratory approval in conditions defined by the above-mentioned order of 17 October 2003. Together with the IRSN, to deal with aspects concerning the organisation and processing of the intercomparisons between laboratories, the ASN concentrated on defining the table of approvals and the criteria for issue of approval, which were accepted by the Approvals Board. Two types of criteria, one technical resulting from statistical processing of the intercomparison results, and the other concerning the quality system implemented in the laboratories, are used to assess the technical and organisational competence of each laboratory.

To ensure that the conditions for laboratory approval are fully transparent, these criteria supplementing the general procedures specified in the ministerial order were published on the ASN web site. These measures came into full effect for approvals issued as of 2005.

The Approval Board also declared itself in favour of the planned 4-year programme of intercomparison tests which, with about fifty tests split into eight campaigns (two per year) will provide virtually exhaustive coverage of all artificial and natural radionuclides likely to be measured in the environment (water, air, soil and foodstuffs).

The Approval Board is also responsible for proposing to the ministers for the Environment and Health those laboratories for which the ministerial approval is to be issued. The Board's decision is based on an approval application file and an analysis of the intercomparison test results obtained by the candidate laboratory.

The intercomparison tests organised by the IRSN cover up to 40 laboratories per test, including some from outside France.

Following the intercomparison tests organised in 2003 and 2004, approval was granted to about forty laboratories for certain activity measurements in water and about twenty laboratories for measuring the activity of gamma emitters in biological matrices. The detailed list of approved laboratories and their scope of technical competence was defined in the order of 21 March 2005 and then that of 3 August 2005.

The four intercomparison tests held in 2005 concerned measurement of gamma-emitting radionuclides in water, radionuclides of natural families in sediment, the activity of aerosols on a filter and, finally, pure beta-emitting radionuclides in milk. The approvals obtained further to these tests will be published in 2006.

The list of laboratories approved according to the different matrices can be consulted on the ASN's website at the following address: www.asn.gouv.fr section: actualite/les mesures de radioactivité/.

2 | 2

Deployment of the national network of environmental radioactivity measurement

Development of the national network of environmental radioactivity measurement is one aspect of the ASN's mission to organise monitoring of radioactivity in the environment. The IRSN participates in this function through its contribution to radiological monitoring of the entire country and through its management of this future national network.

This national network will use a data bank to collect, manage and process the results of environmental radioactivity measurement analyses performed by the approved laboratories or the IRSN's laboratories.

One of the first tasks performed by the ASN, jointly with the IRSN, was to identify the leading players involved in measurement, optimising identification of their measurement framework, their environmental monitoring field and the sensitivity of their analyses, in order to propose a management strategy for these data as a whole.

In 2005, the initial work done into the presentation of radioactivity data on the Internet led to the drafting of a guideline note concerning the orientations of the national network, which was submitted to the Steering Committee at its meeting of 26 May 2005. The Steering Committee is currently working on setting up the national network of environmental radioactivity measurements information system which will eventually offer access to all environmental radioactivity data.

Work on inventorying and characterising the measurement results is continuing, in order to define the conditions for creation of the data bank and the corresponding IT tools. In addition, under the aegis of the ASN, the IRSN is conducting a survey among the national network players (industry, public services, CLIs, associations, representatives of the public, etc.), to gain a clearer understanding of the constraints on the "data suppliers", but also what they expect in turns of data retrieval. The aim of these personalised interviews with the database "users" is to lead to drafting of the functional specifications for the national network, scheduled for the beginning of 2006.

2 | 3

Public information

The second part of the national network is linked to its communication-information aspect, with the development of a web portal common to the ASN and the IRSN, on which the radioactivity measurement results and their interpretation in terms of radiological impact will be available, along with documentation of interest both to the network players and to members of the public, who do not need to be environmental radiation protection specialists.

The ASN and the IRSN have developed a web portal devoted to the national network. It will be accessible from the ASN and IRSN websites. This portal constitutes a doorway to information about the national network currently being developed and comprises a number of parts dealing with the regulatory status of the network, the various parties involved, the organisations carrying out the initial radioactivity measurements and laboratory approvals respectively. Until such time as it is given its own measurements database, planned for 2008, this constantly evolving site will contain links to the websites of network players and other institutional sites dealing with environmental radioactivity.

2 | 4

The radiological quality of water intended for human consumption

The new radiological inspection programmes for public mains water and non-mineral bottled waters (see point 1|5 of chapter 3) will eventually lead to a complete picture being produced of the radiological quality of water intended for human consumption, primarily on the basis of total alpha and beta and tritium radioactivity measurements. These new programmes, which are entrusted to the DDASS, have been mandatory since 1 January 2005. The corresponding data is being gradually integrated into the DDASS health/environment information system (SISE-Eau). It will give a picture of the natural radioactivity of the water distributed. Since 2004, 21,000 samples have been taken to measure the radioactivity of water distributed. The SISE-Eau database today contains more than 14,000 data on total alpha and beta radioactivity indicators. A results summary will be produced in 2006.

The 24 January 2005 order, modified by the order of 11 March 2005, sets the conditions for approval of laboratories which are to take samples and conduct health monitoring analyses of water.

In 2005, 7 laboratories submitted an application file for this approval. The file examination procedure is in progress and the list of laboratories thus approved will be published in the *Official Gazette*, in an order to be finalised in January 2006.

3 BNI EFFLUENT DISCHARGES

Like any other industry, basic nuclear installations (BNIs) generate by-products, whether or not radioactive, and despite the efforts made for recycling or reuse. These by-products can be treated before disposal as waste or, when their characteristics so allow, discharged into the environment in the form of effluent. After efforts are made to reduce these by-products at source, the choice between effluent discharge and production of waste is the result of an optimisation process specific to each installation. It in particular depends on the feasibility of recovering the radionuclides present in the effluent. The process of containment in the form of waste becomes increasingly cumbersome and costly as the radionuclide concentration diminishes. Below a certain level, the radionuclides cannot be reasonably recovered and they are then discharged into the environment if their impact is acceptable. The radioactivity discharged in effluent represents a marginal fraction of that which is confined in the waste.

At the end of this process, the choice of the form of discharge (liquid or gaseous) also plays a part in the approach designed to minimise the overall impact of the nuclear installation. The actual discharges from the installations are presented in the corresponding chapters.

3 | 1

The regulatory context of BNI effluent discharges

Until 1995, liquid and gaseous radioactive discharges from nuclear installations were regulated separately by interministerial order. The chemical characteristics of these discharges were regulated by prefectoral order.

The first authorised discharge limits had been set in such a way that they were lower than the health effect values in force.

The optimisation efforts required by the authorities and made by the operators, led to these emissions being reduced. For example, liquid discharges from the Flamanville nuclear power plant, concerning radionuclides other than tritium and carbon 14, fell from 151 GBq in 1986 to 1.2 GBq in 2003. One particular consequence of this reduction was that the former regulatory limits were no longer representative of the actual discharges situation.

For these two reasons, new effluent discharge regulations became necessary:

- concerning procedural aspects, decree 95-540 of 4 May 1995 concerning liquid and gaseous effluent discharges and water intake by BNIs;
- for discharge limits, monitoring conditions and ASN information procedures, with the order of 26 November 1999 setting the general technical requirements concerning the limits and procedures for water intake and effluent discharges subject to authorisation and carried out by basic nuclear installations.

3 | 1 | 1

Examination of discharge licence applications

The above-mentioned decree of 4 May 1995 defines the conditions in which discharge and water intake licence applications must be examined. It in particular stipulates that:

- the operator's licence application must be backed up by an impact assessment;
- this application is the subject of a public inquiry;
- examination of this application provides for consultation of the parties concerned (administrative conference, opinion of the local authorities, of the departmental health council, etc.).

After this procedure, a single order issued by the ministers for Health, Industry and the Environment, now regulates all effluent discharges and water intakes.

The above-mentioned decree of 4 May 1995 also enables the administration to revise existing licences at any moment, without any request from the operator being necessary. Finally, this decree confirms the ASN as the body with competence for examination of the licence applications submitted by the operators.

This decree constituted a key step improving control of the administrative procedures regulating BNI effluent discharges into the environment. Its application to all BNIs is gradually leading to a clearer picture of BNI impacts on their environment and how they are understood by the public.

3 | 1 | 2

The ministerial order of 26 November 1999

The above-mentioned ministerial order of 26 November 1999, implementing the above-mentioned decree of 4 May 1995, to a large extent defines the procedures regulating BNI discharges.
Its requirements must be included by the administration when drafting of discharge and water intake licences. These orders therefore systematically stipulate:
- the limits on the intake and the chemical and radioactive discharges the operator is authorised to make;
- the analysis, measurement and inspection resources for the facilities, installations, works or activities authorised, and the means for monitoring their effects on the environment;
- the conditions in which the operator notifies the public authorities of its discharges, along with the results of the monitoring of their effects on the environment;
- the inspections carried out by the public authorities;
- the methods to be used for public information.

3 | 2

ASN policy concerning BNI discharge licences

The combined implementation of these two texts has prolonged and indeed strengthened the permanent progress being achieved by the ASN in its efforts to reduce the impact of nuclear installations on both man and the environment, to a level as low as reasonably achievable.

In addition to implementation of these regulatory requirements, the procedures through which the ASN regulates discharges are guided by various other principles.

To put an end to the previous situation in which the discharge limits were far higher than the actual discharge levels, the ASN aims to ensure that the new licences do not comprise a large margin which could potentially mask incident situations. The ASN hopes that setting these limits will not only guarantee that there are no health or environmental impacts, but will also encourage the operators to maintain their efforts to optimise and reduce discharges. The discharge limit values are thus defined as low as reasonably possible using the best available techniques and taking account of the fluctuations linked to normal changes in the process.

The efforts to reduce discharge limits lead to the following reduction factors:

Limit value reduction factors defined by the discharge orders

- for the 900 MWe nuclear power plants:			
	Gaseous discharges:	- gases (rare gases + tritium):	28
		- halogens + aerosols:	23
	Liquid discharges:	- tritium:	1.4
		- other radionuclides:	23
- for the 1300 MWe nuclear power plants:			
	Gaseous discharges:	- gases (rare gases + tritum):	32
		- halogens + aerosols:	34
	Liquid discharges:	- tritium:	1.3
		- other radionuclides:	2.6
- for COGEMA La Hague:			
	Gaseous discharges:	- gases (other than tritium):	1
		- tritium:	15
		- halogens + aerosols:	9
	Liquid discharges:	- tritium:	2
		- other radionuclides:	12
		- alph emitters	10

Implementation of the above-mentioned decree of 4 May 1995 allows improved regulation of chemical substance discharges. This aspect had for a long time been hidden, but nuclear installations also discharge such substances. The ASN wanted to see BNIs regulated in this field in the same way as industrial installations. Monitoring of these recently regulated substances provided a clearer picture of the quantities actually discharged. This helps lead to a real reduction in the discharges, particularly with respect to metals.

Even if the provisions defined by the above-mentioned decree of 4 May 1995 are already relatively old, their application to all sites requires that the effort that has been under way for a number of years needs to be continued (60% of installations are currently fully regulated by provisions implementing this text). The improvements to be gained from implementation of these provisions are justification for continuation of this process.

Finally, the ASN duly notes the Sintra declaration of 23 July 1998 by the ministers of the States who signed the OSPAR Convention, which aims to reduce the discharge of radioactive and other hazardous substances into the North-East Atlantic, so that the concentrations in the marine environment fall to close to zero by 2020 for artificial substances, and close to background values for NORM.

As an illustration, and in order to ensure that the best available technologies are employed, the order licensing the spent fuel reprocessing installation at La Hague requires that new measures concerning discharges are to be defined 4 years after its publication, in other words on 10 January 2007.

3 | 3

The radiological impact of nuclear facilities

Attempting to identify the health impact of nuclear facilities in normal operation consists in detecting the possible appearance of effects that are harmful for health owing to low exposure to ionising radiation, the main risk being inducing cancers. The impact from a nuclear facility does not stem solely from activity discharges through identified outlets (stack, effluent discharge outfall into river or sea). It necessarily includes diffuse liquid and gaseous emissions and the sources of irradiation present in the facility. This allows a correct evaluation to be made of all possible channels for harm to the population, through internal or external exposure.

The impact is determined on the basis of a source term and reference groups identified in the impact assessment. These are homogeneous groups of persons receiving the highest average dose from among the population exposed to a given installation according to realistic scenarios. To assess the impact of the installation, other neighbouring industrial activities and all sources of exposure must be considered. This approach in particular allows comparison between the total dose and the annual allowable dose limit for the public. The impact is in principle assessed on the basis of the annual authorised limit, with a spectrum of radionuclides. The subsequent verification is assessed according to the radionuclide activity measured in the discharges, to which the irradiation (in particular due to interim waste storage) must be added.

According to the principle of optimisation, the operator must reduce the dosimetric impact of its installation to values that are as low as reasonably achievable in the light of economic and social factors.

To guarantee harmonisation in how BNI impacts are calculated and make it easier to read the impact assessments, the ASN and the DGS entrusted the IRSN with the task of drafting a BNI radiological impact assessment guide, which has been a reference document since 2002 (IRSN report / 02-24 October 2002).

In practice, the activity levels present in the environment are generally so low that they cannot be detected by the measuring instruments. Dispersion models fed by installation discharge measurement data therefore have to be used. In any case, programmes to monitor the radioactivity present in the environment (water, air, milk, grass, earth) are imposed on the operators in order to check compliance with the scenarios postulated in the impact assessment. The laboratories taking these measurements must have received ministerial approval.

The radiological impact calculated on the reference group most exposed to the discharges remains far below the allowable limits.

The dose delivered to the reference groups (estimated by calculation on the basis of the actual discharges) remains significantly lower than the public allowable dose limit of 1 mSv per year. As an illustration, in 2004 it reached:
- 9 microsieverts for the COGEMA La Hague site;
- 7 microsieverts for the EDF Flammanville site (most penalising site).

3 | 4

Work programmes initiated by the ASN

3 | 4 | 1

Continued revision of the discharge licences

Since the above-mentioned decree of 4 May 1995, the ASN has been examining BNI applications for liquid and gaseous discharge and water intake licences. The procedure is a complex one, involving many participants.

The ASN has started a process to revise all the existing licensing orders. 8 dossiers are currently being examined (ANDRA Soulaines, ILL, CENTRACO, EDF: Golfech, Dampierre, Tricastin, Penly, Creys Malville).

For the main operators, the procedures have progressed as follows:
- EDF installations: at the request of the ASN, EDF has prepared a programme for production of the licence renewal applications so that the last nuclear power plant discharge licence application will be submitted in 2009. This schedule was revised in relation to the previous programme, to take account of the need to draft and examine these dossiers, and introduce new or partial additional requests (microbiological treatment, change in fuel or burnup fraction, etc.);
- CEA installations: the CEA centres are complex sites on which the installations are usually subject to supervision by different authorities: ASN for the BNIs, DSND for the secret BNIs, DRIREs for the ICPEs outside the BNI perimeters. For these centres, discharge licence renewal procedures are in progress and are being coordinated between the various administrations. To make analysis of the dossiers easier and inform the public better, the ASN asked the CEA to produce a dossier for each centre enabling the overall environmental impact of the site's discharges to be assessed. 2005 in particular saw the completion of preparations for a new discharge licence order for the Cadarache site;
- fuel cycle installations: the main site concerned is that at La Hague. As COGEMA did not wish to submit a discharge licence application for revision of its 1980 and 1984 licences, the ASN, under application of article 13 of the above-mentioned decree of 4 May 1995, carried out a review of these licences. The order is in conformity with ASN policy explained beforehand, leading to a significant reduction in limits.

The following table presents the regulatory situation concerning the main BNIs.

3 | 4 | 2

Improvements to application examination conditions

Taking advantage of the lessons learned from the initial applications, the ASN has begun a series of actions aimed at processing the applications within a reasonable time-frame, set at 2 years, and at improving the transparency of the procedures.

Regulatory situation concerning discharges from nuclear sites

Operator	Site	Regulatory situation
CEA	Cadarache Fontenay aux roses Grenoble Saclay Marcoule (phenix) Marcoule (atalante)	Order pending signature in application of decree 95-540 Licensed according to old procedure Order of 25/05/2004 in application of decree 95-540 Licensed according to old procedure (site) Order fo 30/12/2002 in application of decree 95-540 (LECI – irradiated fuel test laboratory) Licensed according to old procedure Licensed according to old procedure
EDF	Belleville Blayais Bugey Cattenom Chinon Chooz Civaux Creys-Malville Cruas-Meysse Dampierre Fessenheim Flamanville Golfech Gravelines Nogent Paluel Penly St Alban St Laurent Tricastin	Order of 08/11/2000 in application of decree 95-540 Order of 18/09/2003 in application of decree 95-540 Licensed according to old procedure Order of 26/04/2004 in application of decree 95-540 (units 4 and 5 biocide treatment) Order of 11/06/2004 in application of decree 95-540 (thermal discharges) Order of 23/06/2004 in application of decree 95-540 Order of 20/05/2003 in application of decree 95-540 Amendment by the order of 17/08/2005 (biocide treatment) Licensed according to old procedure Amendment by the order of 30/11/2000 Order of 26/04/2004 in application of decree 95-540 (units 1 and 2 biocide treatment) Licensed according to old procedure Procedure in progress in application of decree 95-540 Order of 7/11/2003 according to new procedure Procedure in progress in application of decree 95-540 Order of 27/04/2004 according to new procedure (units 1 and 3 biocide treatment) Licensed according to old procedure Order of 11/05/2000 in application of decree 95-540 Order of 27/04/2004 in application of decree 95-540 (units 1 and 2 biocide treatment) Procedure in progress in application of decree 95-540 Order of 07/11/2003 in application of decree 95-540 Order of 29/12/2004 in application of decree 95-540 Order of 11/05/2000 in application of decree 95-540 Procedure in progress in application of decree 95-540 Order of 29/12/2000 in application of decree 95-540 Order of 02/02/1999 in application of decree 95-540 Procedure in progress in application of decree 95-540
COGEMA	Pierrelatte La Hague	Licensed according to old procedure Order of 10/01/2003 in application of decree 95-540
COMHUREX	Pierrelatte	Order of 17/08/2005 in application of decree 95-540
SOCATRI	Pierrelatte	Order of 16/08/2005 in application of decree 95-540
EURODIF	Pierrelatte	Order of 16/08/2005 in application of decree 95-540
MELOX	Marcoule	Licensed according to old procedure
ILL	Grenoble	Procedure in progress in application of decree 95-540
SOMANU	Maubeuge	Licensed according to old procedure Amending order of 16/02/2005
CENTRACO	Marcoule	Order of 07/05/1998 in application of decree 95-540 Revision procedure in progress
FBFC	Romans/Isère	Order of 22/06/2000 in application of decree 95-540
ANDRA	La Hague	Order of 10/01/2003 in application of decree 95-540
ANDRA	Soulaines	Procedure in progress

At the same time, the ASN has made the operators aware of the quality of the application dossiers to be submitted. Exchanges regularly take place on this subject in order to improve the quality of the dossiers presented by the operators, to enable the examination process to go faster.

The ASN also aims to improve the coordination between the numerous central and local administrative departments involved throughout the procedure, in order to keep control of the examination time.

These efforts led to a clear drop in the time needed to examine certain applications (10 months for the Chinon licence dated 17 August 2005 for example).

However, as time went by, it became obvious that certain elements contributing to the time needed to examine the applications were structurally linked to the examination procedure defined by the above-mentioned decree of 4 May 1995. This is why the ASN has initiated a process to revise this text, which should not however alter the general economics of the process and will strengthen the dialogue that is now mandatory.

3 | 5

Accounting and monitoring radioactive discharges

The reduced activity of the radioactive effluent discharges from BNIs (activity level lower than the measurement thresholds), the changes to the categories of radionuclides regulated in the discharge licence orders and the need to be able to calculate the dosimetric impact of the discharges on the population led the ASN to set new rules for accounting of radioactive discharges, in particular taking account of activity concentrations lower than the decision threshold. The purpose of these rules was also to avoid very low discharges of radionuclides being declared as null, as they could subsequently build up in certain species taken from the environment (sediments, mosses, etc.).

Accounting principles:
- for each category of radionuclides regulated, the activity levels discharged are based on a specific analysis of the radionuclides rather than on total alpha, beta or gamma measurements;
- setting of detection limits to be observed for each type of measurement;
- for each BNI and for each type of effluent, a reference spectrum is defined, in other words a list of radionuclides whose activity must be systematically considered, whether or not higher than the decision threshold, when calculating the activity discharged. These evolving reference spectra are based on experience feedback from the analyses carried out;
- other radionuclides, which are occasionally present, are considered once their activity concentration is higher than the decision threshold.

Reference spectrum for accounting of discharges from nuclear power plants

Liquids: ^{3}H,
^{14}C,
Iodines: ^{131}I,
Other fission and activation products:
^{54}Mn, ^{58}Co, ^{60}Co, ^{110m}Ag, ^{123m}Te, ^{124}Sb, ^{125}Sb, ^{134}Cs, ^{137}Cs.

Gas: ^{3}H,
^{14}C,
Rare gases: - ventilation (permanent discharges): ^{133}Xe, ^{135}Xe
- "RS" tank drainage: ^{85}Kr, ^{131m}Xe, ^{133}Xe
- decompression of reactor buildings: ^{41}Ar, ^{133}Xe, ^{135}Xe.
Iodines: ^{131}I, ^{133}I,
Other fission and activation products: ^{58}Co, ^{60}Co, ^{134}Cs, ^{137}Cs.

These rules are now applied in all nuclear power plants and in most laboratories and other plants (CENTRACO, COGEMA and ANDRA La Hague establishments, FBFC in Romans, CEA centre at

Cadarache, and so on). They will be applied to the other sites as their discharge licence orders are renewed.

Sampling during a nuclear power plant discharge management inspection

In accordance with the provisions of their discharge licence orders, the operators keep up to date registers which record the results of the various measurements taken on the discharges and in the environment, as well as the conditions in which these discharges take place. These registers are transmitted to the ASN for inspection every month.

At the same time as this self-check, the operators regularly send a certain number of discharge and environment samples to the IRSN for analysis. The results of the analysis of these samples are sent to the ASN which, by comparison, can then judge the quality of the measurements made by the nuclear operators.

Finally, as part of its BNI supervision duties, the ASN conducts unannounced inspections to ensure that the BNI operators follow the regulatory provisions of the licensing orders. This is why, in addition to the existing inspections, the ASN set up a system of unannounced inspections during which, with the possible assistance of a laboratory, BNI inspectors check compliance with the licences, take effluent samples and have them analysed by a specialised independent laboratory. Since 2000, the ASN has carried out 10 to 30 inspec-

Observers from the Paluel-Penly CLI with ASN inspectors during an inspection at Paluel nuclear power plant tions - with sampling - every year (27 in 2005). This year, for the first time, the ASN carried out inspections with sampling of gaseous effluent, which is technically more difficult.

Under the terms of article 35 of the Euratom treaty, France voluntarily submits to inspection by the European Commission. A verification within this context was conducted at the La Hague installation and the IRSN's laboratories in October 2005. The international team in charge of the inspection brought to light no significant deviation and underlined the quality of the supervisory system in place.

3 | 6

The other discharges from nuclear installation

Some BNIs (in particular the nuclear power plants operated by EDF and the EURODIF facility) discharge cooling water effluent, known as "thermal discharges" into watercourses or into the sea, either directly for those plants operating in "open" circuit, or after cooling in cooling towers, venting some of the heat into the atmosphere.

Thermal discharges from power plants into watercourses leads to a temperature rise, between upstream and downstream of the discharge, of between a few tenths of a degree and several degrees. They are therefore regulated in the nuclear power plant discharge licence orders.

A committee for monitoring exceptional thermal discharges from electricity generating plants was set up to monitor the impact of these discharges on the watercourses.

From the environmental standpoint, the regulatory limits aim to prevent a modification of the receiving environment, in particular fish life, and to ensure acceptable health conditions if water is taken for human consumption downstream.

These limits can thus differ according to the environment and the technical characteristics of each plant.

The organisational, administrative and technical steps taken following the 2003 heat wave and drought mean that the drought encountered in 2005 was dealt with in good conditions, in particular ensuring full compliance with the discharge licences applicable.

4 DISCHARGES FROM OTHER INSTALLATIONS

The Public Health Code states that regulatory provisions for management of radioactive waste and effluent in installations other than installations classified on environmental protection grounds or basic nuclear installations must be specified in an order signed by the ministers for Health and the Environment. This is why the ASN, together with the professionals handling radioactive sources and the administrations concerned, is drafting an order on this subject. The main requirements will be taken from the DGS/DHOS circular of 9 July 2001 concerning management of effluent and waste from health care activities contaminated by radionuclides. Problems with application of this circular by research and health professionals have been identified, in particular during meetings on preparation of the national management plan for radioactive waste and reusable materials. A working group was set up to propose solutions for inclusion in the draft order on management of radioactive waste and effluent.

5 PREVENTION OF DETRIMENTAL EFFECTS FROM BNIS

5 | 1

Application of the requirements of the order of 31 December 1999 concerning environmental protection

For several years, particular attention has been paid to the chronic or accidental effects on the environment of both conventional and nuclear industries. With respect to the nuclear industry, the interministerial order of 31 December 1999 sets the general requirements to be met by BNIs concerning environmental protection. It supplements the texts specific to each plant on this subject, i.e. the discharge licences or the operating licences for installations classified on environmental protection grounds located on plant. More particularly, and in addition to the onsite emergency rules (staff training, safety instructions, maintenance of installations, etc.), the order specifies objectives for protection against fire, lightning, noise, or the risks of accidental pollution of the environment (water and atmosphere).

Most of the requirements were applicable on 15 February 2002, two years after the date of publication in the *Official Gazette*. However, if the operators can prove that they are experiencing difficulties, article 48 of the order of 31 December 1999 provides for extra time allowances, without however exceeding 15 February 2006.

Considerable work has been done by the operators to check the installation conformity with the requirements of the order, to identify deviations, evaluate and implement the conformity work required or propose preventive measures such as to achieve a level equivalent to that of those requirements that cannot be met. For its part, the ASN analysed these requests before ruling on the operators' proposals. The ASN also conducted spot-checks during the site inspections on the completeness and accuracy of the information provided in the dossiers. As and when necessary, dates for installation conformity work were set by the Director General for Nuclear Safety and Radiation Protection.

During the course of this exercise, a number of problems with application of the ministerial order of 31 December 1999 were detected, in fields such as noise, or the capacity of large-volume tank groups for example.

These findings, along with the wish to improve the applicable fire requirements and the desire to introduce provisions into the regulatory texts concerning prevention of the spread of legionella, led the ASN to revise the order of 31 December 1999 (see chapter 3).

5 | 2

Prevention of water pollution

The ministerial order of 31 December 1999 sets measures designed to prevent or, in the event of an accident, to minimise direct or indirect release of toxic, radioactive, flammable, corrosive or explosive liquids into the natural environment and the sewers. It leads to:
- revision of the design of storage, loading and unloading areas for toxic, radioactive, flammable, corrosive or explosive liquids, by requiring effective retention facilities;
- implementation of an organisation able to deal with accidental spillage of liquids before they can transfer into the natural environment;
- installation of confinement tanks in particular for collecting and treating fire-fighting water.

Application of these measures by the operators led to significant progress in preventing pollution. Pipeline routes and conditions were checked, as was the condition of retention areas. Resources and organisational measures for fighting water pollution were put in place and tested. However, EDF observed that strict application of these requirements to the TER, KER and SEK tank retention areas posed particular difficulties. EDF therefore proposed to implement alternative measures such as to achieve the best possible level of protection of those interests protected by the order.

5 | 3

Protection against noise

Article 48-II-2 of the order of 31 December 1999 requires that by 15 February 2004, a check be carried out on compliance with the specified noise limits. Most of the dossiers submitted by the operators were examined by the ASN.

It became apparent that in certain operating configurations, installations were exceeding the emergence levels specified in the order of 31 December 1999. These overshoots were in particular due to the noise of falling water, for example generated by river weirs. The order of 31 December 1999 as amended makes it possible to take account of these situations when the operator can demonstrate that the provisions implemented do not generate any significant detrimental effects.

5 | 4

Protection against the microbiological risk (legionella, amoebae)

The presence of bacteria in the water is linked to the existence of the nutrients and minerals they need in order to grow. Temperature also plays an important role in their growth. Most natural surface water (lakes, rivers) naturally contain large amounts of bacteria. Some of these bacteria are pathogenic. This is particularly the case with legionella and amoebae such as Naegleria fowleri, for which particular measures are specified.

Consequently, micro-organisms can be found in the installations: sanitary installations (showers, taps, etc.), air-conditioning installations and cooling systems (air-cooling towers, industrial cooling circuits), ponds and fountains, spa waters and medical equipment producing aerosols.

The cooling installations in certain nuclear facilities are particularly large and in that respect differ from conventional cooling systems. The exchange surface area can be up to 5,000,000 m^2.

5 | 4 | 1

Legionella

Legionnaire's disease is an infectious pathology caused by legionella bacteria. The germ responsible is a bacillus that lives in fresh water, with an optimum proliferation temperature of between 35 and 40°C. It can be found in all natural or artificial aquatic environments. Transmission to man is exclusively as a result of inhaling contaminated water aerosols.

This bacterium can grow in all installations with characteristics that are favourable to the development of these micro-organisms:
- warm water between 25 and 45 °C;
- the presence of nutrients;
- the presence of Fe^{+++} essential to growth;
- an aerobic environment;
- the possible existence of hosts (amoebae, etc.).

Some industrial installations, particularly cooling towers, are therefore favourable to their development. In certain cases, these same installations can generate aerosols: cooling towers (TAR), washing with water sprays, etc.

The relationship between the level of contamination of the water from which the aerosol is produced, and the risk of legionnaire's disease has not yet been established. As a preventive measure, a heightened vigilance threshold has been set for ICPEs at 1000 CFU/l (1000 Colony Forming Units per litre), with 100,000 CFU/l leading to shutdown of the installations. The concentration in water can vary widely in just a few hours and the bacterium in question can be found in biological deposits (biofilm) on the walls of the installation (hot water tanks, pipes, valves, shower heads in sanitary hot water installations, or heat exchangers, tower basin and cooling tower exchanger body in cooling circuits), or in a host organism (protozoa: amoebae, etc.) which in bursting can release large quantities of legionella. Current trends are to consider that if a circuit is contaminated, then it is definitive and the risk exists. Curative treatment will have only a temporary impact, because the water feeding the loop is usually contaminated.

The recent cases of legionnaire's disease in wet cooling towers led the ministers for Health and the Environment to combine their efforts to improve prevention of the health risk linked to these installations, as part of the 2004-2008 (June 2004) legionella prevention plan. The nomenclature of installations classified on environmental protection grounds was modified so that these installations are now included within its scope of application. Requirements aimed at preventing and limiting the risk of the spread of legionella were defined within this framework (orders of 13 December 2004 concerning prevention of the risk of the development of legionella in installations subject to authorisation and declaration respectively).

Similar measures were taken within nuclear installations. However, the ASN wished to reinforce their regulatory framework by modifying the ministerial order of 31 December 1999. The modification made to this text explicitly refers to the technical requirements applicable to classified installations, which henceforth constitute the common rule.

Prior to modification of the order, EDF had notified the steps it was taking with respect to nuclear power plant cooling towers, as their particular characteristics (size, cooled flow throughput, etc.) could mean that the usual treatment methods would have a considerable effect on the environment. The cha-

Inspectors checking the cooling towers

racteristics of these installations (in particular their height), enabled EDF to put forward an argument highlighting the very slight health risk.

The Director General for Nuclear Safety and Radiation Protection, the Director General for Health and the Director for the Prevention of Pollution and Risks referred the matter to the French agency for environment and labour health safety (AFSSET) for an assessment of this situation (see chapter 12).

Despite these precautions, it must be possible to respond appropriately to the possible occurrence of legionella clusters, so the public authorities (DGS, DPPR, ASN) formally defined the organisation to be set up in this case, through an interministerial circular shortly to be issued.

5 | 4 | 2

Amoebae

The *Naegleria fowleri* (NF) species of amoebae lives in small quantities in lakes and rivers. This thermophilic species develops primarily at temperatures of between 35 and 40°C.

Stainless steel condensers in nuclear power plants have been identified as a favourable location for proliferation of NF amoebae. In order to limit their quantities in water to an acceptable threshold, EDF was obliged to treat its systems initially with bleach, and then with monochloramine (see chapter 12). Specific licenses were issued to deal with releases linked to these treatments (see point 3|4).

6 WASTE STUDIES

Article 20 of the above-mentioned order of 31 December 1999 states:

"The operator drafts a study on the management of its waste, known as the "waste study", indicating its objectives concerning reduction of the volume and the chemical, biological and radiological toxicity of the waste produced in its installations, and optimisation of its management with emphasis on reuse and treatment for final disposal in an ultimate waste repository. It defines the steps it employs in order to achieve these objectives".

Articles 20 to 27 of the order of 31 December 1999 give the regulatory procedures linked to the waste studies and waste management.

These articles were the subject of two instruction notes from the ASN: SD3-D-01 (Guide for the production of nuclear waste studies) and SD3-D-02 (Specifications for the annual nuclear installation waste balances), available on the ASN's website, which were designed to constitute specifications to which the nuclear operators would refer when drafting their waste studies and their annual waste balances.

The waste studies for the nuclear sites are one aspect of the drive for progress designed to promote improved management of the waste produced on the sites. In particular, the operator of a nuclear site must control its waste inventory, minimise waste production, recycle and reuse the waste produced, insofar as this is technically and economically possible, and package the residual waste in the form of ultimate waste for disposal. These studies must lead to definition of a waste reference framework which can act as a reference for the statutory inspection.

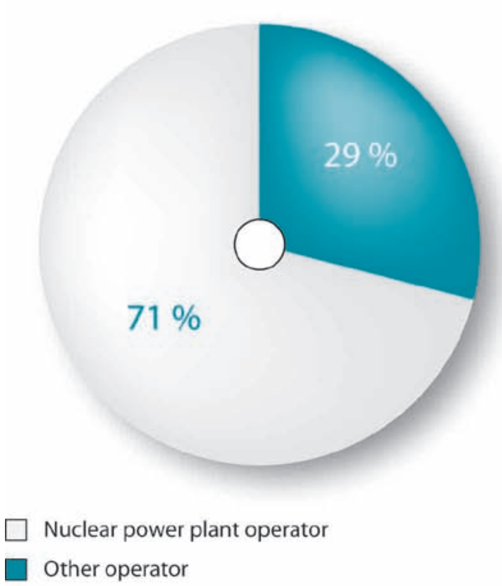
The problem of waste management is described in greater detail in Chapter 16.

7 SIGNIFICANT ENVIRONMENTAL EVENTS

Detecting and processing significant events play a key role in nuclear safety. As soon as an event occurs, the necessary countermeasures must be put in place along with appropriate experience feedback to prevent it from happening again. This first of all implies the existence of a reliable system for detecting events and distributing the relevant information. For some years now, the number of fields in which events must be declared has risen, particularly in the environmental field in accordance with the discharge orders or the order of 31 December 1999.

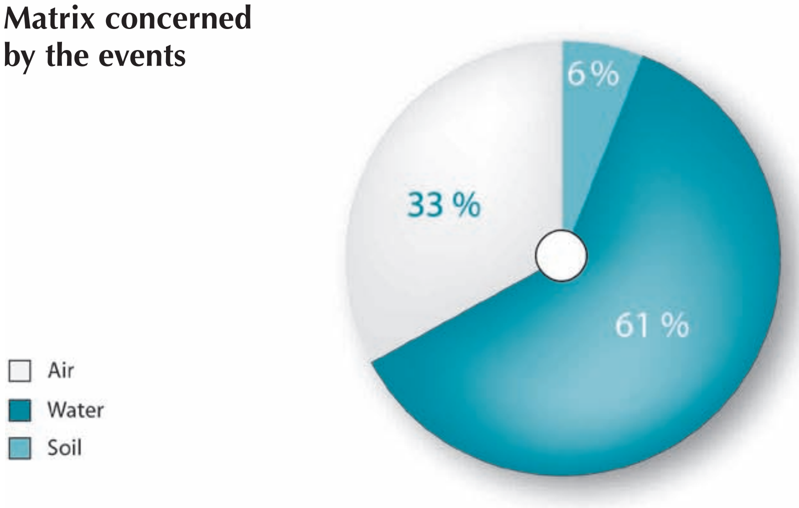
During the course of 2005, the ASN produced a guide for declaring significant events affecting all fields of activity in the nuclear industry (BNIs, Transports) (see point 1|2|1 of chapter 4). This will come into use on 1 January 2006. In this document, significant environmental events are dealt with in the same way as those affecting installation safety, transport of nuclear materials or radiation protection. Nine declaration criteria were identified: releases of unauthorised chemical, radioactive or bacteriological substances inducing an impact, non-compliance with a technical or organisational require-

Breakdown of events per type of installation



Type of events

Matrix concerned by the events



ment which could have had an impact, malicious or attempted malicious act, discovery of a polluted site, non-compliance with the waste study, etc.

This harmonisation of criteria should in particular help achieve uniform declaration conditions and ensure that all the available lessons are learned.

In 2005, 52 environmental events were declared by the operators, as shown in the breakdown given in the previous graphs.

8 Outlook

With regard to environmental supervision, 2005 was marked by improvements to the regulatory requirements concerning the national network of environmental radioactivity measurements (above-mentioned order of 27 June 2005). This process is reaching its conclusion with the modification in progress to article R. 1333-11 of the Public Health Code. This regulatory framework improves the examination of approval applications submitted by the laboratories, the number of which is rising significantly.

The coming years will enable the ASN, together with the IRSN, to define the national radiological monitoring strategy and develop the network as an information tool.

The sustained efforts devoted to supervision and reduction of the impact of nuclear installation discharges will be continued. This approach will lead to the issue of several discharge licenses in 2006. The ASN will initiate a programme of work designed to improve the conditions for retrieval of the results of discharges monitored by the operators, particularly so that they are more easily accessible to the public.

The modification to the interministerial order of 31 December 1999 establishing the general technical regulations for preventing and limiting detrimental effects and external hazards resulting from the operation of basic nuclear installations, will also give the ASN a better opportunity to ensure that the steps taken by the operators conform to the new regulatory requirements, in particular with regard to preventing the development of legionella.

The ASN will ensure that the nuclear operators correctly apply the revised criteria for declaring significant events within BNIs, particularly in the environmental field. This examination will be conducted with the goal of maximising the lessons learned from experience.

PUBLIC INFORMATION AND TRANSPARENCY

CHAPTER 6

1 DEVELOPMENT OF RELATIONS BETWEEN THE NUCLEAR SAFETY AUTHORITY AND THE PUBLIC

1|1 From public information to transparency
1|2 ASN information media
1|2|1 The ASN website, www.asn.gouv.fr
1|2|2 The ASN's MAGNUC viewdata magazine
1|2|3 The report *Nuclear safety and radiation protection in France*
1|2|4 *Contrôle* magazine
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 Public information actions by the heads of the DRIREs and DSNRs
1|5|2 The "Nuclear activities under close supervision" exhibition

1|6 Symposia

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

2|1 The Local Information Committees

2|2 The National Association of Local Information Committees

3 THE HIGH COUNCIL FOR NUCLEAR SAFETY AND INFORMATION

4 THE INSTITUTE FOR RADIATION PROTECTION AND NUCLEAR SAFETY

5 THE OTHER STAKEHOLDERS

6 OUTLOOK

As part of the French Nuclear Safety Authority's (ASN) duty to inform, this report provides the reader with a picture of nuclear safety and radiation protection in France in 2005. In this chapter, the ASN presents its actions and tools for public information and transparency.

Since 2003, the ASN has also used this chapter to present the tools and actions used in informing the public about nuclear safety and radiation protection by other stakeholders.

1 DEVELOPMENT OF RELATIONS BETWEEN THE NUCLEAR SAFETY AUTHORITY AND THE PUBLIC

1 | 1 From public information to transparency

The decree of 13 March 1973, which created the Central Nuclear Installations Safety Department (SCSIN), responsible for supervising nuclear safety in France, also entrusted it with the role of "proposing and organising information of the public on safety-related issues". The decree of 1 December 1993, which created the Nuclear Installation Safety Directorate (DSIN), 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 public information duty 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". Thus, each time an institutional change affected the way civil nuclear supervision was organised in France, the public information role of the ASN was confirmed.

In order to discharge these duties, the ASN uses specific information media and actions in an effort to provide the public with information that is easy to understand and accessible to the greatest number.

Modern technology allows increasingly fast circulation of information and the population is asking for increasingly precise information. For its part, the ASN aims constantly to improve how it reports on what it is doing. This naturally leads it to continue its commitment to transparency, while taking care to avoid saturating the information channels and to set up support, awareness and even training measures enabling the citizens and their representatives to gain easier access to information.

The ASN also informs the various opinion shapers. It contributes to regular information of the media, by organising thematic press conferences as well as encouraging the action of the Local Information Committees (CLIs). The Nuclear Safety Authority also handles the secretariat of the High Council for nuclear safety and information (CSSIN) and regularly presents its actions to it. The ASN maintains ongoing relations with elected representatives and environmental protection associations.

In addition, the ASN wishes to expand participation by the stakeholders (representatives of environmental protection associations, of industry or administrations, elected officials, and so on), in the drafting of regulatory texts of general scope. It also wishes to encourage information of the public about how these texts are drafted and enable it to give its opinion on their content. The draft National radioactive waste and reusable materials management plan (PNGDR-MV) is meant to meet this two-fold objective: it was prepared by a working group coordinated by the ASN and expanded to include various stakeholders and was placed on-line in the summer of 2005 so that opinions could be sent in to the ASN's website, www.asn.gouv.fr. All the comments received were also placed on-line, to nourish the debate on a major topical and social issue.

The image and profile of the ASN

In 2005, together with the TNS SOFRES poll institute, the ASN created a profile and image barometer. This barometer is designed to quantify the ASN's recognition level and the degree of satisfaction of the various audiences at whom its information actions are targeted. It will enable the ASN to adapt its information policy both locally and nationally.

The first wave of this opinion survey was conducted between September and October 2005 with a representative sample of the general public and a sample comprising essentially journalists, elected officials, association managers, administrative managers, CLI chairmen, health professionals and teachers, representing the better informed public.

This survey revealed that even if a large majority of individuals are aware of the existence of a nuclear supervision organisation, few could spontaneously mention the ASN or recognise its name (16 % of respondents among the general public). This is reflected directly in how the ASN's roles are perceived by the general public, who were only able to identify supervision of nuclear installations (75 % of those respondents who said they knew about the ASN).

The overall recognition of the ASN however rises to 61 % among the better informed public, who are more aware of its regulatory function (30 % as against 8% among the general public), but relatively unaware of its information function (13 % as opposed to 4 % of general public respondents who said they knew about the ASN).

For the first time, the ASN has carried out a programme of information with the general public concerning the organisation of nuclear supervision in France. As part of the iodine tablets distribution campaign held in 2005, nearly 500,000 homes near the 19 nuclear power plants received a brochure presenting the supervisory procedures in place for the plant concerned.

Public information and transparency concerning nuclear activities should be further enhanced with the nuclear transparency and safety bill, which is shortly to be tabled before Parliament by the Minister for Ecology and Sustainable Development. This text recognises the public's right to access the information in the possession of the nuclear installation licensees and those responsible for radioactive material transport.

1 | 2

ASN information media

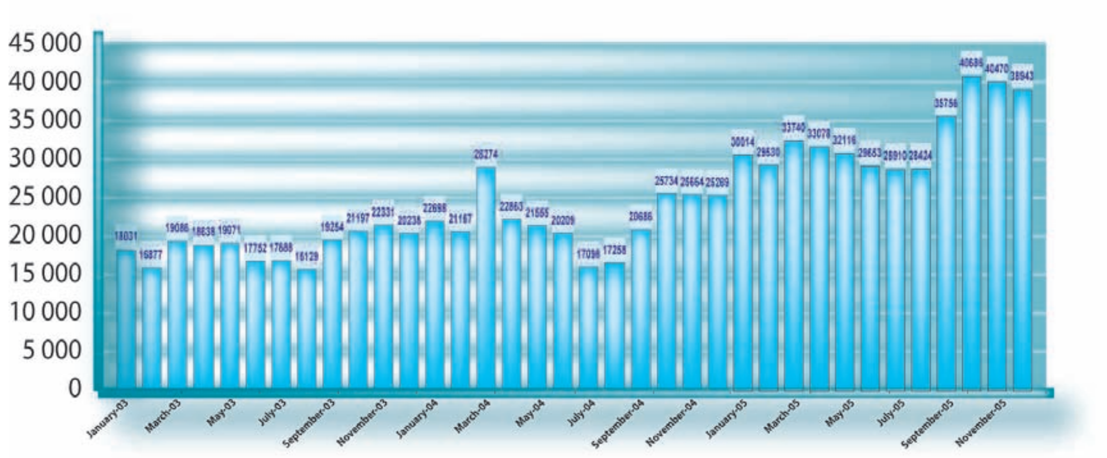
1 | 2 | 1

The ASN website: www.asn.gouv.fr

The ASN opened its website, www.asn.gouv.fr, on 2 May 2000. This site is updated in real time and provides 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 website also presents the assignments of the ASN, the scope of its activities, its publications, the legislative and regulatory texts which govern its daily actions and its relations with foreign counterparts.

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

ASN website homepage: www.asn.gouv.fr



Monthly visitor statistics for the ASN website in 2003 and 2004

Since 1 January 2002, and in line with its commitment to transparency, the ASN website www.asn.gouv.fr has published the results of all the inspections (about 670 per year) carried out by its inspectors in the basic nuclear installations (BNIs), by placing on-line the letters sent to the licensees following each inspection. Since 5 April 2005, the ASN has also placed on-line the information notices concerning EDF reactor outages. In these information notices, it gives the context of the outage, the main worksites involved, the supervision and monitoring actions it carried out and the main events that occurred during the outage. These notices are published after the ASN has approved restart of the reactor concerned.

The Nuclear Safety Authority also wishes to expand consultation of the stakeholders and inform the public when drafting general regulatory texts. Therefore, following on from the experiments begun in 2003, it placed the draft National radioactive waste and reusable materials management plan (PNGDR-MV) on-line for consultation, in July 2005. In September 2005, the ASN also placed on its website, for consultation, a draft decree concerning the licensing and declaration conditions for nuclear activities and their supervision, which in particular modified the Public Health Code.

Since it was first set up in May 2000, the ASN website has seen its audience steadily grow, a phenomenon which has been even more evident since 1 January 2005. For 2005, the average number of monthly visitors to www.asn.gouv.fr stood at more than 33,500 and the site was visited by more than 400,000 people. In

2004, there were on average 22,000 monthly visitors to the ASN website. This represents a 50% increase, which is the highest rate of growth since May 2000.

Other innovations on the ASN website in 2005 included the creation of a "Press conferences" section, publication on the "Regions" pages of information about ASN supervision of the nuclear power plants operated by EDF, the NuPEER international symposium of 22 and 23 June 2005 devoted to nuclear power plant ageing, a revamp of the "Texts" section and updating of the CLI section.

The "Texts" section gives the web user access to the regulations covering nuclear safety and protection against ionising radiation.

As part of the work being done to create the national environmental radioactivity measurements network, the ASN is also continuing to develop the joint portal with the IRSN which will give access not only to a variety of information concerning the network and its objectives, but also to radioactivity measurements and their interpretation in terms of impact.

1 | 2 | 2

The ASN's MAGNUC viewdata magazine

The MAGNUC viewdata magazine was set up by the ASN in 1987 at the recommendation of the CSSIN. It took over from the data bank created after the Chernobyl accident. The number of visitors logging into MAGNUC has been steadily falling since the development of web access and the growth of the www.asn.gouv.fr website. In 2005, there were an average of 43 logins to the MAGNUC magazine per month. The ASN has therefore decided to close it down as of 1 January 2006. All information that was available on MAGNUC is accessible to the public on www.asn.gouv.fr.

1 | 2 | 3

The ASN's report *Nuclear safety and radiation protection in France*

Every year, this report presents the state of nuclear safety and radiation protection in France. It also presents all ASN actions performed during the past year to supervise and improve the safety of French civil nuclear facilities and of the transport of radioactive materials, and to check and minimise exposure of workers, patients, the public and the environment to ionising radiation.

Since 2004, via the "ASN multiyear strategic plan", it also presents the ASN's orientations and goals for the coming 3-year period.

This report, which is the fruit of collective analysis and synthesis work, in which all ASN entities take part, provides an annual record of the changes and difficulties encountered, in both the technical and organisational spheres, within the companies and organisations subject to supervision. It 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 the ASN's 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 report is available in French and in English on the website www.asn.gouv.fr.

1 | 2 | 4

Contrôle magazine

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 magazine.

In France, *Contrôle* is distributed to national and local elected representatives, the media, journalists, members of the CSSIN and the CLIs, the environmental protection and other associations, the licensees 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 regular contacts.

The *Contrôle* print run comprises 8,500 copies and it consists of two parts.

The first part is devoted to news. It reports on what the ASN is doing: supervision of BNIs and of transports of radioactive and fissile materials used for civil purposes; decisions, formal notices and international relations of the ASN; activities of the CLIs, the CSSIN, the interministerial commission on basic nuclear installations (CIINB) and expert groups.

The second part, entitled *Dossiers de Contrôle*, presents a special report on an aspect of nuclear safety or radiation protection. *Contrôle* presents ASN policy concerning the subject chosen and also makes its pages available for the expression of a wide variety of opinions. Publication of these points of view helps lay the foundations for a broader debate and encourages the emergence of a pluralistic form of information, taking greater account of the concerns and expectations of public opinion.

Covers of the issues of *Contrôle* published in 2005

The press conferences organised at each publication of *Contrôle* are regularly attended by journalists from the general and specialist "nuclear", "environment" and "medical" press.

In 2005 *Contrôle* covered the following subjects:

- January → The safety of the fuel cycle (no. 162)
- March → ASN report on nuclear safety and radiation protection in France in 2004: extracts (no. 163)
- May → The EPR reactor (no. 164)
- July → Radioactive waste management in France (no. 165)
- October → Monitoring nuclear safety and radiation protection (no. 166)
- December → Radiation protection: the international stakeholders (no. 167)

Contrôle is free and is distributed on the basis of voluntary subscription (subscription form available on www.asn.gouv.fr or by mail from the following address: ASN Publications, 6, place du Colonel Bourgoin, 75572 Paris Cedex 12).

The *Dossiers de Contrôle* 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 website www.asn.gouv.fr. Back numbers can also be consulted in the public information and documentation centre.

1 | 2 | 5

Other ASN publications

The ASN presentation brochure

ASN presentation brochure

This brochure describes the resources employed by the ASN to supervise nuclear safety and radiation protection and inform the public. It presents the organisation chart, activities and values of the ASN, "independence, competence, stringency and transparency". It is distributed at the meetings and events in which the ASN takes part, and is also published in English in order to facilitate the ASN's international relations.

• The ASN's public information and documentation centre brochure

Brochure describing the ASN's public information and documentation centre

This document presents the types of audience for whom the centre is intended, the information needs it is designed to meet, the main characteristics of its documentary base and how it actually works in practice. It is widely distributed to various information providers: pedagogical documentation centres for teachers, "major risks" contact persons in the academies, science museum media libraries, libraries of the "Ecoles des mines" colleges, CLIs, exhibition and symposia sites in which the ASN participates, as well as the communication departments of the DRASS, DDASS and the prefectures.

The public information sheets

Some of the public information sheets

The "ASN information sheets" are designed to provide targeted, concise and pedagogical information on the main topics of nuclear safety and radiation protection.

These sheets are widely distributed among the general public and the teaching sector. They are available at the exhibitions and symposia in which the ASN participates and are sent out to various information providers such as the CLIs and the documentation centres for teachers. They are also available to the DSNRs (Nuclear Safety and Radiation Protection Departments) for local communication operations.

The collection currently comprises 6 numbers.

Sheet no. 1, “Administration of stable iodine in the event of a nuclear accident”, in particular presents how taking stable iodine counteracts the possible effects on the thyroid of a release of radioactive iodine.

Sheet no. 2, “Radiation protection principles”, presents the principles of justification, optimisation and limitation of ionising radiation exposure doses and the application of these principles to radiation protection of the public, patients and workers.

4 new sheets were published in 2005.

Sheet no. 3, “Nuclear or radiological: which term to use?”, clarifies the definition and usage of these two words in the various fields of activity (industry, medical and research) liable to entail exposure to ionising radiation, and in the corresponding regulations.

Sheet no. 4, “Radiation protection values and units”, describes the characteristics of ionising radiation. It defines the various values and units concerning this radiation or radioactivity, as well as how they are specifically used in quantifying the corresponding hazards.

Sheet no. 5, “The French nuclear fuel cycle” presents the operators involved in the sector, where the facilities are located, the various phases involved in the production and then reprocessing of civil nuclear fuels and how this activity is supervised.

Sheet no. 6, “Radiological emergency situations”, presents the various situations which could lead to a release of radioactive substances, the main parties involved in managing them and the various measures that exist in France to protect the population in the event of a nuclear accident.

· Brochures presenting the supervision of EDF nuclear power plants

Some of the brochures presenting supervision of nuclear safety and radiation protection

In 2005, the ASN issued a brochure to about 500,000 households near nuclear power plants, presenting the organisation of nuclear safety and radiation protection supervision in each of the 19 nuclear power plants operated by EDF. Issue of this brochure coincided with the iodine tablets distribution campaign launched by the public authorities for those living in the vicinity of each of the 19 sites concerned.

1 | 3

The public information and documentation centre

The ASN's public information and documentation centre was opened to the public in 2004 for consultation of documentation concerning the areas of competence of the ASN.

This centre offers the public access to all of the ASN's publications. The public can also consult publications about nuclear safety, radiation protection and ionising radiation published by the other stakeholders (CLIs, CSSIN, nuclear operators, IRSN and other technical experts, health safety agencies, radiology and radiation protection learned societies, professional associations, environmental protection associations, and so on).

To meet the specific needs of a certain better informed public, in particular science students and teachers or specialised journalists, the centre also offers a selection of specialised French and English books and reviews, for consultation on the premises. The centre offers on-site consultation of original administrative documents, such as the file subject to public inquiry prior to authorisation for creation or modification of BNIs.

It offers Internet access and viewing of video documents.

In 2005, the ASN's public information and documentation centre met the needs of nearly 1050 people. It sent 1425 ASN publications out to 300 correspondents, answered information requests from 200 web users and 420 phone callers, and welcomed 124 visitors.

1 | 4

The ASN and the media

1 | 4 | 1

Regular relations with the press

In order to meet its duty to inform, the ASN has adopted a policy of close ties with the press.

The press department maintains regular contacts with several dozen national, regional and international journalists and issues press releases primarily concerning:

• the regulatory actions (authorisation to start up or shut down installations, environmental discharge licences, etc.);

• the decisions taken and stances adopted on sensitive nuclear safety and radiation protection issues;

• incidents of a certain importance, in particular incidents rated 2 and higher on the INES scale.

The ASN also organises press conferences on a regular basis. At the time of publication of Contrôle, it for example invites the media to review a topical nuclear safety and radiation protection issue. These regular events are also an opportunity for discussions between the ASN and journalists on all topical subjects. An annual press conference is devoted to presentation of the nuclear safety and radiation protection report. It enables the ASN to review the past year and present the priorities for the coming one.

The INES scale for rating of nuclear incidents and accidents

Presentation and goals of the INES scale

In 1987, France set up a scale to rank the severity of nuclear events which was extensively used by the IAEA in creating its own INES scale (International Nuclear Event Scale). This scale, based partly on objective criteria and partly on subjective criteria, is designed to facilitate media and public understanding of the significance, in terms of safety, of nuclear incidents and accidents. It is not a safety assessment tool and can, under no circumstances, be used as a basis for international comparisons. There is in particular no strict correlation between the number of non-serious incidents declared and the probability of a serious accident occurring in a facility.

Nature of the events concerned by the INES scale

The INES scale is designed to cover events occurring in all civil nuclear facilities, including those classified as secret, and during transport of nuclear materials.

At the initiative of the ASN, the IAEA Member States are experimenting with a new INES part dealing with radiation protection incidents and covering radioactive sources and transports of radioactive materials. This new part incorporates the principle of the relationship between the radiological risk and the severity of the event. France initially limited the systematic experimental application of this new scale to BNIs. A broader application to medical, industrial and research installations will gradually be implemented. Thus in 2005, this experimental scale was used to rate an irradiation incident in the CEA's Frédéric Joliot unit of the Orsay hospital.

Use of the INES scale in France

All events with significance for nuclear safety are declared by the licensees within 24 hours. This declaration comprises a proposed rating subject to the approval of the ASN, which alone is responsible for the final rating 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 on the www.asn.gouv.fr website.
- incidents rated level 2 and above are also the subject of a press release;
- incidents rated level 0 are not always made public by the ASN. They are published if temporarily classified pending the result of further investigations, if they are of interest in terms of safety analysis or methodology, or if they are of particular interest to the media.

Level	Pressurised water reactors	Other facilities	Transports	Total
3 and above	0	0	0	0
2	1	0	0	1
1	49	24	7	80
0	709	101	41	851
Total	759	125	48	932

Rating of nuclear events on the INES scale in 2005

In 2005, questions from journalists chiefly concerned:

• two radiation protection incidents in hospitals: irradiation of an employee in the CEA's Frédéric Joliot unit of the Orsay hospital and a serious incident affecting a patient during radiotherapy treatment in the Grenoble university hospital;

• the 2005 campaign for distribution of iodine tablets to the populations living in the vicinity of the nuclear power plants;

• the repercussions of the drought on the operation of the French nuclear power plants.

The ASN aims to issue high-quality, clear and comprehensible information that is stripped of excessively technical vocabulary. It therefore offers all of its staff training appropriate to their level of responsibility, on the subjects of oral and written communication and emergency management.

In 2005, 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.

1 | 4 | 2

The ASN and the media in emergency situations

ASN emergency response centre

The ASN must at all times be ready to respond to the need for information should a serious event occur, in particular in a nuclear installation or during radioactive material transport. For this reason, most of the emergency response exercises organised (at the rate of about ten per year) include media pressure. This media pressure, simulated by journalists hired 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 messages put across by the various stakeholders, be they licensees 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 constitutes 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.

In September 2005, the ASN activated its national emergency response system on two occasions, when nuclear power plant on-site emergency plans were triggered:

- following a water leak in an electrical equipment room in the Nogent-sur-Seine nuclear power plant;
- when the pressure rose in the reactor heat removal system while the Blayais nuclear power plant was in outage.

The ASN distributed and placed on its website press releases clarifying the reasons for and consequences of each event, as well as the action it was preparing to take with respect to the licensee.

1 | 5

ASN regional actions

1 | 5 | 1

Public information actions by the heads of the DRIREs and DSNRs

The ASN aims to ensure greater involvement by the heads of the Regional Directorates for Industry, Research and the Environment (DRIREs) - which are the ASN's regional spokespersons - and their Nuclear Safety and Radiation Protection Departments (DSNRs).

Every year, the heads of the DRIREs organise a press conference on nuclear safety and radiation protection to present a review of their activities and of the safety of the nuclear installations and transports of radioactive materials under their supervision. This initiative has been favourably received by the local media, anxious to provide the populations living in the vicinity of nuclear installations with a clear idea of their safety level, often more detailed than that to be derived from national media accounts.

The heads of the various 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. Their comments more specifically deal with nuclear safety and radiation protection.

Similarly, the DSNRs attend CLI meetings to help improve local media understanding of issues linked to nuclear safety and radiation protection.

In 2005, to improve awareness of DNSR actions in the regions, the ASN sent out a brochure to about 500,000 homes in the vicinity of the 19 nuclear power plants, presenting the supervision procedures in the plant concerned.

1 | 5 | 2

The "Nuclear activities under close supervision" exhibition

For more than 6 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, local authorities and schools, scientific, technical or industrial culture centres and museums in 2 or 3 towns host this 250 square metre exhibition for periods of from 3 to 8 weeks.

ASN-IRSN exhibition
"Nuclear activities under close supervision"

In 2005, after a presentation at the Val d'Essonne University in Evry (Ile-de-France region), the exhibition moved on to the General Council of the Cher *département* in Bourges. Nearly 3000 people were thus able to visit it.

At each stop, the DSNR helps with the inaugural events, the conferences and dissemination of information to elected officials, the local press and the general public. All ASN publications are also proposed, in particular to science teachers visiting the exhibition.

In 2005, a joint study was launched by the ASN and the IRSN with a view to updating the content of this exhibition and its support documents.

1 | 6

Symposia

In 2005, the ASN aimed to ensure a higher profile for itself at symposia, meetings with professionals and international seminars.

On 22, 23 and 24 June 2005, it held the first edition of the NuPEER (Nuclear Pressure Equipment Expertise & Regulation) international symposium in Dijon. This symposium dealt with the subject of ageing of pressure vessels in nuclear power plants and had a two-fold objective: on the one hand to exchange views on practices and share experience of ageing issues in nuclear power plants, and on the other to create an international network of experts in the field of nuclear pressure vessels. It brought together nearly 120 participants from nuclear regulators and expert organisations in 13 countries: Belgium, the Czech Republic, Finland, France, Germany, Japan, Norway, Slovenia, Sweden, Switzerland, Spain, United Kingdom and United States. The International Atomic Energy Agency (IAEA), the OECD's Nuclear Energy Agency (NEA) and the European Commission also took part in the debates.

In 2005, the ASN also took part in a large number of scientific conferences, in particular organised by medical learned societies: Société française de radioprotection, Société française de radiologie, Société française de médecine nucléaire et d'imagerie moléculaire, Société française de physique médicale. Together with the professionals concerned, it was thus able to look at the new methods of radiation protection supervision and the new regulatory framework, as well as answering specific questions, for example concerning their facilities.

On 14 December, the ASN also organised the 17th national conference of Local Information Committees (CLIs) on the subject of local emergency management (see point 2|2).

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

2|1

The Local Information Committees

Local Information Committees (CLIs) work alongside the nuclear facilities. These Committees, created at the initiative of the General Councils as recommended by a circular from the Prime Minister on 15 December 1981, have a twofold role: to monitor the impact of these facilities and to inform the populations by means they consider most appropriate.

To do this, they require:

• the necessary information, in particular that forwarded by the licensees and by the administrations that supervise them;

• funding which, according to the above-mentioned circular, must be provided by the local authorities reaping economic benefits from the facility considered.

To help the CLIs expand their actions, the ASN also provides them with financial assistance. This assistance is used in particular to finance 50% of the specific action and assessment expenses of CLIs requesting assistance, and up to 100% of the cost of public information actions. The DSNRs also provide technical support as and when needed. In 2005, State financial support for action by the CLIs and their association amounted to about 350,000 euros.

The CLIs must aim whenever possible to develop their own opinions and adopt a questioning attitude to their various contacts. They comprise locally elected representatives (generally about half the members), representatives from environmental protection associations, trade unionists, socio-professionals and representatives of the public authorities.

Nearly 30 CLIs were created under the circular of 15 December 1981. To this must be added the local information and monitoring committee (CLIS) of the Bure underground laboratory, created under application of the law of 30 December 1991 concerning research into radioactive waste management (the corresponding legal provision now appears in article L. 542-13 of the Environment Code), along with about fifteen information committees created around defence-related nuclear sites, in application of articles 4 and 5 of a decree dated 5 July 2001.

Work began on creating a new CLI for the Large National Heavy Ion Accelerator (GANIL) in Caen and a CLI should also shortly be set up for the uranium mining sites in the Limousin region.

As in previous years, CLI activity reached high levels in 2005.

17th Conference of Local Information Committees

The 17th Conference of Local Information Committees was held on 14 December 2005 in Paris, at the initiative of the ministers for Industry, the Environment and Health. More than 140 people took part.

In 2005, a particular effort was made to mobilise the CLIs for this conference, increasing their involvement in its preparation and encouraging them to send larger delegations. This led to a tripling of the number of CLI representatives, with nearly 70 CLI members (local elected officials or representatives or associations or unions, etc.) playing an active part in the conference.

As in previous years, the conference was also attended by members of Parliament, members of the High Council for Nuclear Safety and Information (CSSIN), representatives of the General Councils and Prefectures of *départements* with a CLI, the administrations concerned, associations and licensees operating nuclear installations.

Preceded by an "inter-CLI meeting" organised by the ANCLI on the subject of its "white paper on local governance of nuclear activities" (see below), the conference was devoted to the question of local emergency management.

After a presentation by the Director for Civil Defence and Security, three round-table sessions dealt in turn with emergency management and the post-accident phase, local safeguard plans, and local emergency communications. CLI representatives presented the lessons they had learned from their experience of these matters. Local elected officials and representatives of central government departments contributed their knowledge of health or environmental emergencies unrelated to the nuclear sector (AZF accident, lead pollution from a factory in the Ardennes, etc.).

The debates confirmed the interest of the CLIs in these questions and the need to continue with the debates and experiments initiated, so that these committees can play a full role in the event of an emergency situation. The question of the role of the CLI in emergency communications needs in particular to be looked at further.

The event was closed by the Chairman of the ANCLI and the Director General of the ASN.

The date of Tuesday 12 December 2006 has already been chosen for the 18th conference.

17th conference of CLI chairmen

The CLI generally held one or more plenary meetings, often supplemented by meetings of specialist committees (“environment”, “communication” and “socio-economic” sub-committees at Cadarache, “technical” and “population safety” sub-committees at Gravelines, working party on the environmental monitoring plan around the FBFC plant in Romans, “science and society”, “information, training and governance” and “news” groups at Saclay, “Economic and “Environment” committees at the Valduc SEIVA (Valduc information exchange structure), and so on).

Site annual operating reports were presented to most of the CLIs. The incidents which occurred were generally reviewed in depth.

The CLIs also dealt with subjects such as the nuclear transparency and safety bill (Blayais CLIN), alerting the population (Civaux CLI), distribution of iodine tablets (Cattenom, Chooz, Gravelines, Nogent CLIs, among others), the EPR project (Dampierre and Flamanville CLIs), the ITER project (Cadarache CLI), etc.

The CLIs are generally involved in the emergency exercices, and at the very least receive a presentation of their conclusions.

The CLIs are invited to take part in ASN inspections: in 2005, the Fessenheim CLS (local surveillance committee) and the Gravelines, Golfech, Nogent-sur-Seine, Paluel-Penly, Saclay and Saint Laurent-des-Eaux CLIs in particular responded to this invitation. They can also request specific assessments (Cadarache CLI on analysis of the impact of the site, Fessenheim CLS on seismic “micro-zoning”, Gard CLI on the radiological consequences of the flooding of December 2003 in the Petite Camargue area, Golfech CLI for chemical releases, and so on).

In order to inform the population, nearly half of the CLIs publish newsletters. Others are offered space in the publications of the General Council or the commune. Information about CLI activities appears on the ASN website and that of the national CLI association (ANCLI). Some CLIs also have their own websites (Bure local committee, Golfech and Gravelines CLIs, La Hague (Special and permanent information committee for the COGEMA La Hague facility). Others have pages on local authority websites.

The Valduc SEIVA made a significant contribution to the organisation of the 2005 ANCLI conference held in Dijon.

CLI information brochures

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.

Since December 2004, the ANCLI has been chaired by Mr Jean-Claude Delalonde, Chairman of the Gravelines CLI and member of the General Council of the Nord *département*.

The ANCLI aimed to revitalise its activities in 2005. At its meting on 2 February 2005, in Dunkerque, its board set three major objectives for the ANCLI:

- to make the CLI voice heard on all subjects of potential concern to them (transparency bill, waste management, power plant ageing, transport of nuclear materials, environmental monitoring, dismantling);
- to represent all the CLIs (or similar structures) set up around nuclear facilities, regardless of their status, and to be representative of all bodies making up the CLIs (elected officials, associations, unions, chambers of commerce, industry and trade, experts, etc.);
- to offer the CLIs the technical and human resources they need to perform their duties: expert assessment resources via the ANCLI's Scientific committee but also, for example, the creation of a website to distribute information from the ANCLI to the CLIs.

This orientation in particular led to the publication by the ANCLI in spring 2005, of a "white paper on local governance of nuclear activities" which was presented to the relevant political bodies and was the subject of a number of communications. The ANCLI website, www.ancli.fr, was opened at the beginning of the summer of 2005.

The ANCLI took part in the public debates held in the autumn of 2005 concerning radioactive waste and the EPR project.

During its general meeting of 19 October 2005, the ANCLI modified its articles of association, in particular so that its ability to represent the various CLI member categories could be improved.

The ANCLI is now more representative and at the end of 2005 acts as the umbrella organisation for about twenty CLIs, or about two-thirds of the total.

The ANCLI's activities in 2005 were also marked by the following actions.

- DÉCLIC bulletin

The ANCLI publishes an information bulletin called DÉCLIC, of which it distributes 6000 free copies. In 2005, issue number 9 was published.

- INFO sheets

These information sheets are distributed as part of the DÉCLIC bulletin, or on request.

- ANCLI annual symposium

The ANCLI held its 5th annual symposium on 14 and 15 September in Dijon, on the subject "Power plant ageing: what health, environmental and socio-economic effects?".

- Training

The ANCLI organises training for CLI members. In 2005, a session was devoted to the local safeguard plans and their implementation. About twenty CLI members took part.

• Scientific committee

This committee was set up on 5 March 2003 and brings together experts from various disciplines in order to answer the scientific questions posed by the CLIs. After a year in which its activities had been suspended, the scientific committee was reactivated in September 2005. It set itself, in particular, the goal of meeting 6 CLIs in 2006, of taking part in the various public debates on radioactive waste and the EPR, and of organising regional conferences on precise topics chosen by the CLIs.

• Site visits

In May 2005, the ANCLI organised a visit to the MELOX plant and the Visiatome at Marcoule.

3 THE HIGH COUNCIL FOR NUCLEAR SAFETY AND INFORMATION

The High Council for Nuclear Safety and Information (CSSIN) was created by a decree dated 13 March 1973 and its role was extended by another decree dated 2 March 1987.

Its role covers all issues concerning nuclear safety and radiation protection and information of the public and media with regard to these matters.

The Council comprises personalities chosen for their information and communication skills, or their expertise in scientific, technical, economic or social fields, members of Parliament, representatives of environmental protection associations, of labour organisations, of nuclear facility licensees and of the administrations concerned.

The composition of the Council was renewed by an order dated 27 May 2005 from the Minister for Ecology and Sustainable Development and the Minister Delegate for Industry. Mr Michel van der Rest, who is Science Director of the Life Sciences department at the CNRS, was appointed chairman.

The new Council held its first meeting on 28 September 2005 and this was an opportunity for the members of the Council to present proposals for questions which they wanted to see included in the Council's programme of work for the next five years of its mandate.

These proposals include, although with no order of priority at this stage:

- the conditions of public information about nuclear safety in the 146 BNIs and the tens of thousands of medical installations,
- management of nuclear waste,
- the transparency of the current organisation of safety,
- plant ageing,
- the risks linked to the terrorist threat,
- the safety of the planned new large installations: George Besse II, EPR, ITER,
- organisational vulnerability,
- professional training on nuclear safety issues,
- management of emergency situations,
- the risks linked to the existence of plutonium,
- monitoring of medical irradiation and its potential impact,
- safety during dismantling of facilities and management of their waste,
- creation of a rating for radiation protection incidents,
- analysis of safety incidents and lessons learned,
- supervision of uranium mines.

These proposals led to a wide-ranging discussion with a view to drafting an initial version of the Council's programme for the coming years, with the programme to be finalised during the next meeting.

The Council expressed its wish to ensure wider coverage of its work than in the past and undertook to publish the minutes of its five annual plenary sessions.

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 IRSN reports to the ministers for the Environment, Health, Research, Industry and Defence.

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 and to contribute to the development of scientific knowledge concerning nuclear and radiological risks. Its role is to provide technical support for the public authorities with competence for safety, security and radiation protection in both the civilian and defence sectors (secret BNIs, weapons systems and nuclear-powered ships). Finally, the decree that created it gives it certain duties outside the scope of research, in particular in monitoring of the environment and of populations exposed to ionising radiation. These missions in particular include radiation protection training, management of national databases (national nuclear materials inventory, national radioactive sources file, SISERI file containing worker exposure to ionising radiation, etc.) as well as helping to inform the public of the risks linked to ionising radiation.

In accordance with this same decree, the IRSN publishes the results of its R&D programmes, except for those related to defence, primarily on its website, www.irsn.org. This same year, the website received more than 900,000 visits and about 900 messages in its contact@irsn.fr mailbox.

The IRSN reports on its activities in the public annual report it officially communicates to its supervisory Ministries, as well as to the Higher Council for Nuclear Safety and Information, to the Higher Council for Public Health in France and to the Higher Council for the Prevention of Professional Risks. The 2004 version of this exhaustive activity report is available in French and English on the IRSN website and can be obtained on request either on paper or on a mini CD-ROM from the Institute (IRSN BP17 92262 Fontenay-aux-Roses Cedex).

In application of the framework agreement signed in 2004, which defines the procedures for dialogue between the IRSN and the ASN, as well as the principles governing the technical support the Institute provides to the ASN, an annual protocol identifying the actions to be performed by the IRSN on behalf of the ASN was signed in 2005.

In 2005, the IRSN submitted about 700 opinions to the ASN and about 20 reports to the advisory committees. It in particular presented its expert opinions to 19 sittings of the advisory committees. These opinions primarily concerned:
- the periodic safety review concerning the third ten-yearly outages for the 900 Mwe reactors,
- the periodic safety review concerning the second ten-yearly outages for the 1300 MWe reactors,
- review of lessons learned from operation of French and foreign pressurised water reactors during the period 2000 to 2002,
- review of the draft safety analysis report for the future EPR reactor,
- review of the preliminary safety analysis report for the Georges Besse II centrifugal enrichment plant,
- review of the waste management policy.

Finally, the travelling exhibition jointly managed by the ASN and the IRSN, entitled "Nuclear activities under close supervision", was presented in the towns of Evry and Bourges. For its run in Evry alone, the exhibition welcomed 1800 visitors, including 300 university students and 200 high school students. This was also an opportunity to organise a round table about the transport of radioactive materials, which was attended by about a hundred people.

The decision was also taken to revamp the exhibition in 2005 and the title, poster and seven thematic booklets were revised. The seven booklets were in fact replaced by an educational visitor's guide.

In addition, a newsletter was created, designed to give a regional and "topical" feel to the exhibition.

For further information, contact www.irsn.org.

5 The other stakeholders

Nuclear safety and radiation protection are complex areas in which many parties are involved. Given the diversity of available information, the public can now make up its own mind in particular by consulting the websites of the main organisations concerned. The information they make available varies in nature, from the most general to the most scientific, from the layman to the informed professional.

In line with its policy of transparency, the ASN presents a non-exhaustive list of the main websites dealing with nuclear matters in the broadest sense:

• Local Information Committees (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 the assessment of scientific and technological options, bills, work done by committees, etc.)
  - www.assemblee-nationale.fr (site of the French Parliament);
  - www.senat.fr.

• Licensees
  - www.andra.fr (site of the National Agency for Radioactive Waste Management);
  - www.cea.fr (site of the Commissariat à l'énergie atomique);
  - www.cogema.fr (site of the Compagnie Générale des Matières nucléaires);
  - nucleaire.edf.fr (EDF site devoted to the French nuclear power plants);
  - www.framatome-anp.com (site of Framatome-ANP, manufacturer of French nuclear reactors);
  - www.laradioactivite.com (popularisation site, produced jointly by the CEA and the CNRS).

• Associations
  - www.criirad.com (site of the Commission for Independent Research and Information on Radioactivity);
  - www.greenpeace.fr (Greenpeace site);
  - www.wise-paris.org (Wise site);
  - www.sortirdunucleaire.org (site of the "Sortir du nucléaire" association).

• Health agencies and technical experts
- www.afssa.fr (site of the French Food Product Safety agency);
- www.afssaps.sante.fr (site of the French Health Product Safety agency);
- www.afsset.fr (site of the French Environment and Labour Health 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.ecologie.gouv.fr (law-related part of the Ministry for Ecology and Sustainable Development's website).
- www.industrie.gouv.fr ;
- www.sante.gouv.fr.

6 OUTLOOK

Setting up an opinion barometer is an important step for the ASN in its public information role. This barometer is designed to quantify the level of recognition of the ASN and the degree of satisfaction with its information action and should enable the ASN regularly to assess the relevance and quality of the information actions it carries out. Subsequent surveys following on from that of 2005 will be conducted and the results will help the ASN enhance its institutional image and raise its profile and the perception of its functions.

Changes to the www.asn.gouv.fr website are also an important project for the ASN in 2006. To better inform the public about what it is doing and about the state of nuclear safety and radiation protection in France, in particular in the local nuclear sector, the new site will enable the web user to access all subjects that interest him or her, easily and rapidly.

Along the lines of the information brochures it distributed regarding supervision of nuclear power plants, the ASN wishes to expand its information programmes aimed at the general public.

The ASN will also continue its policy of stakeholder consultation when drafting regulatory texts of general scope. It aims to make it increasingly possible for web users to find out about these projects and comment on them.

The ASN goal is to be recognised, both nationally and internationally, as an effective, legitimate and credible regulator. This to a large extent depends on its ability to disseminate information, to involve other stakeholders and to report on its actions. All of the ASN's current and future actions in the field of public information and transparency are designed to achieve this goal.

INTERNATIONAL RELATIONS

CHAPTER 7

1 THE ASN'S INTERNATIONAL OBJECTIVES

2 INTERNATIONAL AGREEMENTS

2|1 The Convention on Nuclear Safety

2|2 The Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management

2|3 The Convention on early notification of a nuclear accident

2|4 The Convention on assistance in the case of a nuclear accident or radiological emergency

2|5 Other conventions related to nuclear safety

3 MULTILATERAL RELATIONS

3|1 The International Atomic Energy Agency (IAEA)

3|2 The OECD's Nuclear Energy Agency (NEA)

3|3 The United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR)

3|4 The European Union

3|4|1 The European Commission's working groups

3|4|2 The "Nuclear action plan"

3|4|3 Assistance to the Eastern European Countries

3|5 The Nuclear Regulators Associations

3|5|1 The International Nuclear Regulators Association (INRA)

3|5|2 The Western European Nuclear Regulators Association (WENRA)

3|5|3 The Association of nuclear regulators of countries operating French designed nuclear power plants (FRAREG)

4 BILATERAL RELATIONS

4|1 Staff exchanges between the ASN and its foreign counterparts

4|2 Bilateral relations between the ASN and its foreign counterparts

5 INTERNATIONAL CONFERENCES

6 OUTLOOK

1 THE ASN'S INTERNATIONAL OBJECTIVES

The nuclear fleet supervised by the ASN is one of the largest and most diverse in the world. The ASN's therefore aims to ensure that its nuclear and radiation protection supervisory activities constitute an international reference.

The ASN's international duties were confirmed in decree 2002-255 of 22 February 2002, creating the Directorate General for Nuclear Safety and Radiation Protection, which in particular stipulates:

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

The ASN's main international objectives are as follows:

• To develop information exchanges with its foreign counterparts concerning regulatory systems and practices, problems encountered in the field of nuclear safety and radiation protection, and the steps taken with a view to:
- enhancing its approach;
- improving its knowledge of how foreign nuclear safety and radiation protection authorities really work and learning lessons for its own operating methods;
- and improving its position in technical discussions with the French operators, as its arguments would be strengthened by practical knowledge of conditions abroad.

• In the fields of nuclear safety and radiation protection, to make known and explain the French approach and French practices and provide information on the steps taken to resolve the problems encountered. This approach involves action in a number of areas:
- to make known French positions on certain issues such as very low level waste, the creation of a radiation protection incident and accident classification scale, or the French policy of lowering the authorised limits for basic nuclear installation discharges;
- to provide assistance to countries wishing to create or develop their nuclear safety authority, such as the states of the ex-USSR, and certain emerging countries;
- when requested, to help foreign nuclear safety authorities required to issue permits for nuclear equipment of French origin or design.

• To inform the French public on what is happening abroad;

• To inform foreign States of events that have happened in France and provide the countries concerned with all useful information about French nuclear facilities located close to their borders;

• To help ensure that changes in European and international rules and practices are based on the best practices, in particular by taking part in the think-tanks set up by the international bodies and in the drafting of texts by these bodies describing nuclear safety and radiation protection principles and practices;

• To play an active role in the work being done to harmonise nuclear safety and radiation protection principles and standards and to define community law;

• To implement the undertakings of the French government concerning nuclear safety and radiation protection, in particular within the framework of international agreements.

These objectives are pursued within the framework of bilateral agreements, but also through ASN participation in the work coordinated by international bodies such as the International Atomic Energy Agency (IAEA), the Organisation for Economic Cooperation and Development (OECD) and the European Union, as well as that being done by the nuclear regulators' associations.

Congresses and conferences are also prime opportunities for exchanges, in which the ASN presents its approaches and its practices.

In order to meet these goals, the ASN calls on the expertise of technical support organisations whenever necessary. The Institute for Radiation Protection and Nuclear Safety is the leading organisation of this type.

2 INTERNATIONAL AGREEMENTS

In the aftermath of the Chernobyl accident (26 April 1986), the international community negotiated a number of conventions designed to prevent accidents linked to the use of nuclear power and mitigate their consequences should they occur. These conventions are based on the principle of a voluntary commitment on the part of the States, who retain sole responsibility for the installations placed under their jurisdiction.

Two conventions deal with the prevention of nuclear accidents (Convention on Nuclear Safety and Joint Convention on the Safety of Spent Fuel Management and the Safety of Radioactive Waste Management), while two others deal with management of their consequences (Convention on early notification of a nuclear accident and Convention on assistance in the case of a nuclear accident or radiological emergency). France is a contracting party to these four conventions. The IAEA (see point 3|1 below) is the depositary of these conventions and provides the relevant secretarial services.

2|1 The Convention on Nuclear Safety

The Convention on Nuclear Safety concerns civil nuclear power reactors. France signed it on 20 September 1994 (the first day on which it was open for signature at the IAEA's General Conference). The convention came into force on 24 October 1996. At the end of 2005, it had been ratified by 56 States (since March 2005, this includes all countries in possession of nuclear power reactors).

In ratifying the convention, the contracting parties agree to submit a report describing how they apply the fundamental principles of safety and good safety practices, which are the subject of the various articles of the convention. The reports from the contracting parties are examined during a review meeting at which each party may ask questions to the others.

The first two review meetings were held in April 1999 and April 2002. The third contracting party meeting was held at the IAEA headquarters in Vienna from 11 to 22 April 2005. As at the previous meetings, the ASN was in charge of coordinating the French national report and played an active role in the meeting.

This third meeting was a step forward in relation to the meetings of 1999 and 2002, as each party had learned the lessons of the first exercises. The contracting parties took advantage of prior experience to present the nuclear safety situation in their countries with greater openness and transparency. Among the most significant points were the call by several of the leading nuclear countries (including France) for IRRT (Integrated Regulatory Review Team) missions to assess their safety reference system and regulatory practices (see point 3|1 and IRRT sheet), the importance attributed to work on harmonising the regulatory approaches within WENRA and the desire to preserve safety levels in a context of economic deregulation.

Now that the Convention has been ratified by India, the 2008 meeting will for the first time see all countries operating nuclear power reactors compare their safety practices. Consideration is to be given to enhancing the independency and transparency of the nuclear safety authorities.

2 | 2

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

The "Joint Convention", as it is often called, is the counterpart of the Convention on Nuclear Safety for spent fuel and radioactive waste management facilities. France signed it on 29 September 1997 (the first day it was open for signature at the IAEA's General Conference). The Joint Convention came into force on 18 June 2001. At the end of 2005, it had been ratified or approved by 34 States (Brazil, People's Republic of China, India, Italy, the Russian Federation, as well as many countries in which radioactive waste originates from medical, industrial or research activities, have not yet adopted it).

One key activity by the ASN in 2005 was to coordinate preparation of the French report for the second review meeting, to be held in Vienna from 15 to 24 May 2006. 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. As France had promised, this report also deals with spent fuel reprocessing activities.

The French and English versions of this report were sent to the IAEA, the Joint Convention depositary, in October 2005.

The Director General of the ASN will chair the second review meeting.

2 | 3

The Convention on early notification of a nuclear accident

The Convention on early notification of a nuclear accident came into force in October 1986, 6 months after the Chernobyl accident and at the end of 2005, it had been ratified by 92 States. The contracting parties agree to inform the international community as rapidly as possible of any accident leading to uncontrolled release into the environment of radioactive material likely to affect a neighbouring State. A system of communication between States is therefore coordinated by the IAEA and regular drills are held among the contracting parties. The ASN is the competent national authority for France.

2 | 4

Convention on assistance in the case of a nuclear accident or radiological emergency

The Convention on assistance in the case of a nuclear accident or radiological emergency came into force in February 1987 and at the end of 2005, it had been ratified by 89 States. Its purpose is to facilitate cooperation between countries if one of them were to be affected by an accident with radiological consequences. This Convention has already been used on several occasions for accidents due to abandoned radioactive sources. Within this context, France's specialised services have already taken charge of treating irradiated victims. The ASN is the competent national authority for France.

2 | 5

Other conventions related to nuclear safety

Other international conventions, the scope of which does not fall within the remit of the ASN, may be linked to nuclear safety.

This is particularly the case with the Convention on the physical protection of nuclear material, the aim of which is to reinforce protection against malicious acts and the unlawful use of nuclear materials. This Convention, which came into force in February 1987, had by the end of August 2005 been ratified by 105 States, including France.

Additional information on these conventions may be obtained from the IAEA's website: www-ns.iaea.org/conventions/.

3 MULTILATERAL RELATIONS

3 | 1

The International Atomic Energy Agency (IAEA)

The IAEA is an United Nations organisation , which comprises 137 Member States. With regard to the area of competence of the ASN, the activities of the IAEA primarily consist in:

- organising discussion groups at different levels and preparing texts known as "Safety Standards", describing safety principles and practices which can then be used by Member States as a basis for national regulations. Since the beginning of 1996, this activity has been supervised by the CSS (Commission on Safety Standards), comprising senior representatives of the regulatory authorities of twenty Member States, tasked with proposing standards to the Director General of the Agency. France is represented on this Commission by the Director General of the ASN, who has chaired the Commission since the beginning of 2005, and by one of his deputies. 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. It also takes part in the technical groups which draft these documents.

  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. At the end of 2005, 64 revised safety standards had been published, 4 others have been approved and another 37 standards are currently 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 includes the following missions: OSART (Operational Safety Review Team), IRRT (Integrated Regulatory Review Team), PROSPER (Peer Review of the effectiveness of experience feedback system), TRANSAS (TRANsport Safety Appraisal Service), RASSIA (Radiation Safety and Security Infrastructure Appraisal).

In 2005, an OSART mission took place in May at the Le Blayais plant. A preparatory OSART mission went to the Saint-Laurent-des-Eaux nuclear power plant in December. The reports on all the OSART missions conducted in France are available in their original language, English, on the ASN's website, www.asn.gouv.fr.

A.C. Lacoste (centre) chairs the 17th meeting of the CSS (Commission on Safety Standards) at IAEA headquarters in Vienna, from 6 to 8 June 2005.

In July, France asked for an IRRT mission which, in November 2006, will require the ASN to submit its nuclear safety and radiation protection reference system and regulatory practices to an external peer review.

– harmonisation of communication tools. The French proposal of a radiation protection events classification scale led to intense international debate aimed at improving the international nuclear events scale (INES).

In the past, the ASN played a central role in establishing the INES scale. It also played an active role in drafting the scale for classifying radioactive material transport incidents. France is one of the leading users of the INES scale when communicating about events occurring in its basic nuclear installations (BNI) and radioactive material transports.

Since 2002, the ASN has been looking to develop a communication tool for dealing with radiation protection incidents. The existing INES scale was felt to be insufficient for communications dealing with exposure to ionising radiation, as its radiation protection classification criterion did not refer to the radiological risk, which is the basis of the current regulations. France therefore rekindled the international debate with a view to adding a radiation protection criterion to the INES scale so as to link the radiation exposure dose received to the radiation protection incident or accident gravity index.

The French proposal led to trials in the Member States of the International Atomic Energy Agency (IAEA) of a new part of the INES scale concerning radiation protection incidents, which takes account of radioactive sources and shipments of radioactive materials. This new part, which includes the principle of the relationship between the radiological risk and the seriousness of the event, has been applicable in France since 1 January 2005 on an experimental basis. Initially, France limited application of this new scale to BNIs and to transport. Broader application to medical, industrial and research facilities will then be envisaged.

3 | 2

The OECD's Nuclear Energy Agency (NEA)

The NEA, set up in 1958, comprises all the OECD States, except for New Zealand and Poland, or 29 countries. Its main objective is to promote co-operation between the governments of Member States for the development of nuclear energy as a reliable and environmentally and economically acceptable energy source.

Within the NEA, the ASN takes part in the activities of the Committee on Nuclear Regulatory Activities (CNRA). During its two annual meetings, the CNRA in particular discussed the impact of experience feedback on regulatory actions and the preconditions for safety harmonisation work for new reactors.

The ASN also takes part in the work of the Radioactive Waste Management Committee (RWMC) which brings together the nuclear safety authorities and organisations responsible for waste management.

In the field of radiation protection, the ASN continued its participation in the Committee on Radiation Protection and Public Health (CRPPH).

3 | 3

The United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR)

The United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) was created in 1955. It examines all scientific data on radiation sources and the risks they represent for the environment and for health. The reports published by this scientific body, which constitute the international reference, cover subjects such as the hereditary effects of ionising radiation and the consequences of the Chernobyl accident.

This activity is supervised by the annual meeting of the national representations of the Member States, comprising high-level experts, and at which the ASN is represented.

3 | 4

The European Union

3 | 4 | 1

The European Commission's working groups

Regular contacts with the European Commission (Directorate General for Transport and Energy - DG/TREN in particular) are a means of reviewing progress and upcoming regulatory work in the field of radiation protection: in particular transposition of directives and the workings of the Euratom Treaty committees.

The ASN plays an active part in the work of the Euratom Treaty committees and expert groups:
- scientific and technical committee (STC);
- article 31 experts group (basic radiation protection standards);
- article 35 experts group (checking and monitoring radioactivity in the environment);
- article 36 experts group (information concerning supervision of radioactivity in the environment);
- article 37 experts group (notifications concerning radioactive effluent discharges).

The ASN also takes part in working groups coordinated by the European Commission and designed to compare certain safety practices in the Member States of the European Union:
- standing working group for the safe transport of radioactive materials;
- advisory committee for radioactive waste programme management;
- CONCERT (Concertation on European Regulatory Tasks) and NRWG (Nuclear Regulators' Working Group) groups, which should be merged into a new group called the ENREG (European Nuclear Regulators Expert Group).

3 | 4 | 2

The "Nuclear action plan"

On 30 January 2003, the European Commission adopted two proposed directives, one defining general principles of the safety of nuclear facilities, the other the management of spent fuel and radioactive waste. However, it was impossible for the Council of the European Union to adopt these two texts, commonly referred to as the "nuclear package" owing to the opposition by several Member States of the Union, who felt that texts such as resolutions or recommendations, which are not legally binding, would be preferable.

In June 2004, the Council of the European Union adopted conclusions finding that there was no consensus on this subject and it recommended continuing with the work aimed at achieving progress in nuclear safety harmonisation, similar to the work done by WENRA (see point 3|5|2 below). The Presidency of the Council therefore accepted and agreed to implement a plan of action proposed by the Council's Atomic Questions Group during its meeting of 27 October 2004.

The ASN believes a move towards harmonisation of nuclear safety principles and standards is required and thus plays an active part in the activities of the ad hoc group created for implementation of this European action plan. With a view to achieving greater efficiency, three sub-groups were set up, each of which is responsible for dealing with a particular topic: safety of nuclear installations (SG n° 1), safety of spent fuel and radioactive waste management (SG n° 2) and decommissioning fund (SG n° 3). France is represented in each of the sub-groups and the ASN more particularly participates in SG n° 1 and has the role of chairman and secretary of SG n° 2. The *ad hoc* group is required to submit a report by the end of 2006.

3 | 4 | 3

Assistance to the Eastern European Countries

a) the aim of the assistance programmes

The July 1992 G7 summit in Munich defined three priority areas for nuclear safety assistance to the countries of central and eastern Europe and the newly independent states which were formerly part of the Soviet Union:
- to contribute to improving the operating safety of existing reactors;
- to provide funding for short-term improvements to the least safe reactors;
- to improve safety supervision organisation, making a clear distinction between the responsibilities of the different entities concerned and reinforcing the role and scope of local nuclear safety authorities.

Assistance programmes were set up by the European Commission to achieve these goals. They constitute the nuclear part of the PHARE programme (which is more particularly aimed at the countries applying for membership of the Union) and the TACIS programme (intended for countries of the former Soviet Union).

The European Commission set up the Regulatory Assistance Management Group (RAMG), comprising the nuclear safety and radiation protection authorities from the countries of the European

Union, to advise it on assistance requests from the eastern European countries. The PHARE programmes are coming to an end for the ten countries which entered the European Union on 1 May 2004, but are continuing for the two candidates for whom entry is planned for 1 January 2007: Bulgaria and Romania.

b) ASN participation in the assistance programmes

The European Commission's PHARE and TACIS programmes

The nuclear part of these programmes covers the three areas of assistance defined by the G7, but the nuclear safety authorities of the European Union only participate directly in the last one, by providing their joint assistance to their counterparts in the eastern European countries.

The ASN is pilot for the TACIS programmes in Ukraine and Kazakhstan. In 2005, on behalf of the European Commission, it carried out two missions to assess the impact of the TACIS programmes on improvements to nuclear safety in Ukraine and to evaluate the assistance needs of the Ukrainian nuclear safety authorities. February 2005 saw the final meeting of the 5th regulatory assistance project in Ukraine (UK/RA/05) which lasted 15 months. The ASN also worked on preparing the 6th project, which will run until mid-2008.

The ASN is taking part in the 6th TACIS regulatory assistance programme for the Russian Federation (RF/RA/06) which should last until mid-2007. It in particular advises the Russian nuclear safety authority on how to revise nuclear regulations to bring them into conformity with the Federal law on the technical regulatory process.

Finally, 2005 saw the end of the 3rd PHARE project for assistance to Hungary (HU/RA/03) in which the ASN had taken part with respect to radiological emergency situations. The ASN also contributed to a PHARE project in Bulgaria to reduce the number of radioactive sources for which there was a risk of a lack of regulatory supervision.

Another area of cooperation with the Russian Federation is to help this country nuclear safety authority to construct the regulatory framework necessary to authorise the nuclear facilities that need to be built for elimination of the military plutonium declared as surplus to Russian defence needs.

These actions are supplemented by other international technical assistance programmes in accordance with the resolutions adopted by the G7 to improve nuclear safety in the eastern European countries, and which are financed by contributions from donor States and the European Union.

Other international technical assistance programmes

The ASN is a participant in the expert groups reporting to the EBRD (European Bank for Reconstruction and Development), responsible for managing multilateral funds to finance the following actions:

- decommissioning of nuclear reactors in Bulgaria (Kozloduy 1 to 4), Lithuania (Ignalina 1 & 2), Slovakia (Bohunice V1 1 & 2) and Ukraine (Chernobyl 1 & 3);
- installation of a new sarcophagus on Chernobyl unit 4, in which the April 1986 disaster occurred;
- dismantling of decommissioned Russian nuclear submarines and radiological clean-up of the Barents sea military bases.

Finally, with regard to nuclear safety, the ASN advises the French delegation to the Nuclear Safety and Security Group (NSSG) of the G8 (G7 + Russian Federation). It in particular took part in the meetings of this group in London in March and May 2005.

c) ASN's position

The ASN observes that significant progress has been achieved in the three priority areas defined by the G7:
- improvements have been made to in-service safety of reactors;
- some States (Bulgaria, Lithuania, Slovakia, Ukraine) have committed to final shutdown of the least safe reactors and have already shut some down in accordance with these commitments;
- the role and remit of the nuclear safety authorities have been reinforced and clarified in the European Union accession states. This is apparent in the reports presented by the eastern European countries during the Convention on Nuclear Safety review meeting in April 2005.

The safety authorities of the States which joined the Union on 1 May 2004 have therefore reached a level which should dispense with the need for further assistance.

However, in the states of the ex-USSR, this key objective will not be reached for some time, owing to the profound changes it implies: adaptation of the structures of the State itself, change in mentality to admit the independence of the nuclear safety authorities and thus underpin their credibility, reinforce their status and their means.

3 | 5

The Nuclear Regulators Associations

3 | 5 | 1

The International Nuclear Regulators' Association (INRA)

INRA, which comprises the nuclear safety authorities of Canada, France, Germany, Japan, Spain, Sweden, the United Kingdom and the United States, met twice in 2005 under the German chairmanship of Mr. Wolfgang Renneberg (Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit - BMU, Federal Ministry for the Environment, Protection of Nature and Nuclear Safety), in Bonn in June and in Munich in September.

Apart from presenting the main events in their respective countries, the INRA members discussed the safety consequences of installation ageing, the lessons to be learned from the third meeting of the contracting parties to the Convention on Nuclear Safety (see point 2|1 above), cooperation in the licensing process (for example licensing by the Finnish authority of the Franco-German designed EPR reactor) and the notion of the independence of the nuclear safety authority.

The INRA members appointed the Director General of the ASN chairman of the association for 2006.

3 | 5 | 2

The Western European Nuclear Regulators Association (WENRA)

The WENRA association was officially created in February 1999, the founder members being the heads of the nuclear safety authorities of Belgium, Finland, France, Germany, Italy, Netherlands, Spain, Sweden, Switzerland and the United Kingdom. The Director General of the ASN was nominated first Chairman for a period of two years and his term of office was extended in 2001 for a further period of two years. Following their March 2003 meeting, the WENRA members appointed Mrs Judith Melin (Sweden) as chairwoman. During this same meeting, they decided to admit to the association the regulators of the seven "nuclear" countries (operating at least one nuclear reactor to produce electricity) who were at that time applying for membership of the European Union: Bulgaria, Czech Republic, Hungary, Lithuania, 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 for examining nuclear safety and regulations problems in the countries applying for membership of the European Union;
- to develop a common approach to nuclear safety and regulation, in particular within the European Union.

With regard to the first task, WENRA in October 2000 published a revised version of its report on safety in the seven nuclear countries applying for membership of the European Union. This report contributed to the position adopted by the Council of the European Union and the recommendations sent by the Commission to these countries to enable them to attain the high level of nuclear safety required prior to their acceptance into the Union.

With regard to the second task it set for itself (harmonisation of national approaches to safety), WENRA created two working groups:

- one (under the control of the British nuclear safety authority) for nuclear power plants (see chapter 12);
- the other (under the control of the ASN - until 2004 - and then the Czech safety authority) for management of spent fuel and radioactive waste, plus dismantling operations (see chapter 16).

In each of these fields, the groups began by defining the reference levels for each technical topic, based on the IAEA's most recent standards and on the most demanding approaches employed within the European Union (and therefore, for all practical purposes, in the world).

As an initial pilot study (the conclusions of which are available on the ASN's website) into harmonisation of nuclear reactor safety in the founding countries had demonstrated the relevance and effectiveness of the methodology adopted, a process to assess national practices in relation to these reference levels was then developed.

During its two annual plenary meetings, WENRA is kept informed of the progress of the groups work and determines future guidelines for the groups. Thus, in 2005, during their last meeting in Stockholm (7 - 9 December), in application of the commitments made during the previous meetings - particularly the previous meeting of 15-16 March at The Hague, Netherlands) the WENRA members were able to examine the conclusions of the working groups, presenting the results of the national practices assessment process. For nuclear power reactors, these results indicated that the harmonisation work under way for the past three years was well advanced, with numerous reference levels being defined. For spent fuel and radioactive waste management, this work is less well advanced and will be continued.

The next steps are as follows:

- the conclusions of the working groups will be made public during the course of a seminar to be held in Brussels on 9 February 2006;
- before the end of 2006, each member will present an action plan, that aims to bring its national practices into compliance with the defined reference levels for any technical area in which there are identified differences;
- national practices must be harmonised by 2010.

ASN's position

This work as a whole confirms WENRA's ability to carry out wide-ranging, bottom-up nuclear safety harmonisation work (directives, action plan, etc.).

INRA and WENRA, which were created at the initiative of the Director General of the ASN, also constitute unique and irreplaceable opportunities for free and informal discussions between nuclear safety authority heads.

3 | 5 | 3

The Association of nuclear regulators of countries operating French designed nuclear power plants (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 comprises the nuclear safety authorities of Belgium, France, the People's Republic of China, South Africa and South Korea.

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 nuclear 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 4th meeting was held in Taejon, South Korea on 21 and 22 June. This meeting was organised by the Korean Institute for Nuclear Safety (KINS), which is the technical support organisation for the Korean safety authority (Ministry Of Science and Technology - MOST). The debates in particular covered incident analysis and probabilistic safety studies. The Chinese nuclear safety authority was unable to take part in this meeting.

Participants at the 4th FRAREG meeting (Teajon, South Korea, 21 and 22 June 2005).

4 Bilateral relations

The ASN works with many countries within the framework of bilateral agreements signed at various levels:
- governmental agreements (Belgium, Germany, Luxembourg, Switzerland);
- administrative arrangements between the ASN and its counterparts (about twenty).

4 | 1

Staff exchanges between the ASN and its foreign counterparts

One way for improving knowledge of the actual workings of foreign nuclear safety and radiation protection authorities (and learn lessons for operation of the ASN) is to develop the system of staff exchanges.

The nuclear safety and radiation protection authorities concerned so far have been those of Belgium, Canada, Germany, Japan, People's Republic of China, Spain, Switzerland, United Kingdom and United States.

Provision is made for several types of exchange:

- *very short-term actions (one to two days)* offering our counterparts cross-inspections and joint emergency exercises: they involve inviting foreign inspectors to take part in inspections or emergency exercises performed by inspectors from the country concerned.

In Germany for instance, joint inspections were organised in the hospital sector. The DSNRs of Orleans and Douai also maintain regular contacts with the nuclear installations inspectorate of the Lower Saxony region. A visit by three ASN inspectors was organised from 16 to 19 August 2005 to the KKU reactor operated by E.ON in Lower Saxony. The French inspectors collected information on the supervision procedures employed by the Lower Saxony safety authority and the fire protection and staff radiation protection measures implemented by the operator.

A team of Spanish radiation protection inspectors came to France from 14 to 17 June 2005 to visit the nuclear medicine, brachytherapy and radiotherapy departments at the Institut Bergonié Centre Régional de Lutte Contre Le Cancer (CRLCC) cancer unit in Bordeaux. In Spain, ASN teams took part in a radiation protection inspection in the Asco plant (19 to 21 October 2005), as well as an inspection of a research laboratory equipped with a cyclotron and an inspection of a gammagraphy installation on a worksite (Madrid, from 16 to 18 November).

In the United Kingdom, an ASN team comprising DSNR inspectors from Douai and Châlons-en-Champagne, took part in an inspection from 12 to 13 April 2005 of the Sizewell B site (1200 MWe, 4-loop pressurised water reactor), enabling them to observe the practices of their British colleagues during a unit outage and how the site operator manages contractors working on the site. Joint inspections were also carried out in the spent fuel reprocessing plants at La Hague and Sellafield.

Joint industrial radiology inspections were organised with our Swiss and British counterparts.

In the United States, three ASN inspectors took part in a training course given for radiation protection inspectors by the NRC from 21 to 31 March 2005. This course was an opportunity to compare French regulatory requirements and training reference systems with those in use in the United States.

- *short-term assignments (3 weeks to 3 months)*, aimed at studying a specific technical topic.

There were no missions of this type in 2005;

- *long-term exchanges (up to 3 years)* in order to take part in the working of the foreign nuclear safety and radiation protection authority to gain an in-depth knowledge of it.

This type of exchange must obviously be reciprocal. Therefore:

• since 1997, a number of ASN engineers have been sent on assignment to the British nuclear safety authority. The latest one, in place since the summer of 2002, returned to France in the summer of

2005. Similarly, an engineer joined the Spanish nuclear safety authority in early 2000 and stayed there until mid-2003;
• an engineer from the British nuclear safety authority joined the ASN from February 2001 to August 2002 and he was replaced by another engineer in January 2003. Finally, an engineer from the Spanish nuclear safety authority joined the ASN from September 2000 to June 2001 and his replacement took over from September 2002 to mid-2004.

These exchanges were an opportunity to enhance French practices, for example with the introduction of review inspections in 2000. The ASN has been in charge of radiation protection supervision since February 2002 and has put these exchanges to good use in speeding up development of its own radiation protection system for the industrial and medical field, using proven methods and good practices observed at its counterparts.

Furthermore, the experience acquired by the ASN and its counterparts shows that inspector exchange programmes are an important factor in energizing bilateral relations between nuclear safety and radiation protection authorities.

4 | 2

Bilateral relations between the ASN and its foreign counterparts

The countries and safety authorities with which the ASN had the most frequent contact in 2005 included the following:

South Africa

Bilateral exchanges between the National Nuclear Regulator (NNR) and the ASN were developed further through actions decided on at the previous management committee meeting in 2004.

The research reactors working group held its first meeting in South Africa in May. The subsequent exchanges mainly dealt with conversion of very highly enriched uranium (HEU) fuel to a low enriched uranium (LEU) fuel, an operation which is in progress in the South African SAFARI 1 reactor.

A South African delegation visited France in June 2005 to observe an emergency exercise and discuss emergency situation management.

The NNR-ASN management committee met in Paris on 20 and 21 September 2005. The South African delegation then visited the ANDRA sites in eastern France: Bure underground laboratory, Aube repository and VLL waste repository in Morvilliers.

Germany

In 2005, the plenary session of the Franco-German Commission on nuclear installation safety issues (Deutsch-Französische Kommission für Fragen der Sicherheit kerntechnischer Einsichtungen – DFK) could not be held. This meeting will therefore take place at the beginning of 2006. The DFK working groups continued their work by exchanging information on safety and radiation protection aspects of reactors located near national borders and by improving exchanges of information between the various organisations concerned, particularly in the event of an incident or accident. Exchanges concerning radiation protection were continued.

Argentina

In 2005, the ASN and the Argentinian regulator (Autoridad Regulatoria Nuclear) continued their cooperation in the field of radiobiological scientific watch, resulting in the publication of:
– a scientific review entitled “Genetic and epigenetic features in radiation sensitivity”, published in two parts in the European Journal of Nuclear Medicine in February and March 2005;

– an UNSCEAR document (annual meeting from 26 to 30 September 2005) entitled “Ionising radiation and the immune system”.

Belgium

ASN relations with the Belgian Federal Agency for Nuclear Control (FANC) covers a number of fields, particularly safety, waste management, transport and radiation protection. In 2005, cross-inspections continued in both nuclear and industrial/medical fields.

Joint work to consider a geological disposal safety doctrine led to a first European seminar in November 2004. A second European seminar was organised on 20 May 2005 and concluded with the creation of a working group for European harmonisation of regulations concerning geological disposal (see chapter 16).

Canada

Exchanges primarily concerned the management of emergency situations and the safety of new reactors. In March, the ASN received a delegation from the CNSC (Canadian Nuclear Safety Commission) to present how France manages nuclear emergencies and the ASN’s involvement. In December, the ASN received a Canadian delegation, to present the safety of the EPR reactor and the licensing procedures.

On 27 September, the Director General of the ASN and his Canadian counterpart signed a new cooperative administrative arrangement in Vienna.

People’s Republic of China

In 2005, the ASN-NNSA (Chinese National Nuclear Safety Administration) management committee, which met in Beijing in June, reviewed the actions completed and defined a new programme, which in particular includes assignment of a Chinese inspector to France.

The most noteworthy actions in 2005 were the March seminar on the safety of the EPR reactor and the continued inspector visits. French inspectors went to China and Chinese inspectors were received in France.

Spain

In addition to the joint inspections mentioned earlier, exchanges took place in 2005 with the nuclear safety council (Consejo de Seguridad Nuclear) in particular concerning the hydrostatic tests to be conducted on plant SEC (essential service water) systems.

United States

From 8 to 11 March, the Director General of the ASN took a French delegation to participate in the annual public conference by the American Nuclear Regulatory Commission (NRC). The Regulatory Information Conference (RIC) was held in Rockville (near the NRC headquarters) and attracted 1400 American and foreign participants (24 countries represented). The programme of the 2005 conference comprised sessions dedicated to research and development concerning reactor safety, probabilistic safety studies, materials ageing and new reactor concepts.

On the occasion of the RIC conference, the Director General of the ASN took part in a meeting organised by the NRC Chairman concerning international regulations on fourth-generation reactor design. He in particular warned his counterparts of the risk of prematurely freezing the safety requirements for reactors which will still be in service at the beginning of the next century.

From 23 to 25 May 2005, the ASN organised technical meetings with its counterpart, the NRC, as well as a visit to La Hague to look at spent fuel handling systems safety, in the light of the possible creation of the Yucca Mountain repository.

The annual bilateral meeting with the NRC office in charge of reactor safety (Office of Nuclear Reactor Regulation - NRR) was held on 16 and 17 June, for discussions on recent topical subjects and the respective nuclear safety action priorities.

Finland

In 2005, relations with the Finnish nuclear safety and radiation protection authority (Säteilyturvakeskus - STUK) were once again dominated by cooperation on the EPR project, as Finland is the first country to build a reactor of this type (see chapter 12). Relations also concerned waste management, a subject which also involves cooperation with the Swedish authorities.

India

The 5th Franco-Indian nuclear safety dialogue session was held in India from 24 to 26 October 2005, under the chairmanship of the Director General of the ASN. The meetings in Bombay concluded with renewal of the administrative arrangement signed in July 2001 between the ASN and its counterpart AERB (Atomic Energy Regulatory Board). A programme of future exchanges was defined, including meetings in 2006 on the safety of fast neutron reactors and a seminar on the safety of the EPR reactor.

The French delegation was able to visit the nuclear site at Kalpakkam, near Madras, on the eastern coast of the country, which had been affected by the December 2004 tsunami.

Ireland

On 4 August 2005, the ASN signed an administrative arrangement with the Radiological Protection Institute of Ireland (RPII). This bilateral action is confirmation of the ASN's desire to intensify its international relations in the field of radiation protection and to diversify them into countries which do not actually use nuclear energy.

Japan

2005 was marked by a sustained high level of information exchanges with Japan and there is strong demand for cooperation with France. The Japanese authorities hope to cooperate with the French nuclear safety authority, and their technical support organisations with the IRSN.

This in particular concerns the safety of the fuel cycle (MOX fuel manufacturing plant and spent fuel reprocessing facilities at Rokkasho-Mura), waste management, nuclear power plants (operator certification, maintenance, installation conformity examination, periodic safety reviews of existing facilities and implementation of new safety rules) as well as radiation protection.

The ASN, and its technical support organisation, the IRSN, took part in the international technical seminar organised in Tokyo from 10 to 12 May by the Japanese Nuclear Safety Commission (NSC) concerning the applications derived from the use of probabilistic safety assessments in the regulations (Risk-Informed Regulation). The ASN on this occasion recalled that a "risk-informed" type of regulation went far beyond simply using the results of probabilistic safety assessments, which themselves require a solid data underpinning and in particular include safety culture, human and organisational factors.

The exchanges also covered inspector training and the regulations drafting process.

United Kingdom

The annual meeting by the heads of the French and British nuclear safety authorities was held in France on 20 and 21 June 2005. In addition to reviewing the main events that occurred during the year, this meeting was an opportunity for continued discussions concerning the safety problems involved in the dismantling of nuclear installations. The meeting was accompanied by a visit to the Chinon nuclear power plant, including a PWR in operation and a dismantled UNGG (natural uranium - graphite - gas) reactor.

Switzerland

The Franco-Swiss Commission met in Berne on 31 May 2005. The discussions concerned the safety of power reactors, radiation protection and waste management. For the first time, radiation protection was accorded equal status with reactor safety.

On 8 June, the Franco-Swiss Commission's Expert Group on nuclear emergency management met in Paris. This Group exchanges information on the emergency response organisation in the two countries and helps harmonise practices, in particular through joint participation in emergency exercises.

5 INTERNATIONAL CONFERENCES

ASN participation in international conferences offered opportunities for the exchange of extremely useful information concerning regulatory practices and the problems encountered in the field of nuclear safety, radioactive material transport, radioactive source safety, waste management and disposal and radiation protection.

Among these events, those organised by the ASN were as follows:
- the second European seminar (like the first one in Paris on 5 November 2004), organised on 20 May 2005 by the ASN and the Belgian Federal Agency for Nuclear Control (FANC) on the safety approach to waste disposal (see chapter 16), the aim of which is to initiate collaboration with a view to establishing "reference levels" for geological disposal of radioactive waste. The objective is to finalise these reference levels by 2010, after a "pilot study" designed to validate the feasibility of the project and define a working method;
- the NuPEER (Nuclear Pressure Equipment Expertise and Regulation) symposium, organised by the ASN in Dijon from 22 to 24 June 2005 and devoted to pressure vessel ageing in nuclear power plants. This symposium attracted nearly 120 participants from the nuclear safety authorities and expert bodies in 13 countries which possess nuclear power plants: Belgium, Czech Republic, Finland, France, Germany, Japan, Norway, Spain, Slovenia, Sweden, Switzerland, United States and United Kingdom. The IAEA, the NEA and the European Commission also took part in the discussions. The Director General of the ASN concluded the symposium by announcing the creation of an international information network, which will enable discussions on the subject to be continued and taken a stage further.

The organisation and follow-up of these events reflect the importance the ASN attaches to the safety issues related to:
- ageing of the nuclear power plant fleet;
- radioactive waste management.

Main French nuclear safety authority participation in international conferences in 2005

DATE	PLACE	SUBJECT
26 – 28 January	Tokyo (Japan)	Seminar on the effectiveness of safety inspections and management, organised by the IAEA and the OECD/NEA
8 – 11 March	Rockville (United States)	Regulatory Information Conference organised by the NRC
25 – 28 April	Kansas City (United States)	Conference of national radiation protection directors, organised by the NRC
10 – 12 May	Tokyo (Japan)	Risk-Informed Regulation seminar
19 – 20 May	Lucerne (Switzerland)	Task group on operating experience, organised by the OECD/NEA
20 May	Brussels (Belgium)	Second European seminar on “Elements of the Safety Approach related to Geological Disposal of Radioactive Waste”, organised by the ASN and the FANC
18 – 22 June	Toronto (Canada)	Annual Conference of the American Society of Nuclear Medicine
22 – 24 June	Dijon (France)	NuPEER (Nuclear Pressure Equipment Expertise and Regulation) symposium devoted to pressure vessel ageing in nuclear power plants, organised by the ASN
27 juin – 1 July	Bordeaux (France)	Conference on the safety and security of radioactive sources, organised by the IAEA
5 – 9 September	Vienna (Austria)	Conference on Chernobyl (“The Chernobyl heritage: health, environmental and socio-economic consequences) organised by the IAEA
26 – 30 September	Vienna (Austria)	Annual UNSCEAR meeting
3 – 7 October	Tokyo (Japan)	Conference on the safety of radioactive waste disposal, organised by the IAEA
25 – 26 October	Stockholm (Sweden)	Workshop on Human Resources Management in Safety and Regulation, organised by the OECD/NEA
30 November – 2 December	Vienne (Austria)	Conference on the operational safety of nuclear installations, organised by the IAEA

6 OUTLOOK

International relations are important activities for the ASN and are an efficient way of taking nuclear safety and radiation protection forward both in France and abroad.

They enable the ASN and its counterparts to become more familiar with and gain a clearer understanding of their reciprocal operation and the problems that beset them. They also enable assistance to be given to countries that wish to develop or improve their nuclear safety and radiation protection authorities.

They are also the driving force behind the necessary harmonisation of safety and radiation protection principles and standards.

ASN's goal in this field is to develop a common approach to nuclear safety, but without in any way compromising on the fundamental principle: nuclear safety must remain the number one priority. This is the purpose of the work by WENRA, and the public presentation of the results in February 2006 will be a key step towards harmonisation of national practices scheduled for 2010.

This is also the reason for the ASN's active participation in implementing the European Union's nuclear action plan.

WENRA and INRA are also incomparable opportunities for free and informal discussions between heads of nuclear safety authorities. The Director General of the ASN, who was the original creator of these two associations, will chair the INRA in 2006.

The ASN, whose proposals are behind the new part of the INES scale applicable to radiation protection incidents will, under the aegis of the IAEA, be organising an international meeting in March 2006 on the experience feedback from its implementation. The results could lead to more extensive application to medical, industrial or research facilities being envisaged.

The International Radiation Protection Association (IRPA) congress scheduled for Paris in May 2006 and participation in the organisation of the world nuclear medicine conference (October 2006, Seoul, South Korea) clearly reflect the importance the ASN attaches to radiation protection.

The ASN will be further reinforcing its international actions in this field through a major restructuring effort. Bilateral frameworks are few and far between and "multi-bilateral" frameworks (associations of radiation protection authority heads) still 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.

Finally, the ASN attaches prime importance to evaluation of its actions by its foreign peers. This is why:
- on the one hand it regularly asks the IAEA for OSART missions (nuclear power plant operational safety review): in 2011, all EDF plants will have undergone an OSART review;
- on the other, and this is the first time that a safety authority from a major nuclear country has done so, it requested an IRRT mission for a November 2006 assessment of its nuclear safety and radiation protection reference system and regulatory practices.

To conclude, the ASN will continue to act as one of the leading safety authorities on the international stage, making sure that it shares its work with its peers and that nuclear safety and radiation protection principles are implemented worldwide. In order to consolidate its reference status, the ASN will in particular continue its actions so that it can:
- fully assume its responsibilities in international radiation protection regulation;
- promote its organisation and practices for supervision of nuclear safety and radiation protection;
- submit to external assessment by its peers.

RADIOLOGICAL EMERGENCIES

1 RADIOLOGICAL EMERGENCIES NOT COVERED BY EMERGENCY PLANS

1|1 Response to radiological emergencies
1|1|1 Responsibility for the response
1|1|2 Response principles
1|1|3 The role of the ASN
1|1|4 Care and treatment of contaminated victims

1|2 Response interventions in 2005

2 NUCLEAR EMERGENCY SITUATIONS

2|1 General organisation
2|1|1 Local provisions
2|1|2 National provisions
2|1|3 Emergency plans

2|2 The role and organisation of the ASN
2|2|1 The ASN's emergency role
2|2|2 Provisions concerning nuclear safety
2|2|3 The ASN emergency response centre
2|2|4 Role of the ASN in the preparation of emergency plans

2|3 Accident simulation exercices
2|3|1 Exercice sessions involving the ASN
2|3|2 Lessons learned from the exercice sessions

2|4 Developments in nuclear emergency provisions
2|4|1 Stable iodine preventive distribution
2|4|2 Emergency response provisions regarding radioactive material transport accidents
2|4|3 Post-accident management

3 OUTLOOK

CHAPTER 8

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, however improbable. A "radiological emergency" is one resulting from an incident or accident likely to lead to the release of radioactive materials or to a level of radioactivity likely to harm public health, as defined in article R. 1333-76 of the Public Health Code. The term "nuclear emergency" is reserved for events which could lead to a radiological emergency in a basic nuclear installation or a transport of radioactive materials.

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 licensee 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 regularly tested and appraised emergency arrangement is regularly revised to take account of experience feedback from exercises, and the management of real situations such as those which occurred in the nuclear power plants at Civaux on 12 May 1998, le Blayais on 27 December 1999, Cruas and Tricastin on 2 and 3 December 2003 and, more recently, at Nogent-sur-Seine and le Blayais on 30 September and 28 October 2005.

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 on-site emergency plan. It is up to the authorities to ensure protection of the population when necessary. The ASN is involved in this for questions relating to radiation protection.

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 ("long-term" exposure), do nonetheless present a human health risk in the medium to long term. They are mentioned in Chapter 15.

In the light of the experience acquired in recent years through regular emergency exercises and through application of France's international commitments, the texts concerning the organisation of the various parties involved in managing radiological emergencies were updated in 2005. The ASN was closely involved in preparing four interministerial directives adopted during the course of the last year:

- interministerial directive of 7 April 2005 concerning the action of the public authorities in response to an event leading to a radiological emergency;

- interministerial directive of 30 May 2005 concerning application of the International Convention on Early Notification of a Nuclear Accident (signed by France on 26 September 1986) and the 14 December 1987 decision by the Council of European Communities concerning community procedures for a rapid exchange of information in the event of a radiological emergency;

- interministerial directive of 29 November 2005 concerning the collection and processing of environmental radioactivity measurements in response to an event leading to a radiological emergency;

- interministerial directive of 30 November 2005 concerning application of the International Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency (signed by France on 26 September 1986).

1 RADIOLOGICAL EMERGENCIES NOT COVERED BY THE EMERGENCY PLANS

1 | 1

Response to radiological emergencies

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 where they are not supposed to be.

It is then necessary to respond, to put an end to any risk of human exposure to ionising radiation.

Owing to the diversity of the situations and locations in which these events can occur, it would be unfeasible to create a specific emergency plan for each one. This is why, in order to deal with these situations and in addition to the nuclear emergency management system described in point 2, the ASN together with the ministers and stakeholders concerned, drafted interministerial circular 2005/1390 of 23 December 2005. This circular defines how the State's services are organised in the case of an event leading to a radiological emergency other than those situations covered by an existing emergency plan. It also comprises a specimen local agreement for the technical support that EDF or AREVA could provide to the public authorities in the event of a radiological or nuclear (non-BNI) situation.

1 | 1 | 1

Responsibility for the response

In these situations, responsibility for the decision and for implementing protective measures lies with:

- the head of the establishment performing a nuclear activity (hospital, research laboratory, etc.) who implements an on-site emergency plan as stipulated in article L. 1333-6 of the Public Health Code (if the potential risks from the installation so warrant) or with the site owner concerning human safety on the site;
- the mayor or prefect concerning human safety in areas accessible to the public.

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 Mayor or with the Prefect of the *département*[1].

1 | 1 | 2

Response principles

Faced with the number of possible sources of alerts and the corresponding alert circuits, there has to be a "one-stop shop" where all alerts arrive and where they are then passed on to the other parties concerned. This one-stop shop is the fire brigade's central emergency call alert processing unit which can be reached by dialling 15, 17, 18 or 112.

1. Administrative division of the size of a county.

Once the authorities have been alerted, the response generally consists of four main phases: care for the persons involved, confirmation of the radiological nature of the event, securing the zone and reducing the emission and, finally, clean-up.

The prime objective of the authorities must be to care for the persons involved. Both physical and psychological care must be provided for those involved, treatment must be given to the injured and, if the radiological nature of the event is confirmed, to any persons likely to have been contaminated or exposed to the emission sources.

Confirmation of the radiological nature of the event involves verification and validation of any information concerning the possible existence of a radiological risk and assessment of the need for any specific response resources. This assessment is based on the intervention by specialised teams (licensee, CMIR, IRSN, CEA, etc.).

The purpose of securing the zone and reducing emissions is human and environmental protection. During this phase, the following types of measures are taken: marking out a safety perimeter, confinement of the emission sources, biological protection, and so on. All these measures are designed to bring the situation back under control.

Clean-up is part of the post-emergency phase. The aim is to restore an acceptable situation, in particular by cleaning up the site and removing any emission sources to installations authorised to receive them.

The Mayor or the Prefect coordinates the response teams, on the basis of their technical competence, and decides on the protection measures.

1 | 1 | 3

The role of the ASN

In these situations, in the same way as for accidents occurring in nuclear installations, the ASN is responsible - with the support of the IRSN - for supervising the actions of the head of the establishment or site owner, for advising the relevant police authority with respect to the steps to be taken to prevent or mitigate the direct or indirect effects of ionising radiation on human health, including through damage to the environment, and to take part in dissemination of information.

The ASN opened a telephone hot-line in 2003 (toll-free radiological emergency number 0 800 804 135). The purpose of this hot-line is to receive calls from the one-stop shop (see point 1|1|2) notifying incidents involving non-BNI sources of ionising radiation and is open round the clock, 7 days a week. The information given during the call is transmitted to an ASN supervisor who will act accordingly. Depending on the seriousness of the accident, the ASN can activate its emergency response centre in Paris.

1 | 1 | 4

Care and treatment of contaminated victims

The terrorist attacks of 11 September 2001 in New York and the explosion of the AZF plant in Toulouse on 21 September 2001 led the authorities to envisage disaster scenarios which could occur anywhere in the country, with large numbers of injured (from several hundred to several thousand). In the case of a nuclear or radiological accident, a significant percentage of these injured could be contaminated by radionuclides, posing specific care and treatment problems for the emergency response teams.

Circular 800 of 23 April 2003 specifies the national policy concerning the use of emergency and care resources in the event of a terrorist act involving radioactive materials. The methodology described in this interministerial document does not aim to replace the generic procedures contained in the plans currently in force, in particular the government's PIRATOME plan, but more to guide the services and organisations in charge of planning and managing emergency situations.

Together with the Hospitalisation and Health Care Directorate (DHOS) of the Ministry for Health, the services of the Defence High Official (HFD) of the Ministry for Health, the specialists of the Paris SAMU (emergency medical service), the armed forces radiological protection service (SPRA), the IRSN, CEA, EDF and universities, the ASN drew up a series of primary response sheets called the "Medical response to a nuclear or radiological event". This document contains all useful information needed by front-line medical personnel responsible for collecting and transporting the injured, as well as by hospital personnel who will be receiving them in the nearby hospital facilities. This guide acts as a teaching aid for the medical emergency professionals national training programme set up by the Ministry for Health and the French SAMU emergency medical service.

The "Medical response to a nuclear or radiological event" file comes in addition to circular 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 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 2005, jointly with the Hospitalisation and Health Care Directorate (DHOS) and the General Directorate for Health (DGS) at the Ministry for Health, the ASN took part in the visits organised by the Defence High Official (HFD) to the various defence areas, in order to identify any difficulties and the procedures for implementing these arrangements.

Management of contaminated victims during an exercise in Brazil on 6 October 2005

1 | 2

Response interventions in 2005

In 2005, the ASN was contacted via its radiological emergency hot-line, through its on-call staff or directly by those in charge of the dossiers, with regard to events such as triggering of detection portals (customs posts, technical landfills), discovery of unidentified sources during an inventory (hospital, high school), or even theft of sources. Even if they entail no health risk, these events warrant verification and radioactivity measurements.

In December 2005, in its capacity as competent national authority under the terms of the 30 November directive mentioned above, the ASN was contacted with regard to the gammagraphy accident that occurred in Chile (see box).

Gammagraphy accident in Chile

On 15 December 2005 in Chile, three workers accidentally came into contact with a high-level iridium 192 source that had been lost the previous day following a gammagraphy operation on the site on which they were working. One seriously irradiated worker was sent to France to receive the necessary care.

A team of international experts appointed by the IAEA, including a specialist physician from the IRSN, went to visit the site on 19 December. Given the worrying state of health of one of the three workers, the team recommended that he be transferred to a specialist unit.

Through the intermediary of the IAEA, Chile requested French help, which was approved and on 29 December the injured worker was admitted to the Percy armed forces teaching hospital in Clamart, where he was looked after by a specialised medical team.

As the competent national authority under the terms of the International Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency, the ASN will continue to ensure that this care is given in satisfactory conditions.

2 NUCLEAR EMERGENCY SITUATIONS

The Chernobyl accident on 26 April 1986, showed that a nuclear accident was possible, and that it was necessary to make adequate preparation for and be able to respond to it. The psychological, social and economic consequences of possible population displacement or a more general restriction on the consumption or sale of foodstuffs must be taken into account by the authorities. Furthermore, more realistic assessments of the potential releases are needed.

Since this accident, France has continued to perfect its nuclear emergency management system, reinforcing its response measures and its regulatory framework for preventing and mitigating the consequences of a nuclear accident:

• With respect to the licensees:
- developing the notion of “Safety Culture”, and attaching greater importance to human factors;
- taking account of experience feedback from significant events in order to improve the organisation, working methods and installations (see chapter 4 point 1|3|3);
- setting up on-site emergency response organisations: on-site emergency plans (PUI) required by a decree of 1990;
- more complete and realistic assessments of the radiological consequences of accidents (reassessment by the IRSN).

• With respect to the authorities:
- limitation of the radiological consequences for the population in the event of a major release: the off-site emergency plans (PPI) were set up by a decree of 1988 and then improved in 2000 to include a reflex phase. Decree 2005-1158 of 13 September 2005 concerning the off-site emergency plans specifies exercise frequency, PPI updating and public consultation;
- definition of response levels (sheltering, evacuation, absorption of stable iodine): initial recommendations in 1993 and levels finally determined in 2003;
- organisation of the authorities: directives mentioned at the beginning of the chapter (action by the authorities in response to an event leading to a radiological emergency (public information, alert management, national emergency response organisation, both locally and centrally), organisation of radioactivity measurements);
- public information and communication actions;
- definition of a severity scale for classifying nuclear safety events on the basis of factual criteria which led to the INES scale, implemented in France in 1994 and extended in 2004 to take in radiation protection (see chapter 6);
- orders of 30 November 2001 concerning creation of an emergency alert system around a BNI with a PPI and of 4 November 2005 concerning information of the population in the event of a radiological emergency.

All these measures were taken in a context of exchanges with the international community, particularly within international organisations (IAEA, NEA). The International Convention on Early Notification of a Nuclear Accident (1986), the International Convention on Assistance in the Case of a Nuclear Accident (1986) and European regulations on the importation or contamination of foodstuffs (1987) are noteworthy examples.

If it is to be considered fully operational, the entire response system must be regularly tested. This is the purpose of the nuclear emergency exercises. These exercises, which are the subject of an annual circular, involve the licensee, the local and national authorities - particularly the prefectures - the ASN and the IRSN. They are a means of testing the emergency plans, the response organisation and procedures and help with training the participating staff. The main aims of the exercises are defined at the beginning of the exercise. They are primarily to ensure a correct assessment of the situation, to bring the installation on which the accident occurred to a safe state, to take appropriate measures to protect the population and to ensure satisfactory communication with the media and the populations concerned. At the same time, the exercises are a means of testing the arrangements for alerting the national and international organisations.

Efforts are today continuing into improving post-accident situation management. France takes part in the working groups of the OECD's Nuclear Energy Agency (NEA) concerning post-accident management and organises INEX international exercises, analysis of which should lead to a draft policy within the next two years.

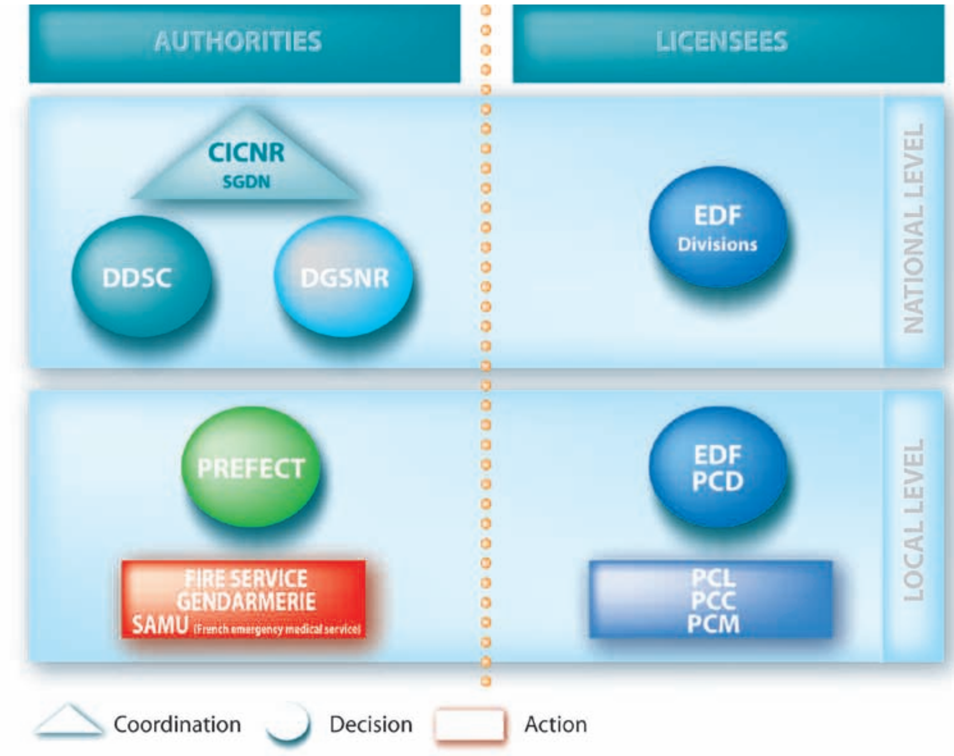
2 | 1

General organisation

The response by the authorities to an incident or accident is determined by a number of legal texts concerning nuclear safety, radiation protection, public order and civil defence, as well as by the emergency plans.

Law 2004-811 of 13 August 2004 modernising civil defence sets new guidelines. It in particular provides for an up to date inventory of the risks, an overhaul of operational planning, the performance of exercises involving the population, information and training of the population, an operational watch and the alert. In 2005, a number of decrees implementing this law were adopted, in particular:
- decree 2005-1156 of 13 September 2005 concerning the local safeguard plan;
- decree 2005-1157 of 13 September 2005 concerning the ORSEC plan (general plan organising the emergency services if a disaster is declared by the State at departmental, defence zone, or maritime prefecture level);
- decree 2005-1158 of 13 September 2005 concerning PPIs.

Standard emergency management arrangement for a nuclear reactor operated by EDF



- CICNR: Interministerial committee on nuclear or radiological emergencies
- SGDN : General secretariat for national defence
- DDSC : Directorate for defence and civil security
- PCD : Management command post
- PCL : Local command post
- PCC : Supervision command post
- PCM : Resources command post

The main purpose of these regulations is to organise the emergency services at Mayor and Prefect level.

The scope of a nuclear emergency and more generally of any radiological emergency, is clarified in the interministerial directives described at the beginning of this chapter. The response organisation of the authorities and of the licensee is presented in the above arrangement. This is specifically designed to deal with an accident in an EDF reactor. A similar organisation is put in place when dealing with another nuclear licensee or in the event of an accident involving a radioactive material transport. In this latter case, the emergency plan is referred to as the Specialised Emergency Plan for the Transport of Radioactive Materials (PSS-TMR).

2 | 1 | 1

Local provisions

In a emergency situation, only two parties are authorised to take the operational decisions:
- the licensee 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. This arrangement is defined beforehand in the licensee's mandatory PUI;
- the Prefect of the *département* 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. His actions will be regulated by the PPI specially prepared for the vicinity of the installation concerned. 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 appropriate decisions, notably by providing, as does the licensee, all information and recommendations which could assist him in his appraisal of the condition of the installation, the seriousness 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, which has at its disposal the Operational Centre for Interministerial Emergency Provisions and the Nuclear Risk Management Aid Mission, which place at the disposal of the Prefect the human reinforcements and equipment resources he requires to safeguard people and property;
- Ministry for Health: the ASN, which is responsible for the human health protection against the effects of ionising radiation;
- Ministry of Industry and Ministry for the Environment: the ASN for supervision of the safety of nuclear installations with the technical support of the IRSN. The Minister for Industry also coordinates national communications in the event of an incident or accident affecting a nuclear installation under his supervision, or occurring during a radioactive materials transport. As the competent authority, the ASN collects and summarises the information necessary for the notifications, information and assistance requests provided for in the international conventions dealing with notification of third parties in the event of a radiological emergency;
- Ministry of Defence and Ministry of Industry: the Defence Nuclear Safety and Radiation Protection Delegate is the competent authority for supervising the safety of secret basic nuclear installations, military nuclear systems and defence-related transports. A protocol between the Director General of the ASN and the DSND was signed on 26 January 2005 to ensure coordination between these two entities if an accident were to affect an activity supervised by the DSND, in order to facilitate transition from the emergency phase managed by the DSND to the post-accident phase for which the ASN is competent;
- General Secretariat for National Defence (SGDN): the SGDN handles the secretarial functions for the Interministerial Committee for Nuclear and Radiological Emergencies (CICNR). It is responsible for coordinating the action of the ministries concerned regarding the planned measures in the event of an accident and for ensuring that exercises are scheduled and then assessed.

The CICNR is a committee convened at the initiative of the Prime Minister. Its role is to coordinate governmental action in the event of a radiological or nuclear emergency situation.

2 | 1 | 3

Emergency plans

a) 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 on-site emergency plan (PUI), prepared by the licensee, 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 off-siteemergency plan (PPI or PSS-TMR), drafted by the Prefect, are aimed at protecting populations in the short term in the event of potential danger and providing the licensee 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.

b) technical bases and countermeasures

The emergency plans must allow an effective response 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. This task is made all the more difficult by the fact that real significant accidents are fortunately extremely rare and the approach is therefore mainly based on a conservative theoretical scenario involving estimation of the source terms (in other words the quantities of radioactive material released), with calculation of their dispersal into the environment and a final assessment of the radiological impact.

On the basis of the response levels defined in the 13 October 2003 order, it is then possible to define in the PPIs the population protection measures that appear to be justified in order to limit the direct impact of the release. Such measures could include:

- sheltering and monitoring the situation from indoors, firstly to protect the inhabitants from direct irradiation and from contamination from the radioactive plume, and secondly to keep them informed;
- absorption of stable iodine in addition to sheltering in cases where the release comprises radioactive iodine (notably iodine 131);
- preventive evacuation, when the above measures offer inadequate protection owing to the levels of activity released.

For example, the maximum conceivable accident on a pressurised water reactor could lead to the decision being taken within 12 to 24 hours to evacuate the population living within a 5 kilometre radius, and order sheltering of the population with absorption of stable iodine within a 10 kilometre radius.

2 | 2

The role and organisation of the ASN

2 | 2 | 1

The ASN's emergency role

In an emergency situation, the ASN, with IRSN assistance and the co-operation of the Regional Directorate for Industry, Research and the Environment (DRIRE) concerned, has a four-fold function:

1) ensure that judicious provisions are made by the licensee;

2) advise the Prefect;

3) contribute to the circulation of information;

4) act as competent authority within the framework of the international conventions.

a) supervision of licensee actions

In the same way as in normal operating conditions, licensee actions are supervised by the ASN in an emergency situation. In this particular context, the ASN must ensure that the licensee fully carries out its duty to control the accident, minimise the consequences and rapidly and regularly inform the authorities, but it will not attempt to replace the licensee in implementing the technical measures to deal with the accident. In particular, when several action strategies are available to the licensee to control the accident, some may have significant environmental consequences. It is therefore important for the ASN to monitor the conditions in which the corresponding choice is made by the licensee.

b) advising the prefect

The decision by the Prefect concerning the population protection measures to be taken depends on the actual or possible consequences of the accident around the site and it is the ASN 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.

c) circulation of information

The ASN is involved in information circulation in a number of ways:
– information of the media and the general public: the ASN contributes to informing both the media and the general public in different ways (press releases, website, press conference). It is important that this should be done in close collaboration with the other organisations who are themselves involved in communication (Prefect, local and national licensee, etc.);
– information of the authorities: the ASN keeps the supervisory Ministers informed, together with the SGDN (General Secretariat for National Defence), which in turn informs the President of the Republic and the Prime Minister. The ASN also ensures that the DGEMP (General Directorate for Energy and Raw Materials) at the Ministry for Industry is kept informed;
– 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 have radiological consequences, the ASN informs foreign safety authorities, especially those with which it has mutual safety information agreements (Belgium, Switzerland, United Kingdom, etc.).

d) function of competent authority as defined by international conventions

Since the publication of decree 2003-865 of 8 September 2003, the ASN has been the competent authority under the terms of the above-mentioned international conventions. In this capacity, it collects and summarises the information needed for the notifications, information and requests provided for in these conventions. This information is forwarded to the international organisations (IAEA and European Union).

In 2005, France in particular took part in the international exercises organised by the European Community and the IAEA (Convex 3 and Ecurie 3). These exercises in particular test the alert, information transmission and exchange procedures between the national alert contact point (Ministry of foreign affairs), the national competent authority (ASN) and the emergency centres of the European Community and the IAEA.

2 | 2 | 2

Provisions concerning nuclear safety

Main components

In the event of an incident or accident occurring in a BNI, the ASN, with the technical support of the IRSN and the Nuclear Safety and Radiation Protection Divisions (DSNRs) of the DRIREs, sets up the following organisation:

– at national level:
• a decision-making body or command centre (called PCD), located in the ASN's emergency management centre in Paris. This body is managed by the Director General of the ASN or his representative. It is required to adopt positions or make decisions but to refrain from technical analysis of the ongoing accident. A spokesperson, who is not the PCD head, is appointed to represent the ASN with the media;

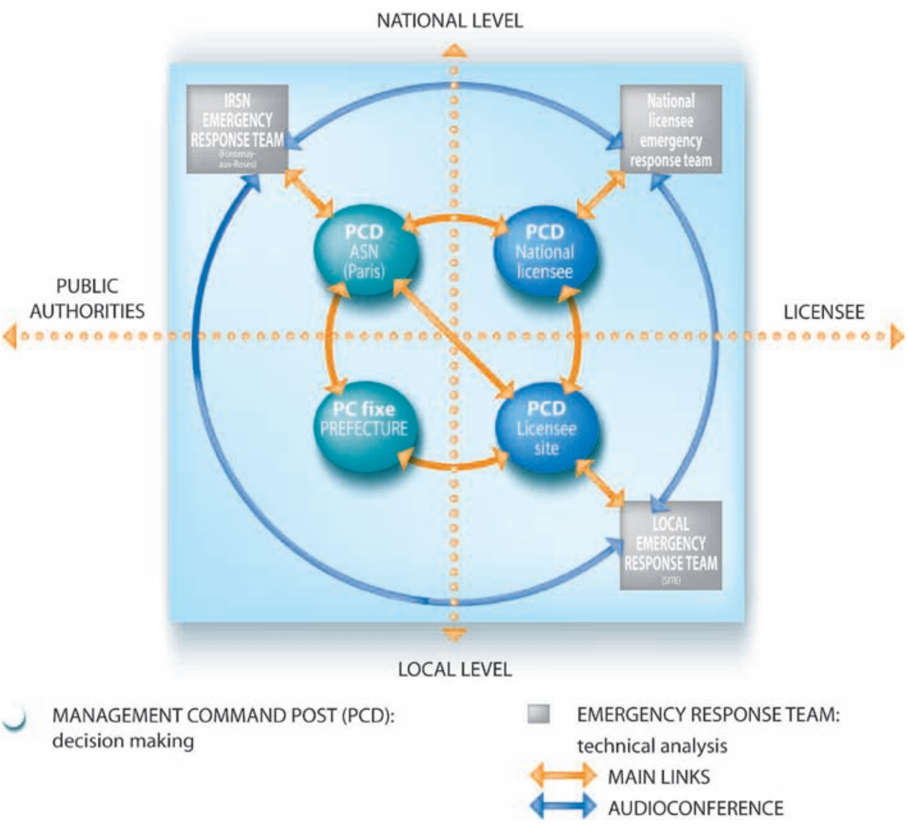
• an information unit located near the ASN PCD, coordinated by an ASN representative with the help of staff from the Communication department (SIRCOM) of the Ministry of the Economy, Finance and Industry;
• an emergency response analysis team, led by the IRSN Director General or his representative. This team is resident at the IRSN technical emergency centre, located in the nuclear research centre at Fontenay-aux-Roses. This team is required to work closely with the licensee's technical teams to exchange the available information for analysing the accident situation and predicting its development and consequences;

– at local level:
• a local team at the prefecture, consisting mainly of representatives from the ASN's regional offices, 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 ASN PCD;
• a local team at the affected plant site, also consisting of DSNR engineers, assisting the site PCD head. It takes no part in licensee decisions, but ensures that responsibilities are correctly assumed, notably as regards information of the authorities. This team also collects relevant data for use in the context of the ensuing post-accident inquiry.

The ASN, its technical support organisation the IRSN, and the main nuclear licensees 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.

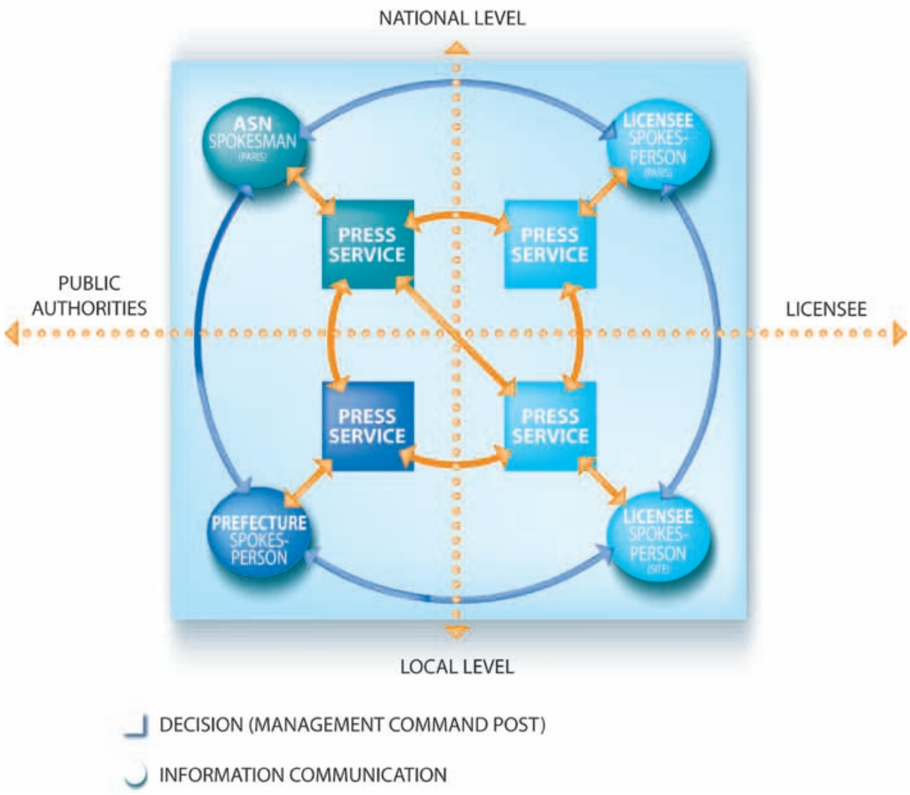
The diagram below presents the overall safety structures set up, in collaboration with the Prefect and the licensee. It shows that the licensee has a local PCD on the site and usually a national PCD in Paris, each connected with its own emergency response team. The various connections shown on the diagram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

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.

Communication organisation



2 | 2 | 3

The ASN emergency response centre

In order to be able to carry out these assignments, the ASN 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 activated in a real situation for the first time on 12 May 1998 when an incident occurred in the Civaux plant, and on 28 and 29 December 1999 to deal with the incident in the Le Blayais nuclear power plant, following the severe storm of 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 on-sitePUI and alert the ASN. During the course of these two days, the Tricastin plant and its operational hot unit (BCOT)

The ASN emergency centre during an emergency exercice

also triggered their PUI. The emergency response centre was also used on 16 May 2004 when a fire broke out in a non-nuclear zone in the Cattenom plant.

In 2005, the emergency response centre was activated on 30 September, when an incident occurred on one of the reactors in the Nogent-sur-Seine plant after water was sprayed onto the reactor's electrical control cubicles. In the night of 27 October 2005, it was again called into service after a pressure rise in the core cooling system of a reactor in the Le Blayais nuclear power plant.

As demonstrated by these events, the ASN alert system allows rapid mobilisation of the ASN staff and the IRSN engineer on-call. This automatic system sends out an alert signal to all staff carrying radio-pagers or mobile phones, as soon as the alert is triggered remotely by the licensee of the nuclear installation in which the alert originated. It also sends out the alert to the staff of the DDSC, the SGDN and Météo-France. This system is regularly tested during about ten exercises a year, as well as when actual emergencies occur.

In addition to the public telephone network, the emergency response centre is connected to several restricted access networks providing secure direct or dedicated lines to the main nuclear sites. The ASN PCD also has a video-conferencing system which is the preferred means of contact with the IRSN's CTC. The PCD also makes use of IT equipment adapted to its assignments, in particular for information exchanges with the European Commission and the Member States.

Since 2005, the PCD has had access to the dose rate values permanently measured by the IRSN's Téléray network of probes.

2 | 2 | 4

Role of the ASN in the preparation of emergency plans

a) on-site 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 PUI is among the safety documents which have to be submitted to the ASN by the licensee 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 ASN monitors correct application of the on-site emergency plans, in particular through inspections (see chapter 4).

b) participation in off-site plan preparation

Under application of the 13 September 2005 orders concerning the PPI and the ORSEC plan, the prefect is responsible for preparing and approving the PPI. He is assisted by the ASN, which supplies the basic technical elements, as derived from the IRSN assessment, taking account of the most recent available data on serious accidents and dispersion of radioactive or chemical materials and ensuring consistency in this respect between the PPI and the PUI.

Considerable work has been done in recent years to take account of accidents which could cause a radioactive release leading to a response level being exceeded off the site within less than 6 hours. A response reflex phase, containing special provisions enabling the prefect to initiate a response, has been introduced into the PPIs. The licensee is provided with objective criteria approved by the ASN and comprising predetermined and easily accessible parameters. Definition of the response levels is based on the most recent international recommendations and, since 2003, has been stipulated in regulatory requirements (see point 2|1|3).

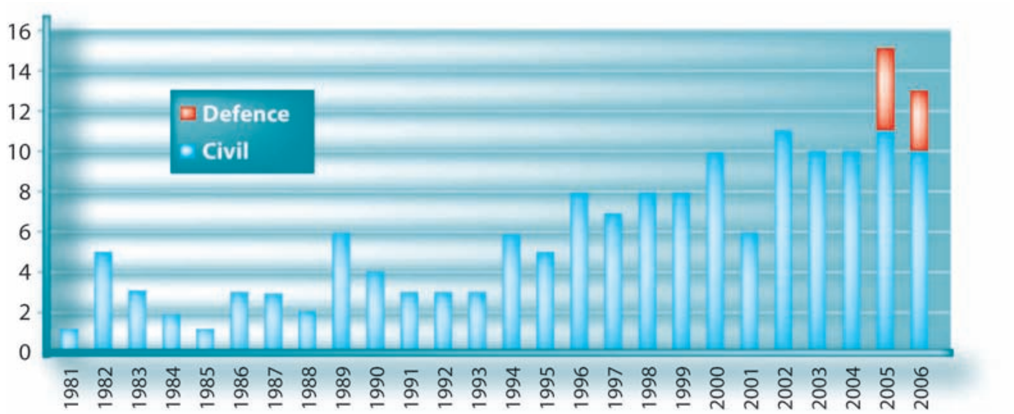
As part of this PPI overhaul, the ASN approved the rapidly evolving accident scenarios defined by the licensees.

2 | 3

Accident simulation exercices

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. In practice, carrying out an emergency exercise every three years on each site with a BNI would seem to be a fair compromise between staff training and the time needed to make changes to the response organisation. Since the 1980s therefore, the number of exercises has risen significantly and in 2005, reached a level of about ten a year for civil installations, as shown on the following graph:

Number of emergency exercices (1981-2006)



Review meetings are organised in each emergency command post immediately after each exercise. Along with the other participants in the emergency exercise, the ASN aims to identify the good and bad practices highlighted during the experience feedback meetings in order to improve the response organisation as a whole.

One major benefit of the emergency exercises has been to improve procedures and policies. For example, to avoid exposure of the personnel in charge of distributing iodine tablets during the release phase, the authorities decided on preventive distribution of iodine tablets within a 10 km radius around nuclear power plants. Furthermore, to take account of rapidly evolving accidents in which the authorities do not have time to react, the decision was taken to incorporate a reflex phase in the PPIs asking the populations to take shelter by alerting them through a network of sirens, which can be activated by the nuclear licensee on behalf of the prefect.

2 | 3 | 1

Exercice sessions involving the ASN

a) nuclear alert tests and mobilisation exercices

The ASN periodically conducts checks to ensure that the resources in its emergency response centre and its staff alert system network are working correctly. The system is also used for the exercises described below and undergoes unannounced tests.

b) national nuclear accident simulation exercices

As in previous years, the ASN prepared a programme of national nuclear emergency exercises for 2005, announced by the prefects in a circular signed jointly by the Director General of the ASN, the DSND, the DDSC and the SGDN. This circular of 10 January 2005 in particular describes two different types of exercises:
- 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 scenario based on the population participation conditions adopted.

During most of these exercises, simulated media pressure is placed on the main parties concerned, in order to test their ability to communicate. The following table describes the key characteristics of the national exercises conducted in 2005.

In addition to the national exercises, the prefects are asked to conduct local exercises with the sites under their jurisdiction, in order to improve preparations for an emergency situation.

The national emergency exercise carried out on 22 March 2005 around the Belleville-sur-Loire site was of a civil defence type targeting post-accident conditions. Civil defence actions were planned, including the creation of decontamination chains involving several dozen volunteers and a medical/psychological emergency unit. This exercise enabled the following to be tested:
- deployment and integration of the measurements taken by Hélinuc (helicopter-borne radioactivity measurement system);
- draft sheets to popularise technical information concerning radioactivity;
- restrictions on the consumption of fresh produce.

National nuclear emergency exercices carried out in accordance with the circular of 10 January 2005

NUCLEAR SITE	DATE OF EXERCICE	EXERCICE TARGET	PARTICULAR CHARACTERISTICS
Nogent-sur-Seine (EDF)	3 February 2005	Nuclear safety	
Golfech (EDF)	3 March 2005	Civil defence	Management of numerous injuries on the nuclear power plant site
Belleville (EDF)	22 March 2005	Civil defence	Long exercise. Practice in the post-accident phase
Fessenheim (EDF)	19 May 2005	Civil defence	International relations with the CENAL (Swiss national alarm centre)
Institut Laue Langevin	14 June 2005	Civil defence	
Penly (EDF)	23 June 2005	Nuclear safety	Participation by the maritime prefecture
Radioactive materials transport (Val d'Oise)	22 September 2005	Civil defence	
Saint Laurent des Eaux (EDF)	11 October 2005	Civil defence	Prior triggering of the flood (PSS) (specialized emergency plan)
La Hague	20 October 2005	Civil defence	Interfacing with the maritime prefecture, ensuring sheltering by a school
Tricastin (EDF)	24 November 2005	Civil defence	PSS implementation

c) international exercice sessions and cooperation

The ASN maintains international relations to exchange good practices observed during exercises carried out abroad. In 2005, the ASN therefore:

- took part in an emergency exercise in Brazil (see box);
- jointly with the NEA, ran the INEX exercise dealing with post-accident situations;
- went to Bratislava in Slovakia, to take part in an international workshop.

The ASN also welcomed foreign delegations (United Kingdom, South Africa) as observers for the national exercises organised in France.

A French delegation went to Brazil between 4 and 7 October 2005, on the one hand to observe a nuclear emergency exercise and on the other to discuss radiation protection practices. Brazil has 2 power reactors at Angra dos Reis, a coastal site 150 km south of Rio de Janeiro. The emergency exercise was "large scale" and mobilised more than 600 people. The following points were particularly noteworthy:
- significant participation by the armed forces (navy, army, air force) in policing, transportation of decontamination specialists, provision of long-term structures for population care and management duties;
- alerting and distribution of messages and instructions to the population via a network of sirens and loudspeakers installed throughout the area concerned;
- in the vicinity of the power plant, construction of a robust hospital for decontamination and treatment of contamination injuries, training of doctors in dealing with persons who have been injured or contaminated with radioactivity;
- extensive media pressure.

The ASN took part in an international workshop organised by the NEA in Bratislava in Slovakia, from 18 to 20 May 2005. This workshop focused in particular on compensation for nuclear-related damage. It was supervised by the OECD's Nuclear Energy Agency (NEA) and brought together 114 participants from 27 countries. The exercise concentrated on application of the Vienna Convention on civil liability for nuclear damage and the Joint Protocol relative to application of the Vienna Convention and the Paris Convention. This workshop was an opportunity to compare responses from various countries and identify the discrepancies and shortcomings that exist in implementation of the nuclear accident compensation mechanisms. Finally, the problems linked to the coexistence of several international compensation regimes were highlighted.

The ASN took part in the IAEA's work to implement an action plan by the competent authorities to improve international exchanges of information in the event of a radiological emergency. For this action plan, the ASN is helping to define the international strategy, requirements and assistance resources and to set up the emergency assistance response network (ERNET). The ASN is also working with the NEA to define a strategy for carrying out international exercises.

This work in particular led to the above-mentioned interministerial directive of 30 May 2005. Work is also in progress with respect to international assistance in the event of an accident or radiological emergency, which in particular includes creation of a data bank listing the technical and human resources available and defining a protocol for the exchange of information with foreign safety authorities.

2 | 3 | 2

Lessons learned from the exercice sessions

The emergency exercise scenarios generally involve a simulated release of radioactivity outside the installation in which the accident occurs. This enables the entire national emergency response organisation, particularly the local emergency response services, to practice dealing with the risks and consequences of radioactive contamination of the population, their homes, the food chain and the environment. The first protective steps taken are generally based on highly conservative estimates and calculations. However, in the longer term, radioactivity measurements from around the installation are vital in being able to define the authorities' response to the events.

Experience feedback from the exercises shows that the measurement results were reaching the experts and decision-makers too late. In the light of these findings, the national stakeholders worked to improve the response organisation and procedures. This led to drafting of the above-mentioned interministerial directive of 29 November 2005.

This directive now needs to be implemented in the emergency plans, if local measurement programmes are to be tailored to the individual installations. There are plans to have these arrangements tested during emergency exercises in 2006. An initial assessment will then be conducted following this first year of testing.

"TMR" exercice of 22 September 2005
Val d'Oise *Département*

A national "radioactive materials transport" (TMR) exercise was held on 22 September 2005. It was headed by the Val d'Oise prefect's office and coordinated by the ASN, in close collaboration with the Ministry of the Interior (DDSC). This exercise involved a COGEMA LOGISTICS road convoy from the Paluel nuclear power plant.

All of the State regional offices concerned and the mayors of the communes of Chauvry and Bethemont-La-Forêt were mobilised to manage the technical and communication aspects of the event.

Some photos taken on an accident exercise site

This exercise demonstrated the importance of the following points:
- rapid transmission of radioactivity measurements to the decision-making centres;
- training of those involved in the emergency, in particular the field response crews;
- mutual familiarity of all those involved, and cooperation between services.

Every three years, each nuclear installation is required to take part in a national emergency exercise, involving the entire national emergency response organisation. The various prefectures involved in these exercises have been seen to be constantly progressing. To ensure that this constant improvement continues, the exercise scenarios are made increasingly complex and include increasing numbers of parameters and players. The exercises are also a means of improving existing procedures:

- the Channel and North Sea region maritime prefecture took part in the exercises at Penly and La Hague in 2005. These exercises tested and improved joint interaction with the land-based prefectures;
- the scenarios increasingly frequently include a health component, involving treatment of the injured (sometimes contaminated), who have to be given care and be evacuated in a potentially or actually hazardous environment;
- the various emergency command post procedures now include joint audio-conferences which can, when necessary, improve the understanding of sometimes complex situations.

Experience feedback from these emergency exercises also brings to light those actions or procedures which need to be improved. All the stakeholders take these points on board and actively look for solutions. In this respect, the ASN calls all participants together twice a year to review good procedures, but also to define where improvements could be made.

Finally, on 30 September and 27 October 2005, two incidents which occurred in the nuclear power plants at Nogent-sur-Seine and Le Blayais triggered a national emergency response. The ASN's emergency response centre was activated in less than 30 minutes and the oft-practiced procedures were put into motion calmly and unhurriedly. The incidents did not entail any measures to protect the populations and no radioactivity was released into the environment.

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 experience in France are the exercises and exchanges with other countries, as well as any significant events in France (see point 2|2|3) or abroad (Tokai-Mura accident on 30 September 1999).

On 14 December 2005, the ASN held the seventeenth national conference of local information committees (CLIs), jointly with the national CLI association (ANCLI). This conference was devoted to local emergency management and involved discussion of the potential role of the CLIs, particularly in the post-accident phase.

An effective means of protection against radioactive contamination of the thyroid gland

2 | 4 | 1

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 exercise 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 1997, preventive distribution of stable iodine tablets to the populations living in the vicinity of the nuclear power plants was carried out.

The tablets distributed had a shelf-life of 3 years. A further preventive distribution of stable iodine tables therefore took place in 2000. Since then, the shelf-life of the tablets has been raised to 5 and then 7 years. In 2005, the third preventive distribution of iodine tablets took place (see box). It

Results of the iodine pre-distribution campaign in 2005

The purpose of the campaign was to achieve a high level of coverage and enable anyone moving into the PPI zone during the 5-year tablet validity period to be able to find a local distribution point easily.

The chosen method was to initiate a first phase on 4 March 2005, with distribution of boxes of tablets around 4 pilot sites (Nogent, Belleville, Fessenheim, Golfech). This was based on a system of personal, nominative letters sent out on official headed notepaper, signed by the DDSC, the ASN and the French Order of Pharmacists. A nominative exchange voucher was enclosed with the letter, for presentation at one of the pharmacies listed on the back of the letter. A total of 45,243 letters were sent and a specific support programme was organised locally (information of pharmacists, communication with local stakeholders and local population).

The results of this initial phase are detailed in the following table and show:
- that the average distribution rate for the 4 sites is better than 60%,
- that distribution was to a very large extent via the nominative exchange vouchers sent out with the letter. However, blank vouchers available from pharmacies complemented the nominative voucher system.

SITE	Belleville	Fessenheim	Golfech	Nogent	Total
Number of letters sent	18732	5778	10657	10076	45243
Percentage of vouchers returned to the licence	63.3%	73.1%	52.6%	57.9%	60.8%
including blank vouchers	4.9%	7.5%	3.9%	7%	5,6%
Number of boxes collected from pharmacies	12147	4968	6710	6515	30340

To improve the coverage in the PPI zones concerned, additional distribution took place, with direct mailing of boxes of tablets to the homes which did not come to collect theirs. In the end, 47,509 boxes were distributed around the 4 pilot sites.

This method was a way of better controlling distribution because those who actually received boxes were precisely identified. In this way, the final coverage was close to 100%. It also enabled a strong partnership to be forged with the pharmacists, providing identical, clearly identified points of contact in all areas, for the tablet 5-year validity period. To guarantee this service on a long-term basis, a stock of boxes will be available in each pharmacy in the area via the pharmaceutical distribution channel.

involved two phases. The first phase was at the beginning of the year on four sites, in order to assess the most efficient distribution method in terms of population coverage (circular of 8 February 2005 concerning preventive distribution of stable iodine tablets). On the basis of the lessons learned from this phase, a second distribution phase was applied to all remaining sites, starting in the summer (circular of 11 August 2005 concerning preventive distribution of stable iodine tablets). During the course of this campaign, the ASN sent out a folder to about 500,000 homes, presenting nuclear safety and radiation protection supervision (see chapter 6 point 1|2|5).

Furthermore, in the terrorism context of autumn 2001, the Government also asked the prefects, in a second part of the circular of 14 November 2001, to make provision for stockpiling in each *département* to meet national requirements and improve protection of children, adolescents and young adults against the effects of radioactive iodine outside the PPI perimeters. 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 ended in 2005. 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.

Finally, on the basis of the experience acquired over the past ten years and practices in neighbouring countries (Belgium, Switzerland), a working group initiated updating of the policy for use of iodine tablets and submitted its conclusions at the end of 2005.

2 | 4 | 2

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 licensee supervision assignment covers the consignor, the carrier of the packages involved and possibly the carriage commission agent.

The organisation of the ASN relies mainly on local bodies: the DRIREs and in particular the DSNRs, whether located in the region or in a neighbouring region.

Following on from the action taken in 2004, and in conjunction with the Ministry for the Interior, the ASN is monitoring the work being done to overhaul the PSS-TMR, initiated by the circular of 23 January 2004 sent out to the prefects and revising the PSS-TMR. The ASN participated in drafting the circular. This aspect is developed further in Chapter 11.

Emergency exercise involving transport of radioactive materials on 22 September 2005

As in previous years, the ASN took part in organising a "transport" exercise involving the Val d'Oise prefecture and all the authorities concerned, with the Paluel plant as consignor and COGEMA Logistics as transporter. This exercise was carried out on 22 September 2005 (see "TMR" exercise box).

2 | 4 | 3

Post-accident management

The post-accident phase concerns how to deal with the consequences of the event, which are of widely differing natures (economic, health, social) and which have to be resolved in the short, medium and indeed long term if a situation felt to be acceptable is to be restored. In application of the interministerial directive of 7 April 2005, the ASN, in association with the ministerial departments concerned, is responsible for "establishing the framework, for defining, preparing and implementing the steps necessary to deal with the post-accident situation".

In order to draft a post-accident policy, the ASN first of all focused on developing the post-accident aspect when carrying out national and international exercises (such as INEX3) and initiating a more general debate by bringing together all the stakeholders in a steering committee (CODIR-PA) in charge of the post-accident aspect. The ASN set itself a time-frame of 2 years for reaching agreement on a post-accident phase policy.

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 how the various post-accident phase problems should be dealt with. Other exercises were carried out to identify the main topics involved:

- the exercise of 22 March 2005 concerned the Belleville-sur-Loire nuclear power plant. National and local working groups were set up, to prepare for the national emergency exercise. These groups in particular took account of the conclusions of the Aube prefecture task force;
- the "INEX3 FR" exercise was an international event organised by the ASN and managed by the NEA. This exercise, which took place in France on 9 December 2005, was an opportunity to confirm and classify the main problems involved in radioactive contamination of cereal crops.

One of the first noteworthy lessons learned from these exercises was the simulated restriction on the consumption and sale of foodstuffs. These exercises were an opportunity for a more detailed look at how to manage the beginning of this phase.

Finally, in a letter of 13 April 2005, sent out to the main ministerial departments and organisations concerned, the ASN proposed creating a steering committee for managing the post-accident phase of a nuclear accident or radiological emergency (CODIR-PA). The committee began its work at a meeting held on 24 June 2005. To assist with the deliberations of the CODIR-PA, a summary of all the studies conducted on post-accident phase management, both in France and abroad, was produced in 2005.

3 OUTLOOK

In 2005 a considerable amount of work was done to update texts dealing with the response organisation to be implemented in the event of a radiological emergency, with the issue of a circular and four interministerial directives. The ASN aims to use 2006 to adapt its organisation and test interactions between the various stakeholders. To do this, the ASN intends:

- to organise an exercise to test implementation of an emergency response organisation appropriate to radiological emergencies that could arise outside nuclear installations as defined in the circular of 23 December 2005;

– to produce a protocol for exchange of information between safety authorities, in particular comprising a standard exchange format and to propose it to its counterparts in the neighbouring countries to facilitate application of the 30 May 2005 directive on early notification;
– to create a database of national authorities with competence for assistance in the event of a nuclear accident or radiological emergency in application of the 30 November 2005 directive on assistance. This work will be done jointly with the IAEA's ERNET (Emergency Response Network) which is designed to create a joint database to allow early identification of the available international assistance;
– to lay down the framework and prepare the measures necessary for dealing with post-accident situations in accordance with the role entrusted to it in the 7 April directive on the actions of the authorities.

In collaboration with the administrations and public institutions concerned, the ASN drafted the circular of 28 December 2005 regarding exercises in 2006, ensuring that precise and factual goals can be defined sufficiently early. Defining these goals, which take account of experience feedback, will allow better preparation of the specifications and a better appreciation of how well the exercise was performed. Sufficiently early, multi-year programming will also make it easier to distribute these exercises more evenly.

The ASN will also strive to increase and diversify international relations, which are always a mine of information, with other countries (for example: Belgium, Finland, Italy, etc.).

Finally, the ASN will test the response organisation put in place by the Pierrelatte plant licensees to deal with an accident involving several of them, during an in-depth inspection. On this occasion it will simulate accidents to test coordination between licensees.

RADIOLOGICAL AND BIOMEDICAL ACTIVITIES

CHAPTER 9

1 PRESENTATION OF MEDICAL ACTIVITIES USING IONISING RADIATION

1|1 Medical and dental radiodiagnosis
1|1|1 Medical radiodiagnosis
1|1|2 Dental radiodiagnosis
1|1|3 Installation construction rules

1|2 Radiotherapy
1|2|1 External radiotherapy
1|2|2 Brachytherapy

1|3 Nuclear medicine
1|3|1 In-vivo diagnosis
1|3|2 In-vitro diagnosis
1|3|3 Metabolic radiotherapy
1|3|4 Nuclear medecine department organisation and operating rules

1|4 Blood product irradiators

1|5 Medical exposure

2 INSTALLATION INVENTORY

2|1 Medical and dental radiology installations

2|2 Tomography appliances

2|3 External radiotherapy installations

2|4 Brachytherapy units

2|5 Nuclear medicine units

2|6 Blood product irradiators

3 REGULATIONS CONCERNING MEDICAL APPLICATIONS OF IONISING RADIATION

3|1 Notification or licensing of radiation sources used for medical purposes

3|2 Radioactive source management rules

3|3 Notification or licensing procedures
3|3|1 Notification dossiers
3|3|2 Licensing application dossiers

4 2005 SUMMARY OF RADIATION PROTECTION IN MEDICAL INSTALLATIONS AND IMPORTANT EVENTS

4|1 Radiodiagnosis installations

4|2 Tomography, radiotherapy, nuclear medicine and blood product irradiation installations

4|3 Important events in 2005
4|3|1 Serious radiotherapy incident at the Grenoble university hospital
4|3|2 Accidental irradiation in a fluorine 18 manufacturing unit in the Service Hospitalier Frédéric Joliot (SHFJ) in Orsay (Ile-de-France region)

4 | 4 Changing medical techniques
4 | 4 | 1 The new radiotherapy techniques
4 | 4 | 2 New tracers in nuclear medicine

5 IMPACT OF MEDICAL INSTALLATIONS ON THE EXPOSURE OF PERSONNEL AND THE PUBLIC

6 ASN VIEWPOINT ON THE PERCEPTION OF RADIATION PROTECTION IN THE MEDICAL FIELD

7 OUTLOOK

Since ionising radiation was discovered more than a century ago, medical applications have been one of its main uses. Whether for diagnosis or therapy, medicine employs various sources of radiation, produced either by electrical generators or by artificial radionuclides inside sealed or unsealed sources.

In medical applications of ionising radiation, the principle of dose limitation, one of the three fundamental principles of radiation protection, does not apply. Unlike the other types of applications, medical exposure is of direct benefit to the patient exposed, either for diagnostic purposes or for therapeutic reasons. Therefore, it is up to the practitioner to carry out case by case an assessment of the level of exposure to be applied to the patient in order to achieve the specified goal. However, the practitioner must first of all employ the principles of justification and optimisation.

Although the benefits and usefulness of medical applications have been established for many years now, they do contribute significantly to exposure of the population. They are the primary source of artificial exposure, behind natural exposure. This is why medical uses of ionising radiation are subject to a wide-ranging regulatory framework and the ASN is in this area developing specific activities, particularly with respect to installation monitoring.

The work that started in 2001 to overhaul the radiation protection regulations continued in 2005 with the publication of new regulations implementing the Public Health Code (protection of patients) and the Labour Code (protection of workers).

The ASN also focused on putting in place tools for assessing changes to radiation protection in the medical field and reinforcing the information available to health professionals concerning radiation protection regulations.

1 PRESENTATION OF MEDICAL ACTIVITIES USING IONISING RADIATION

1|1 Medical and dental radiodiagnosis

Radiodiagnosis is the discipline of medical imaging covering all techniques for morphological exploration 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 gathered either on radiological film or more and more often on digital media allowing computer processing of the images obtained.

Radiodiagnosis, which is the oldest of the medical uses of radiation, occupies predominant place in medical imaging area, which now comprises various specialisations which have become increasingly independent as time has gone by. Technological change has also led to the development of imaging techniques which meet a wide variety of user needs.

The variety of types of radiological examination available for modern medicine should not however lead the practitioners to forget that they all involve irradiation of the patient. Therefore, the doctor must only prescribe the examination if it is part of a diagnostic strategy that takes account of the pertinence of the information looked for, the benefit to the patient, the irradiation of the patient and the possibilities of other non-irradiating investigative techniques. Section 1|5 of this chapter gives details concerning the exposure levels of patients 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 output images onto a TV screen (radioscopy) for real-time guidance of the surgeon.

It should be noted that radioscopy devices without image intensifiers (simple radioscopy) are now prohibited by the regulation of 17 July 2003.

• Surgical radiology

They are radiological techniques which use radioscopy with image intensification and require special equipment allowing to replace certain surgical operations, in particular in cardiology (dilation of coronary arteries, etc.). They often require long-term exposure of the patients, who then receive high doses which can sometimes lead to radiation deterministic effects (cutaneous lesions, etc.). The surgical staff usually working in the immediate vicinity of the patient are also exposed to higher levels than during other radiological practices. Then, given the risk of external exposure for the operator and the patient, surgical radiology must be justified by clearly determined medical need and its practice must be optimised in order to improve the radiation protection of both operators and patients.

Operating theatre radiology appliance

· **Digital angiography**

This technique, which is used to explore the blood vessels, is based on digitisation of images before and after injecting a contrast medium. Computer processing masks the bone structures around the vessels by subtracting two series of images.

· **Mammography**

Given the composition of the mammary gland and the degree of detail sought for the diagnostic, high definition and perfect contrast are required for the radiological examination. This can only be achieved by special appliances working with low voltage.

These generators are also used for breast cancer screening campaigns.

Mammography appliance

· **Tomography**

Using a closely collimated X-rays beam, emitted by a generating tube rotating around the patient and a computerised image acquisition system, tomography appliances give a three-dimensional picture of the organs with image quality higher than that of conventional equipment, providing a more detailed picture of the organ structure.

Tomography appliance

When first used, this technique revolutionised the world of radiology, in particular in the neurological exploration area, but is today being rivalled by magnetic resonance imaging (IRM) for certain investigations. However, the new generation of appliances (multi-slice scanners) offer an extension of the investigative field of tomography, somewhat offset by the fact that these appliances deliver higher doses of radiation to the patients.

Overall, although tomography examinations only account for a small percentage of the total number of radiological tests, they contribute significantly to the exposure due to radiology.

1 | 1 | 2

Dental radiodiagnosis

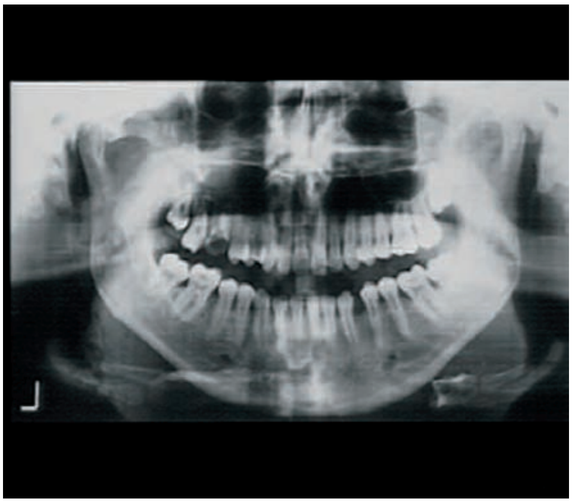
Of the radiological installations inventory, dental radiodiagnosis equipment occupies a dominant position, even if only three techniques are employed.

· Intra-oral radiography

Intra-oral type radiography generators are generally 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. This technique is increasingly frequently combined with a system for digital processing of the radiographic image which is displayed on a monitor.

· Panoramic dental radiography

Primarily used by dental specialists (orthodontists, stomatologists) and radiologists, panoramic radiography gives a single picture showing both jaws, by rotating the radiation generating tube around the patient's head for about ten seconds.



Panoramic dental radiography appliance and panoramic dental radiography image

· Cranial tele radiology

These generators are more rarely used by practitioners. They operate with a focus - film length of 4 metres, and are mainly used to take radiographic images for orthodontic diagnosis.

1 | 1 | 3

Installation construction rules

A conventional radiological installation comprises a generator (high-voltage unit, radiation generating tube and control unit) and a stand for moving the tube and an examination table or chair. The general standard NFC 15-160, published by the Union technique de l'électricité (UTE), defines the conditions in which the installations must be fitted out to ensure human safety against the risks resulting from the action of ionising radiation and electrical current. It is supplemented by specific rules applicable to medical radiodiagnosis (NFC 15-161) and dental radiodiagnosis (NFC 15-163). In compliance with these standards, the walls of radiology rooms must be sufficiently opaque to radiation and may require the installation of reinforced lead protection. In the light of the changes to the radiation protection regulations, which have in particular led to a reduction in the exposure limits for both the general public and workers, a revision of these standards was initiated by the UTE in 2005. The ASN is taking part in the corresponding work, in partnership with the IRSN and the professional representatives concerned.

1 | 2

Radiotherapy

With surgery and chemotherapy, radiotherapy is one of the key techniques employed to treat cancerous tumours. It uses ionising radiation to destroy malignant cells. The ionising radiation needed for the treatment is either produced by an electrical generator, or emitted by artificial radionuclides in a sealed source. A distinction is made between external (or transcutaneous) radiotherapy, with the radiation source placed outside the patient, and brachytherapy, in which the source is positioned in direct contact with the patient, inside or very close to the area to be treated.

1 | 2 | 1

External radiotherapy

The irradiation sessions are always preceded by preparation of the treatment plan which, for each patient, details the dose to be delivered, the target volume to be treated, the dosimetry, the irradiation beam ballistics and the duration of each treatment. Preparation of this plan, which aims to set conditions for achieving a high, uniform dose in the target volume while protecting sound tissues, requires close cooperation between the radiotherapy specialist and the person specialising in medical radiophysics (PSRPM), previously known as the radiophysicist.

Irradiation is performed either using particle accelerators producing photon or electron beams with an energy of between 4 and 25 MeV and delivering dose rates varying between 2 and 6 Gy/mn, or - albeit now to a lesser extent - telegammatherapy appliances equipped with a cobalt 60 source, the activity of which is about 200 terabecquerels (TBq). The number of these latter appliances is declining rapidly in France, where they are being systematically replaced by particle accelerators whose superior performance offers a wider range of treatments. Given the characteristics of these machines, they must be installed in rooms specially designed to guarantee radiation protection of the personnel, turning them into true bunkers (the ordinary concrete walls can vary from between 1 to 2.5 m thickness). A radiotherapy installation comprises a treatment room including a technical area containing the appliance, a control station outside the room and, sometimes, auxiliary technical premises.

It should be noted that experiments should shortly be conducted in France into new irradiation techniques (tomotherapy and radiosurgery). Section 4|4|1 of this chapter gives details on these changes, in which the ASN is keenly interested, in order to anticipate their consequences on radiation protection of both operators and patients.

Radiotherapy particle accelerator

The protection of the premises, in particular the treatment room, must be determined in order to respect the annual exposure limits for the workers and/or the public around the premises. A safety case must be produced for each installation by the supplier of the machine, together with the PSRPM and the person with competence for radiation protection (or the department with competence for radiation protection) of the establishment in which it is to be installed. This study 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 use of the adjacent rooms, including those vertically above and below. This study should be included in the file presented to support the application for a licence to use a radiotherapy installation, examined by the ASN.

In addition, safety systems must indicate the machine status (operating or not) or must switch off the beam in an emergency or if the door to the irradiation room is opened.

1 | 2 | 2

Brachytherapy

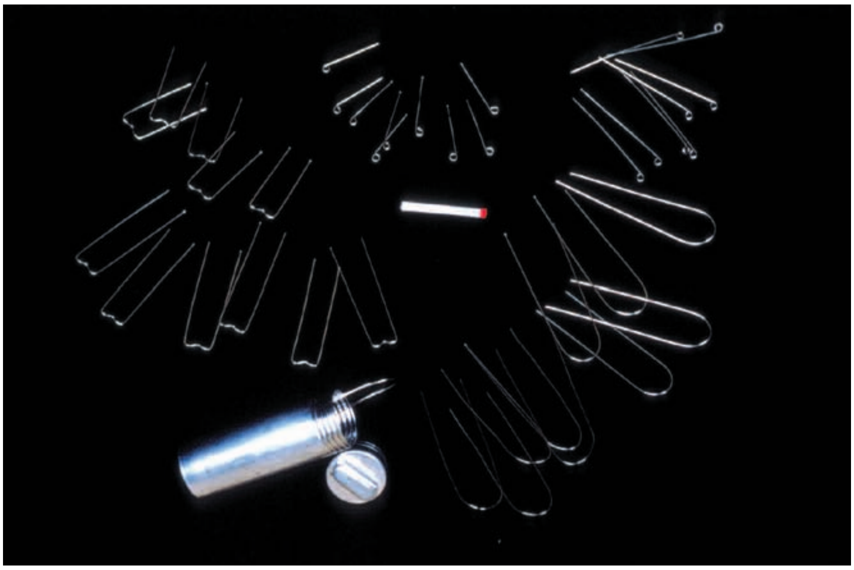
Brachytherapy allows specific or complementary treatment of cancerous tumours, specifically in the ENT field, as well as of the skin, the breast or the genitals.

The main radionuclides used in brachytherapy, in the form of sealed sources, are caesium 137 and iridium 192, which have definitively replaced the radium 226 needles or tubes used in the first half of the 20th century. These two radionuclides have half-lives of 30 years and 74 days respectively.

Brachytherapy techniques involve three types of applications.

Low dose rate brachytherapy, requiring patient hospitalisation for several days, gives dose rates of 0.4 to 2 Gy/h. The iridium 192 sources are used for interstitial applications (inside the tissues). The sources generally come in the form of wires of 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 radioac-



Iridium 192 sources used in low dose rate brachytherapy

tive 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 8,200 MBq or an iridium 192 source of 5,600 MBq, placed in the centre of the patient's bed, which must be fixed in place.

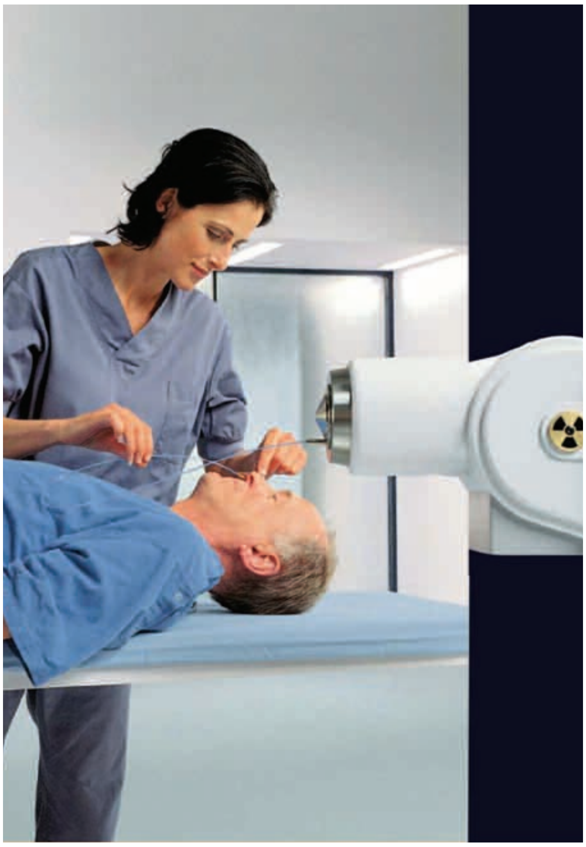
In recent years, low dose rate brachytherapy techniques have been supplemented by the use of sealed sources of iodine 125 (half-life of 60 days) to treat prostate cancers. The iodine 125 sources, just a few millimetres long are permanently installed in the patient's prostate. Their unit activity is between 10 and 25 MBq and treatment requires about one hundred grains representing a total activity of 1,500 MBq, delivering a prescribed dose of 145 Gy to the prostate.

Medium dose rate pulsed brachytherapy uses dose rates of 2 to 12 Gy/h delivered by iridium 192 sources of small dimensions (a few millimetres), with maximum activity limited to 18.5 GBq. Each source is applied with a specific source applicator. This technique delivers doses identical to those of low dose rate brachytherapy, and over the same period, but given the higher dose rates, irradiation is split up into several sequences (pulses). The patient does not therefore carry the sources permanently, which is more comfortable and enables him to receive visitors. This technique, which is likely to

Iodine 125 sources used for prostate brachytherapy

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 uses an iridium 192 source of small dimensions (a few millimetres) and maximum activity of 370 GBq delivering dose rates higher than 12 Gy/h. A source applicator comparable to that employed for pulsed brachytherapy is used. The treatment times are very short (no more than a few minutes), unlike the previous techniques. Irradiation is carried out in a room similar to an external radiotherapy room, with the same safety measures. High dose rate brachytherapy is primarily used to treat cancers of the oesophagus and bronchus.



High dose rate brachytherapy appliance

1 | 3

Nuclear medicine

Nuclear medicine includes all uses of unsealed source radionuclides for diagnostic or therapeutic purposes. Diagnostic uses can be divided into in-vivo techniques, based on administration of radiopharmaceuticals to a patient, and exclusively in-vitro applications. As for radiology, paragraph 1|5 gives additional information on the patient exposure levels during the main nuclear medicine procedures.

1 | 3 | 1

In-vivo diagnosis

This technique consists in examining the metabolism of an organ with a specific radioactive substance - called a radiopharmaceutical - administered to a patient. The nature of the radiopharmaceutical, which 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, table 1 presents some of the main radionuclides used in the various investigations.

Technetium 99m, delivered to nuclear medicine departments in the form of a generator, is by far the most commonly used radionuclide. Moreover, its short radioactive half-life of 6 hours and its limited gamma radiation energy (140 keV) are extremely favourable to the patient from the dosimetry viewpoint. The activity administered to a patient for an examination is a few hundred megabecquerels (MBq). Fluorine 18 is a radionuclide that emits positrons (511 keV, 2 hours half-life) and is increasin-

Type of exploration	Type of radionuclide	Type of carrier
Thyroid metabolism	Iodine 123, technetium 99m	
Mycocardial perfusion	Thallium 201, technetium 99m	MIBI
Pulmonary perfusion	Technetium 99m	Albumin macroaggregates
Pulmonary ventilation	Xenon 133, krypton 81m, technetium 99m	Solid (carbon) or liquid (DTPA) aerosols
Osteo-articular process	Technetium 99m	Phosphonate
Oncology – search for metastasis	Fluorine 18	Fluorodeoxyglucose (FDG)

Table 1

gly widely used in nuclear medicine units for cancerology examinations.

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 the images are digitised, quantification of the physiological processes is possible, as is a 3-dimensional reconstruction of the organs, using the same principle as for the X-ray scanner. The use of fluorine 18 requires that a gamma camera able to detect positrons and called a positron emission tomograph (PET) be employed. This is now coupled with scanner, forming a hybrid device called a PETSCAN.

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).

Scintillation camera

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

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 the case with treatment of certain thyroid cancers after surgery. This is done by administering about 4,000 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 5,550 MBq of iodine 131.

The year 2005 was marked in France by the start of biomedical research to experiment with new radiopharmaceuticals emitting high-energy alpha and beta radiation. Section 4|4|2 gives details on these experiments and their radiation protection consequences.

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 unsealed radioactive sources to the patients or handle them in a laboratory (case of radioimmunology). Provisions must also be made for the collection, storage and disposal of radioactive waste and effluent 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 (the case with fluorine 18 and iodine 131), along with an internal exposure hazard through accidental intake of radioactive substances. The patients also eliminate radioactivity through their urine, which must be specially treated to minimise releases into the public domain. Finally, as we are here dealing with medical applications, the risk of infection is ever-present.

In these conditions, nuclear medicine departments must comply with specific construction and organisation rules, the main provisions of which - for the in-vivo diagnosis units - are as follows.

I Location and layout of promises

The premises of a nuclear medicine unit must be located away from the general circulation areas, clearly sep,arated from premises intended for ordinary use, grouped so that they form a single unit allowing easy marking out of a controlled area, and categorised in descending order of radioactive activity levels. The controlled area will comprise at least the following:
- a changing area airlock for the staff, separating normal clothing from work clothing;
- examination and measurement rooms and rooms set aside for injected patients waiting for their examination (separate rooms should be provided for mobile patients and patients lying down);
- areas for storage and preparation of unsealed sources (hot laboratory);
- an injection room adjoining the hot laboratory;
- installation for delivery of radionuclides and storage of radioactive waste and effluent.

II Fitting out the controlled area

The thickness of the hot laboratory and injection room walls must be at least equivalent to 15cm of ordinary concrete. Floor coverings (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 must not be hand-operated. The changing area airlock must have washbasins and a shower and the sanitation facilities reserved for injected patients must be connected to a septic tank, itself connected directly to the establishment's main sewer. The hot laboratory must 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.

Shielded chamber for handling unsealed radioactive sources

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 effluent

A room intended solely for storage of radioactive waste pending disposal must be provided. Similarly, liquid radioactive effluent 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, must 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, so that it can be installed in a room which does not require additional radiation protection. Depending on the version, the irradiators may be equipped with one, two or three caesium 137 sources with a unit activity level of about 60 TBq. The blood bag is irradiated with an average dose of about 20 to 25 grays. Regional blood transfusion centres are equipped with this type of appliance.


Blood product irradiator

1 | 5

Medical exposure

Patient exposure to ionising radiation is differentiated from the other types of exposure (workers, population) because it is not subject to any strict limitations. Nonetheless, the justification and optimisation principles still apply. This is also the only case in which exposure is delivered for the direct benefit of the exposed persons, i.e. the patients. The worker and the population exposure consequences of the use of ionising radiation for medical purposes are mentioned in section 5 of this chapter.

The situation differs according to whether one considers patient exposure in the course of diagnostic applications (diagnostic radiology or nuclear medicine) or of external or internal radiotherapy: in the first case, optimisation is required, by delivering the minimum dose needed to obtain pertinent diagnostic information, while in the second, the dose needed to sterilise the tumour must be delivered, while preserving as much of the surrounding sound tissue as possible.

The dose received by the patient depends on the quality of the equipment used, what fully justifies retiring obsolete equipment and developing a quality control system for the medical appliances used. This concerns not only the irradiating equipment, but also those used for this exposure (if a radiological film viewer is defective, this could lead to increase the radiation doses to produce the films). The dose also depends on the nature of the procedures and the emission of radiation (X-ray tube, particle accelerator, unsealed source of radionuclides, etc.).

At present it is hard to gain a precise picture of overall exposure of medical origin, because the number of examinations carried out (per type) is still inadequately known and the doses delivered for the same examination may vary widely, depending not only on the performance conditions but also on the morphology of the patients. This is why, through its Action Plan for monitoring patient exposure to ionising radiation - PASEPRI (see chapter 1, point 3|4) the ASN has initiated a process to collect these data, with the assistance of the IRSN and the InVS. These 2 organisations therefore set up a survey unit with the purpose of collecting and analysing data. The work carried out was first of all to identify the various available sources of information, to update the available data on the volume and nature of the radiological examinations and to initiate targeted studies of scanners, neuroradiology and paediatric radiology.

Based on the initial results available after a year of operation of the survey unit, the number of radiological examinations carried out in France every year is somewhere between 61 and 74 million procedures, broken down as follows:
- 90% of the examinations made involve conventional radiology techniques;
- About 8% of examinations involve tomography;
- Nuclear medicine and surgical radiology each account for between 1 and 1.5% of the total number of examinations.

Starting from these data, the IRSN and InVS estimate that the average annual effective dose due to medical exposure per inhabitant in France, is somewhere between 0.66 and 0.83 mSv. Morover, although conventional radiology accounts for 90% of the examinations conducted, its contribution to the annual effective dose is only 35%. Conversely, tomography examinations, which only represent 8% of the number of examinations carried out, account for 41% of the annual effective dose, while surgical radiology (less than 1.5% of examinations) represents 15%.

Worldwide statistics, which need to be updated - (UNSCEAR 2000 report, volume 1) covering 1,530 billion inhabitants (1991-1996 data), indicate an annual effective dose per inhabitant of 1.2 mSv for radiology, 0.01 mSv for odontology and 0.08 mSv for nuclear medicine. In western Europe, for diagnostic radiology, the average annual effective dose per inhabitant is 0.33 mSv in the United Kingdom and 1.9 mSv in Germany.

Stamp representing A. Béclère, father of French radiology

The studies conducted so far generally show a wide variability in the doses delivered for a given examination. The choice of dosimetric parameter is thus very important. The range of doses delivered by medical exposure is fairly wide. For example, in radiology, measurements taken in the same conditions for a given examination performed in three hospitals (report by the Bonnin/Lacronique, OPRI and SFR mission, March 2001) revealed doses (doses at the entry surface on a phantom) varying by a factor of 1 to 3 for a lumbar examination (profile) or a factor of 1 to 10 for a cervical examination (profile).

In nuclear medicine, the activities administered vary widely from one department to another, from one Member State to another. Even if the doses are generally lower than in radiology, there are variations that cannot always be justified. For a pulmonary perfusion scintigraphy performed as part of the diagnosis of a pulmonary embolism, the activity administered can vary from 100 MBq (Netherlands) to 300 MBq (France), or an estimated delivered dose variation of 1.2 mGy to 3.75 mGy.

In order to improve knowledge of medical exposure and implement the principle of optimisation, 2005 saw work continue into the drafting, by the health professionals concerned, of prescription and procedure guides, based on a number of regulatory texts (see chapter 3, points 1|3|1 and 1|3|2) concerning:

• The diagnostic reference levels (regulation of 12 February 2004): radiology and tomography units must conduct annual dosimetry assessments of common radiological examinations carried out on “typical” patients, the results of these assessments then being compared with the reference levels. In the case of nuclear medicine, the levels administered to the patients will be recorded and compared with the activity levels recommended by the radiopharmaceutical’s notice of compliance. These levels, which are neither regulatory limits, nor optimum values, will constitute guidelines for implementing the principle of optimisation. They should not be exceeded if there is no technical or medical justification, but compliance with them does not obviate the need for continued optimisation. In order to ensure periodic updating of the reference levels, the IRSN collects the results of these annual assessments. It should however be noted that to date, only a limited number of radiology and nuclear medicine departments have forwarded their assessments to the IRSN.

• The obligation to fit a device on recently installed radiology appliances indicating the quantity of radiation produced during a radiological procedure (decree 2004-547 of 15 June 2004): this device will give the professionals concerned a clearer picture of the doses actually delivered, will make it easier to implement and assess the reference levels and thus help optimise the radiological practices.

• The training, duties and working conditions of persons specialising in medical radiophysics - PSRPM - (regulation of 19 November 2004): this is the first regulatory text precisely defining the training requirements for these specialists and the nature of their duties. This regulation also requires that all establishments using ionising radiation for diagnostic or therapeutic purposes draw up a plan specifying all of their medical radiophysics resources, in particular taking into account of the medical techniques employed, the resulting constraints and the number of patients treated. Application of this regulation will clarify the role of the PSRPM and strengthen their actions to obtain a clearer understanding of the doses delivered.

• Training of health professionals in patient radiation protection (regulation of 18 May 2004): the training programmes are spelt out in this regulation, in compliance with the requirements of article R.

1333-74 of the Public Health Code. This training is intended for medical and paramedical personnel responsible for carrying out procedures involving ionising radiation.

At the same time, the AFSSAPS in 2005 took a further decision concerning quality control procedures applicable to bone mineral density test installations and published two modifying decisions dealing with analogue mammography appliances. They complete those previously published concerning external radiotherapy units. These AFSSAPS decisions are wholly in line with the optimisation approach (see chapter 3, point 1|3|2).

2 INSTALLATIONS INVENTORY

2 | 1

Medical and dental radiology installations

Table 2 presents the inventory of medical and dental radiology appliances in service in 2005, established on the basis of the notifications by users of this type of equipment. In 2005, the number of radiological installations fell 8.1% in relation to 2004.

	Medical radiodiagnosis	Dental radiodiagnosis	Total
Private sector	8,470	31,880	40,350
Public and related sector	7,503	1,420	8,923
Total	15,973	33,300	49,273

Table 2

There is however a rise in the public sector part of the inventory, probably linked to the new notification procedure requiring hospitals to update the information they had previously submitted.

Table 3 presents the breakdown of radiology installations as of 31 December 2005, per category of appliances.

Medical and dental radiodiagnosis

	Private sector	Public and related sector	Totals	% change in
Light radiodiagnosis, including bone mineral density tests	1,303	2,956	4,259	+ 5,4 %
Sophisticated radiodiagnosis	5,162	4,042	9,204	– 7 %
Mammography	2,005	505	2,510	– 10,8 %
Dental radiology	31,880	1,420	33,300	– 9,7 %
Totals	40,350	8,923	49,273	– 8,1 %

Table 3

According to the information collected by the ASN, the radiology installations counted in the above tables and the tomography installations covered in point 2|2, are spread over about 4,000 radiology units, in which about 7000 radiology practitioners work, assisted by more than 22,500 electroradiology operators or similar. In the field of dental radiology, 40,000 dentists in 28,600 facilities share the use of the appliances listed above.

2 | 2

Tomography appliances

The French radiological inventory comprises 754 tomography installations, representing a 7.7% increase over 2004. It should be noted that this count includes appliances intended for radiotherapy simulation and that there are almost twice as many appliances in the public sector as in the private.

2 | 3

External radiotherapy installations

The trend, which has already been established for a number of years, continued in 2005 with a rising number of particle accelerators, now standing at 359 units (+2.5% in relation to 2004) and a regular fall in the number of telegammatherapy machines, which is now down to 34 (-27%).

These installations, along with the brachytherapy units mentioned in point 2.4 below, are used by about 600 radiotherapists (350 in the public sector and 250 in the private) who work in 179 radiotherapy centres (source: SFRO).

Telegammatherapy appliance

2 | 4

Brachytherapy units

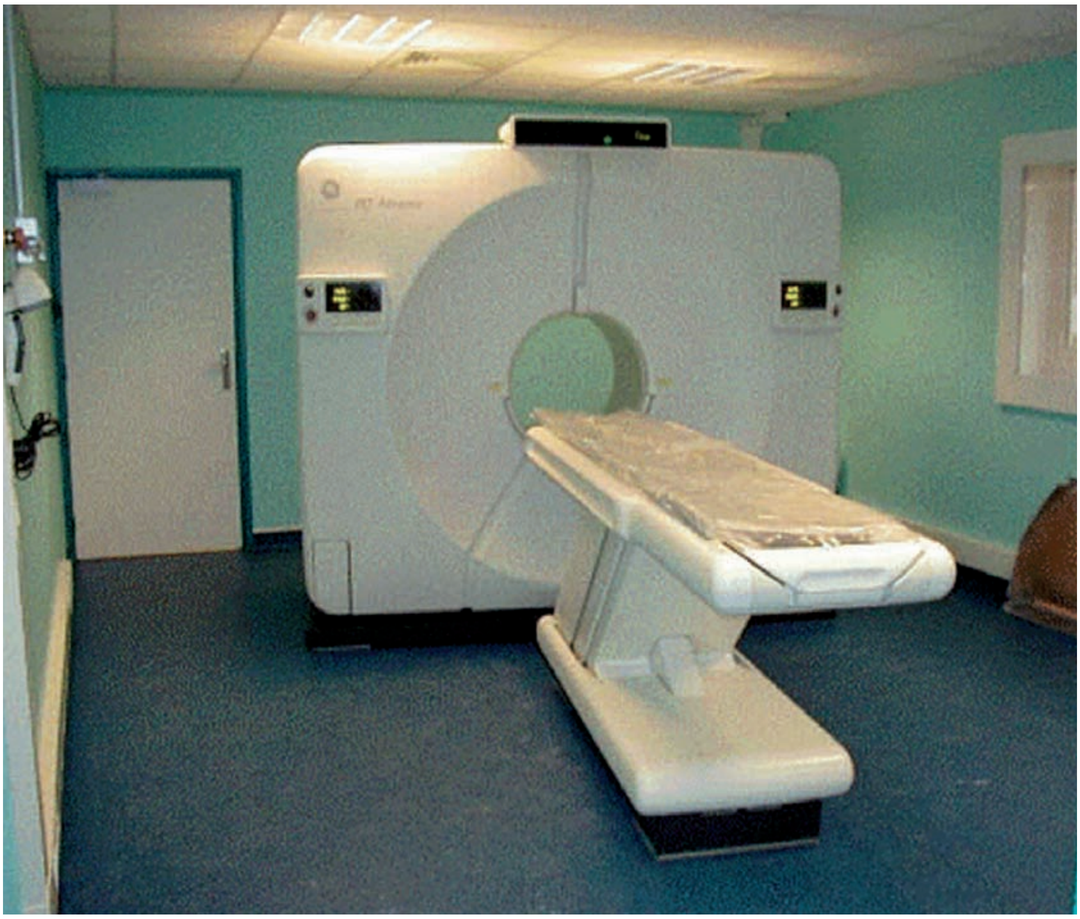
With a total of 102 brachytherapy units, the downward trend evident over the past two years continued in 2005. Closure of the small units with limited brachytherapy activities was the reason for this drop. However, the breakdown between public sector (52) and private (50) remained stable.

2 | 5

Nuclear medicine units

With a total of 288 nuclear medicine units in service (comprising both in vivo and in vitro installations), the situation in 2005 remained on the whole stable in this sector. It should however be noted that the number of medical analysis laboratories using unsealed radioactive sources (radioimmunology laboratories) continued to fall. The public/private split between nuclear medicine units is 220 and 68 respectively. In 2005, 48 nuclear medicine units acquired positron emission tomography installations (PETSCAN cameras - PET camera coupled with a tomograph) using fluorine 18 in the form of fluorodeoxyglucose (^{18}FDG).

According to information in the possession of the ASN, it would seem that about 550 specialist practitioners are today working in this field, to which should be added 1,000 physicians involved in the operation of nuclear medicine units (interns, cardiologists, endocrinologists, etc.).



Positron emission tomograph

2 | 6

Blood product irradiators

In 2005, 29 installations of this type were identified as operating in blood transfusion centres. Owing to the failure to replace the older appliances, and the concentration of blood product irradiation activities in a smaller number of facilities, 2005 saw a drop in the total number of appliances in relation to 2004.

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 notification 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

Notification or licensing of radiation sources used for medical purposes

The Public Health Code (articles R. 1333-17 to R. 1333-44) sets licensing and notification provisions concerning all nuclear activities, in particular those linked to medical and biomedical research applications of ionising radiation (articles R. 1333-17 to R. 1333-20 and articles R. 1333-21 to R. 1333-25), whether or not the establishments are subject to the regulations applicable to installations classified on environmental protection grounds (see article L. 1333-4 of the Public Health Code).

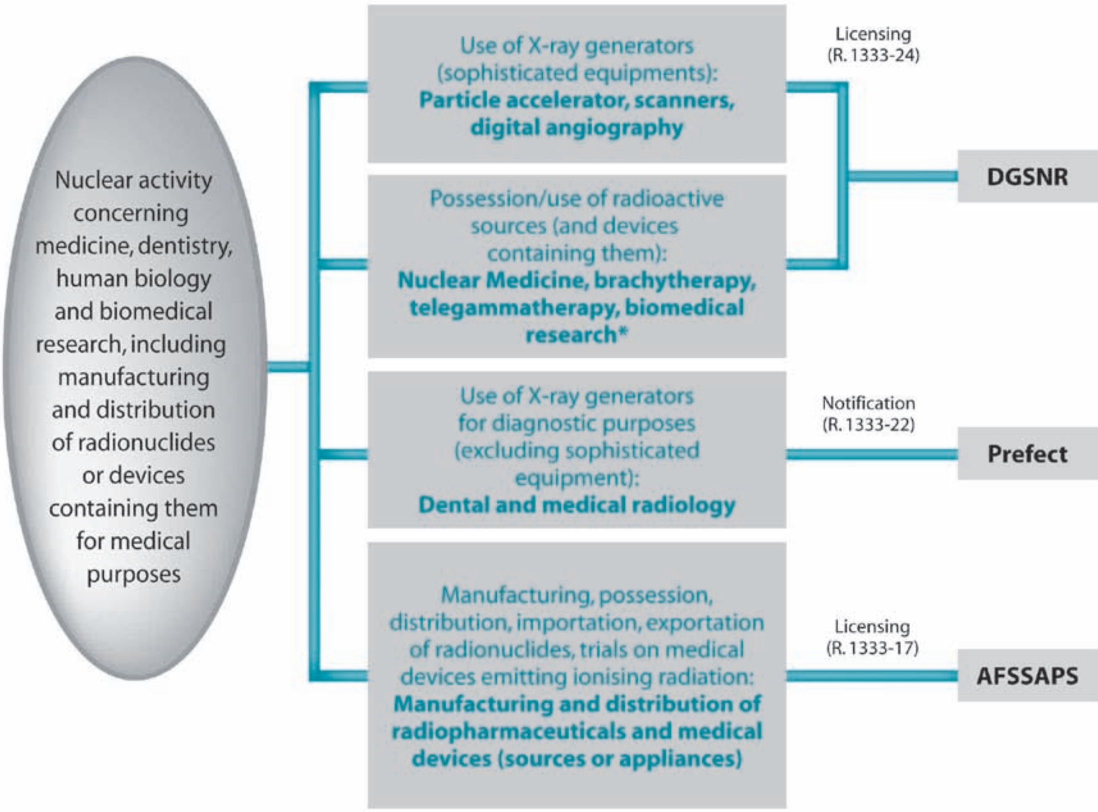
The following diagram presents the procedures governing the various medical and biomedical research applications, whenever it is relevant, these procedures do not replace those concerning sophisticated equipment as specified in articles L. 6121-1 to L. 6121-12 of the Public Health Code:

Finally, any incident or accident liable 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 this purpose, the ASN has a hot-line reserved for emergency situations (toll-free number: 0 800 804 135) accessible 24 hours a day (see chapter 8, point 1|1|3) but it can of course also be used for any radiological incident occurring in a medical installation.

In addition, article R. 162-53 of the Social Security Code, states that: “Practitioners and establishments using appliances generating ionising radiation or comprising the use of radionuclides or products containing them, for therapeutic or diagnostic purposes, may only carry out examinations or give treatment to persons covered by social security insurance if the appliances and installations have been declared or licensed as mentioned in articles R. 1333-22 and R. 1333-24 of the Public Health Code. Only those radiological examinations and radiotherapy treatments carried out using appliances and installations declared or licensed in the conditions laid out in the previous paragraph may be reimbursed or paid for”.

Paragraph 3|3 describes the contents of the notificationn and licence application files specified in articles R. 1333-22 and R. 1333-24. The regulation of 14 May 2004, based on article R. 1333-44, specifies the practicalities for implementation of these procedures.

Radiation protection regulations applicable to medical activities



no exemption to notification or licensing procedures

*according to Public Health Code § L. 1121-1: trials or experimentation organised and performed on human to develop biomedical or medical knowledge

3 | 2

Radioactive source management rules

These rules, already presented in chapter 3, point 1|2|4, of course also apply to the medical and biomedical fields. They concern:

Cobalt 60 source for telegammatherapy

- the obligation to have a licence for all transfer, acquisition, possession or use of sources;
- preliminary registration of all source movements to the IRSN;
- book keeping by the beneficiary of the licence of detailed accounts for the sources in his possession, and their movements;
- immediate notification to the Prefect and the ASN of any loss or theft of radioactive sources;
- return by the user 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

Notification or licensing procedures

3 | 3 | 1

Notification dossiers

The procedure involving notification to the department Prefect concerns the use of electric appliances generating X-rays for medical or dental diagnostic purposes - except for installations classified as sophisticated equipment (article R. 1333-22). Publication of the regulation of 14 May 2004 concerning the standard licensing and notification system defined in chapter V.I "Ionising radiation" of the Public Health Code, allows implementation of this procedure, which definitively replaces the approval procedure.

The notification is to be submitted on a form that can be downloaded from the ASN's website (www.asn.gouv.fr) or obtained from the DSNRs (Nuclear Safety and Radiation Protection Divisions). For each establishment using medical or dental radiology appliances, only a single notification mentioning all the radiological installations has to be provided. When the dossier is considered to be complete by the DSNR, the Prefect sends back to the declaring party an acknowledgement of notification of a radiodiagnostic installation, recalling the general conditions to which its operation is subject.


AUTORITE DE SURETE NUCLEAIRE

DÉCLARATION D'APPAREILS
DE RADIODIAGNOSTIC MÉDICAL ET DENTAIRE

Je soussigné Nom : .... Prénom : ....
Titre/Qualité : ....
déclare les appareils de radiodiagnostic désignés dans la liste annexe ci-jointe (nombre de pages : ......).
Si le déclarant est le praticien responsable des appareils, préciser sa spécialité :
□ Chirurgien □ Radiologue □ Gastro-entérologue □ Gynécologue □ Médecin généraliste
□ Pédiatre □ Pneumologue □ Rhumatologue □ Cardiologue □ Chirurgien dentiste
□ Docteur en chirurgie dentaire □ Médecin stomatologue □ Orthodontiste □ Médecin du travail □ Médecin de prévention
□ Autres (préciser) : ....

1 – MOTIF DE LA DECLARATION
□ Première déclaration
□ Renouvellement de la déclaration : □ N° de la déclaration antérieure : ....
□ échéance quinquennale de la déclaration
□ changement d'appareil □ adjonction d'appareil
□ transfert de local □ modification substantielle du local
Examens radiologiques donnant lieu à remboursements par les organismes de Sécurité Sociale : □ oui □ non

2 – ÉTABLISSEMENT
□ Secteur public ou assimilé □ Secteur privé à but non lucratif □ Secteur privé libéral
□ Clinique □ Centre de médecine du travail ou préventive □ Centre de santé
□ Cabinet privé individuel □ Cabinet privé collectif
□ Centre hospitalier universitaire □ Centre hospitalier □ Centre régional de lutte contre le cancer
□ Hôpital local □ Centre de moyen - long séjour
□ Autre (préciser) : ....
Utilisation hors établissement d'appareil(s) embarqué(s) sur des véhicules : □ oui □ non
Nom (ou raison sociale) : ....
Rue : .... N° : ....
Code Postal : .... Ville : ....
Tél. : .... Fax : .... Mél : ....

Direction générale de la sûreté nucléaire et de la radioprotection

Notification form for medical and dental radiodiagnostic equipments

After a five-year period, a further notification must be submitted. If, prior to expiry of the period of validity, significant modifications are made to the notification (change in or addition of appliance, transfer or substantial modification of the premises or change in the practitioner responsible), the Prefect must be immediately notified accordingly.

The notification dossier must comprise the reports of the inspections conducted, in application of articles R. 1333-43, R. 5211 and R. 5212-25 to R. 5212-32 of the Public Health Code and R. 231-84 of the Labour Code (protection of workers against the hazards of ionising radiation). If inadequacies are observed during these inspections, a report describing the remedial measures taken must be submitted along with the notification dossier.

The declared installations must be:
- equipped with a generator less than 25 years old (the case of medical appliances used for medical treatment) carrying CE labelling guaranteeing conformity with the essential health and safety requi-

rements 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:
• X-ray tomography and digitised angiography;
• radiotherapy (particle accelerators, telegammatherapy and brachytherapy appliances);
• nuclear medicine;
• biomedical research on human beings in one of the above-mentioned disciplines, subject to a “Huriet law” biomedical research protocol,
which are subject to prior licensing by the Minister for Health (article R. 1333-24 of the Public Health Code), valid for a maximum renewable period of 5 years, issued by the ASN to the practitioners who are responsible for them.

For each installation mentioned above, the corresponding dossier is to be drawn up using a form that can be downloaded from the ASN’s website (www.asn.gouv.fr). These dossiers, accompanied by the required documents, are to be returned to the ASN for examination, either through the DSNR (scanner, digital angiography, radiotherapy), or the ASN (nuclear medicine, brachytherapy and biomedical research).

The licence is granted on the basis of criteria concerning necessity (in particular the case of installations classified as sophisticated equipment), the competence of the practitioner in charge, and conformity with the installation technical arrangement and layout rules and the radiation protection organisation. Furthermore, the appliances mentioned above may not be used once they are more than 25 years old.

In the case of nuclear medicine, particular attention will be given to the collection and disposal of the waste and radioactive effluent produced. For instance, the dossier must comprise a waste and effluent management plan for the entire establishment within which the nuclear medicine unit is located.

If biomedical research is performed in one of the above disciplines, the criterion of competence of the practitioners in charge of this research and the technical rules concerning the installations remain applicable.


AUTORISATION D'UTILISATION D'UNE INSTALLATION DE RADIODIAGNOSTIC (SCANOGRAPHIE / ANGIOGRAPHIE NUMÉRISÉE)
AUTORISATION DE DÉTENTION ET D'UTILISATION DE RADIONUCLÉIDES EN MÉDECINE NUCLÉAIRE ET EN RECHERCHE BIOMÉDICALE
AUTORISATION D'UTILISATION D'UNE INSTALLATION DE RADIOTHÉRAPIE EXTERNE (ACCÉLÉRATEUR DE PARTICULES / APPAREIL DE TÉLÉGAMMATHÉRAPIE)
AUTORISATION DE DÉTENTION ET UTILISATION DE RADIONUCLÉIDES EN CURIETHÉRAPIE (SOURCES SCELLÉES)

Licensing application forms

4 2005 SUMMARY OF RADIATION PROTECTION IN MEDICAL INSTALLATIONS AND IMPORTANT EVENTS

4 | 1

Radiodiagnosis installations

The ASN, via the DSNRs, received about 4200 notifications of use for medical or dental radiodiagnosis appliances during the course of 2005.

4 | 2

Tomography, radiotherapy, nuclear medicine and blood product irradiation installations

The ASN issued 522 decisions (commissioning or renewal licences, cancellation notifications) according to the breakdown given in table 4.

Decisions	Particle accelerator	Telegamma-therapy	Brachy-therapy	Nuclear medicine	Scanner	Blood product irradiator	Angio-graphy	Contac-therapy
Total	111	10	37	123	172	15	52	2

Table 4

4 | 3

Important events in 2005

4 | 3 | 1

Serious radiotherapy incident at the Grenoble university hospital

In April 2005, the Grenoble university hospital submitted a notification to the ASN and the AFSSAPS concerning a serious incident which occurred in the first quarter of 2003 during radiotherapy treatment. This incident led to exposure of a patient to a dose about 20% higher than that initially planned for his treatment. This over-exposure was only detected in the patient in November 2004 further to a complication requiring surgery.

This incident, which is the first of this type declared to the ASN, was due to an anomaly in transmission of the computer data to the radiotherapy appliance used, a fact that was brought to light by the university hospital in May 2003 and corrected. The results of the investigations carried out show that the problem could only occur in a specific configuration on only one of the radiotherapy appliances in service between June 2002 (date the appliance was installed) and May 2003 (date on which the problem was corrected).

As soon as they became aware of this incident, the ASN and the AFSSAPS, together with the Isère DDASS, carried out investigations during the course of inspections in the university hospital radiotherapy unit, to check the organisation of radiation protection in the preparation and performance of the treatment, to assess the IT system and monitor its conditions of use.

Following this event, the ASN and AFSSAPS sent a letter dated 26 April 2005 to all of the 180 French radiotherapy units in order to recall the main provisions concerning patient radiation protection and the regulatory obligations concerning equipment supervision, maintenance and inspection of radiotherapy installations. This circular can be consulted on the ASN's website (www.asn.gouv.fr).

4 | 3 | 2

Accidental irradiation in a fluorine 18 manufacturing unit in the Service Hospitalier Frédéric Joliot (SHFJ) in Orsay (Ile-de-France region)

Accidental irradiation of an employee occurred in March 2005 in the CEA's Service Hospitalier Frédéric Joliot (SHFJ) located in the Orsay hospital.

This incident occurred during production of a fluorine 18-based radiopharmaceutical used in nuclear medicine. After noting a malfunction in the automated manufacturing process, an operator carried out an inappropriate manual intervention which led to body and clothing contamination. This contamination involved irradiation of the operator's right forearm, which was given specialist medical treatment.

After being informed of this incident, the ASN inspected the SHFJ, bringing to light inadequacies in the design of the installation and in the organisation for dealing with radiation protection incident situations. The ASN only authorised continued operation of the installation after confirmation was received that effective corrective measures had been taken and that new permanent operational procedures were in place, to prevent such an incident happening again.

Ten other fluorine 18 production installations are in operation in France and, jointly with the AFSSAPS and the Labour Inspectorate, the ASN carried out a series of checks on these installations in order to verify their personnel radiation protection arrangements. Further to these checks, the ASN asked for various corrective actions to be taken, to improve operator radiation protection.

4 | 4

Changing medical techniques

The ASN is attentive to changes in medical techniques using ionising radiation, so that it can assess the consequences of their use in terms of radiation protection of personnel and patients. During the course of 2005, the ASN was informed of innovative radiotherapy development projects, with new radiotherapy appliances soon to be installed in France, and new radioactive tracers which are to be experimented in the field of nuclear medicine.

4 | 4 | 1

The new radiotherapy techniques

In addition to conventional methods of tumour irradiation, new techniques called tomotherapy and radiosurgery should shortly start being used in France.

Tomotherapy combines scanner and particle accelerator technologies. A photon beam of 6 MeV and 8 Gy/mn irradiates a tumour using techniques inspired by the helical scanner (complete rotation around the patient and breakdown of the volume to be processed into basic cross-sections, which are irradiated). A multileaf collimator and modulation of the radiation intensity allow highly-localised irradiation of regions independently of each other. It is also possible to acquire images of the zone being irradiated and compare them with reference tomography images in order to improve patient positioning quality. This technique is currently employed in about fifty centres in the United States and Europe. Two devices of this type should be installed in France in 2006.

Radiosurgery consists in using a small particle accelerator placed on a robot arm with 6 degrees of freedom. By combining the robot's ability to move around the treatment table and the degrees of freedom of its arm, it is thus possible to use multiple, non-planar beams to irradiate small tumours that are difficult to access using conventional surgery and radiotherapy. At present, three centres in Europe (Belgium, Germany and Italy) are using this technique and one or two French teams should shortly be acquiring this equipment. Given the movement capabilities of the robot and its arm, the radiation protection of the treatment room does not correspond to the usual standards and will therefore require a specific study.

4|4|2

New tracers in nuclear medicine

The routine use in nuclear medicine of fluorine 18, in the form of fluorodeoxyglucose (^{18}FDG), for cancerology purposes, has opened the door to research into development of new radioactive tracers intended for both diagnosis and internal radiotherapy. Other than fluorine 18 marking on new vectors, current work in progress concerns the use of other radionuclides such as rubidium 82, copper 64 or iodine 124 for diagnostic applications. In the field of internal radiotherapy, research is beginning to look at using high-energy alpha (astatine 211, bismuth 213, radium 223 or actinium 225) or beta (copper 67, yttrium 90 or lutetium 177) emitting radionuclides.

The use in nuclear medicine of at least some of these radionuclides - if their medical interest can be proven - will require that the radiation protection requirements associated with their use be taken into account as early as possible. Given the activity levels potentially involved (usually far higher than those normally employed in nuclear medicine), the characteristics of the radionuclides and the preparation and administration protocols as today made known to the ASN, exposure of the operator - particularly the hands - could reach or exceed the regulatory dose limits, which is of course unacceptable to the ASN.

In these conditions and pending the initial licensing applications, the ASN is combining a reminder of regulatory requirements with awareness raising programmes, in particular by encouraging the development of automated systems for preparation and/or injection of these radioactive products.

5 IMPACT OF MEDICAL INSTALLATIONS ON THE EXPOSURE OF PERSONNEL AND PUBLIC

The ASN currently has little data for assessment of the use of ionising radiation for medical purposes, other than that regarding worker exposure (exposure of patients was described in paragraph 1|5).

According to the data collected by the IRSN in 2004 (IRSN report on worker radiation protection, 2004 summary), about 135,000 people working with medical uses of ionising radiation - or 53% of the total number of monitored exposed workers, covering all activity sectors - were subject to dosimetric exposure monitoring. Medical radiology covers about 69% of the medical personnel exposed. In total, nearly 99% of the persons monitored in 2004 and working in medicine or dentistry received an annual effective dose of less than 1 mSv while 34 overshoots of the annual limit of 20 mSv were recorded (46 in 2003). These overshoots can be broken down as follows: 28 in medical radiology, 3 in radiotherapy, 2 in dental radiology and 1 in occupational medicine. Inquiries are systematically carried out by the occupational medicine services in order to identify the origin of these individual cases.

In 2005, the IRSN's centralised system for collection and analysis of dosimetric data (SISERI) was launched. With the increasingly widespread use of operational dosimetry in the medical field, these tools will give a more detailed picture of exposure, better identify the origin of any cases of the regulatory limits being exceeded and highlight any abnormal situations more quickly.

Except in special circumstances, there is no specific surveillance of the impact of medical applications on the environment and the population. The available information concerns general surveillance of the environment carried out by the IRSN, in particular measurement of ambient gamma radiation, and overall no significant exposure level above the background radiation variations has been highlighted. However, checks on rivers or sewage plants in large towns occasionally reveal the presence above the measurement thresholds of artificial radionuclides used in nuclear medicine (iodine 131, technetium 99m). The available data on the impact of these discharges show that they are estimated at a few microsieverts per year for the most exposed persons (sewerage network staff) and that these radionuclides have never been measured in water intended for human consumption. However, so that more precise data is available on the impact of these releases, and at the request of the ASN, the IRSN is carrying out studies to determine the exposure of certain professional categories working in waste water treatment (sewerage network staff, treatment plant operators, etc.).

In the case of patients who have undergone a nuclear medicine test or treatment, the 21 January 2004 regulation requires that nuclear practitioners provide their patients with relevant information to limit exposure of persons in contact with them. Now, it is up to the nuclear practitioners and their representative bodies to draft a guide including all the recommendations to be given to the patients. Regular distribution of this information will help limit unnecessary exposure of those in the patient's entourage.

Apart from these measures related to nuclear medicine procedures, the gradual development of the ASN's radiation protection controls, allied with environmental monitoring targeted on certain installations and the use of appropriate computer models, should provide a clearer view of the impact of medical uses of sources of ionising radiation. These actions are part of multi-year programmes.

6 ASN VIEWPOINT ON THE PERCEPTION OF RADIATION PROTECTION IN THE MEDICAL FIELD

With the hindsight offered by several years of monitoring of medical installations and contacts with professionals in the medical and dental sectors, as well as the suppliers, installers and inspection organisations, the ASN has now sufficient information to assess the perception of radiation protection by professionals using sources of ionising radiation for medical purposes. The considerable diversity of the installations and medical practices means that radiation protection is dealt with in widely differing ways. The ASN encounters many kinds of situations, ranging from purely administrative radiation protection with the main purpose of declaring the use of a radiology installation or obtaining a licence, to the implementation within an establishment of a structured organisation in order to heighten the awareness and make all those concerned by the use of sources more responsible.

In addition, the radiation protection approach varies considerably depending on whether the ionising radiation is used for its therapeutic and functional imaging effects (dose or level administered) or simply to obtain radiological images.

W. Roentgen and the first radiography negative (Mrs Roentgen's hand)

In the first case, corresponding to the fields of radiotherapy or nuclear medicine, overall the radiation protection rules are known and accepted, provided that they do not constitute an obstacle to the development of medical practices and the performance of medical procedures. However, actual implementation of these rules may often be delayed by administrative, financial or technical constraints specific to hospitals.

In the second case, many users of radiodiagnosis appliances - although this number is now beginning to fall - still see radiation protection as a constraint imposed from outside, with consequences of an administrative (regulatory pressure), technical (obligation to make various installation or work procedure modifications) and financial (cost of modifications, checks, time required, etc.) nature that are felt to be excessive given the fact that the risks are not clearly quantified. Therefore this situation leads to delays in applying current radiation protection regulations.

However, this situation can be offset by information programmes and the work being done by various learned societies and professional bodies which, through high levels of sustained investment, are regularly helping to raise the awareness of those concerned by radiation protection.

These findings should therefore encourage the ASN to continue its efforts to develop supervision of application of the regulations as well as its training and information programmes with the professionals in the medical world, to ensure a continuous process of radiation protection improvement.

In August 2005, the ASN therefore published a letter intended for nuclear medicine professionals, recalling the current radiation protection regulations, together with recommendations designed to make them easier to implement. This document, which is added to that intended for radiotherapists (see point 4|3|1 of this chapter), is a response to a request from the Société française de médecine nucléaire et d'imagerie moléculaire (SFMNIM). It is available from the ASN's website (www.asn.gouv.fr).

To allow a more precise assessment of changes with respect to radiation protection of personnel, installations and patients, the ASN also defined a series of specific indicators.

These indicators will be collected as of 2006 during each inspection of medical or industrial installations conducted by the ASN. A summary of these data will be produced following the annual inspection programme and will be published. Table no. 5 below details the indicators selected, with the corresponding objectives.

7 OUTLOOK

With the creation of the radiation protection inspectorate in 2006, combined with continued growth in its resources, the ASN will be able to expand the development of long-term actions in the field of radiation protection supervision of medical installations, in particular on the basis of the findings regarding the current situation. These actions will more specifically be aimed at:

- from the radiation protection viewpoint, the ways in which new irradiation techniques can be used in radiotherapy, or new radioactive tracers can be used in nuclear medicine;
- the creation of a notification system for radiation protection incidents in medical installations, so that lessons can be learned from the data collected in this way;
- medical radiophysics, with each establishment containing a radiotherapy, nuclear medicine, tomography or surgical radiology unit drafting a plan organising this discipline within the establishment. The ASN will closely check that these plans exist and that the resources allocated to radiophysics are appropriate and operational;
- new radiation protection supervision actions in surgical radiology;
- implementing radiation protection assessment indicators in the medical field.

Table 5: radiation protection indicators

Indicators selected	Presentation of the indicator
	Personnel radiation protection
Presence of a person with competence in radiation protection (PCR) or a department with competence in radiation protection (SCR)	Strict minimum when attempting to organise radiation protection within an establishment
Performance of workstation studies	Proves that consideration is being given to the organisation of work and radiation protection
Implementation of operational dosimetry (whenever relevant) and transmission of results to SISERI	Provides the PCR and the personnel concerned with a tool for estimating the doses received. Through knowledge of the doses at the workstations, helps improve individual and collective radiation protection. Apart from the regulatory aspect, transmission of data to SISERI is one way of contributing to setting up a radiation protection organisation
Implementation of RP continuing training programmes	Contributes to raising the personnel's knowledge of radiation protection and is a tool allowing structuring of radiation protection for the long-term
Periodic inspections by approved organisations	Tool giving an outside view of the radiation protection system, enabling RP to be structured for the long-term
Overshooting of one of the annual exposure limits	Indicates serious inadequacies in optimisation and problems with controlling radiation protection
	Installations radiation protection
Administrative situation of the installation in good order (currently valid licence, notification submitted). The nuclear activity is covered, at least in part, by a licence (expiry date has not passed) or a notification	The ASN is thus aware of the installation and can carry out supervision, both administrative and in the field. Account taken of regulatory obligations confirming a minimum RP level.
Existence of a waste and radioactive effluent management plan (if unsealed sources)	Proves that an organisation has been set up for collection and then disposal of radioactive waste and effluent
	Radiation protection of patients
Presence of PSRPM in the units	Competence for determining and guaranteeing the doses delivered
Preparation of a radiophysics plan	Long-term consideration given to developing radiophysics in the establishment, allowing definition and then acquisition of tools for implementing the optimisation process
Creation of reference diagnostic levels (NRD) (if radiology or nuclear medicine)	Optimisation approach for identifying and then controlling the doses
Existence of quality control	Contributes to the optimisation process. Search for improved reproducibility of exposure quality and medical procedure safety

INDUSTRIAL AND RESEARCH ACTIVITIES

CHAPTER 10

1 PRESENTATION OF INDUSTRIAL AND RESEARCH ACTIVITIES USING IONISING RADIATION

1|1 Sealed radioactive sources
1|1|1 Industrial irradiation
1|1|2 Non-destructive testing
1|1|3 Checking of parameters
1|1|4 Other common applications

1|2 Unsealed radioactive sources

1|3 Electrical generators of ionising radiation

1|4 Particle accelerators

1|5 Activities being phased out, unjustified activities, prohibited activities

2 REGULATORY PROVISIONS CONCERNING INDUSTRIAL AND RESEARCH APPLICATIONS

2|1 Licensing procedures for ionising radiation sources used for industrial and research purposes

2|2 Radionuclide source management rules

2|3 Licensing procedures

3 INSTALLATIONS INVENTORY AND SOURCE MOVEMENTS

3|1 Sources of ionising radiation
3|1|1 Radionuclides
3|1|2 Electrical generators of ionising radiation

3|2 Radionuclide manufacturers and suppliers

3|3 Radioactive source users and monitoring

3|4 Source inventory
3|4|1 The inventory of radioactive sources
3|4|2 Inventory of electrical generators of ionising radiation

4 PRIORITIES IMPLEMENTED DURING THE YEAR

4|1 General actions

4|2 Suppliers

4|3 Users

5 CHECKS ON RADIATION SOURCES AND INSTALLATIONS

5|1 Checks conducted by the ASN

5|2 Sealed source retirement

5|3 Impact of industrial and research installations

6 SIGNIFICANT EVENTS

7 OUTLOOK

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 production, possession, use and disposal of the sources. The investigations carried out by the ASN in 2004 confirmed that the means devoted to radiation protection in the industrial and research worlds vary widely. This situation led the ASN to define areas for action, in the light of these existing resources. This year, particular efforts were therefore focused on the manufacturers and suppliers of radionuclide sources, as they have considerable responsibility for the entire life of the radioactive sources, from production up to final disposal. It is 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 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 radioactive sources

The main uses of sealed radioactive 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 shelf-life of fresh fish and strawberries, eliminates deterioration agents and pathogenic micro-organisms in shellfish and meat (fresh or frozen), and technically improves foodstuffs, for example by increasing juice production from grapes or reducing the cooking time of dehydrated vegetables.

At high doses, ionisation offers industrial sterilisation of meat and seafood, of ready-to-eat foods, of hospital meals and decontamination of certain food additives and ingredients such as spices, gums, and enzyme preparations. These consumer product irradiation techniques may be authorised because once the products are treated, they show no signs of added artificial radioactivity. Industrial irradiators use cobalt 60 sources, the total activity of which can exceed 250,000 TBq. Some of these installations are classified as basic nuclear installations (BNIs).

1 | 1 | 2

Non-destructive testing

Of the non-destructive testing techniques, gamma radiography in particular uses radioactive sources. It is used to inspect homogeneity defects in metal, particularly in weld beads. It uses iridium 192 sources and cobalt 60, with activity not exceeding about twenty terabecquerels. A gamma radiography appliance mainly comprises:

- a source applicator, used as a storage container when the source is not in use and for transport;
- an ejector tube and remote control designed to move the source between the applicator and the object to be radiographed, while protecting the operator who can remain at a distance from the source;
- a radioactive source inserted into a source-holder.

The gammagraph is usually a mobile device that can be moved from one site to another.

Gammagraphy equipment and its radioactive source

1 | 1 | 3

Checking of parameters

The radionuclides most frequently employed are krypton 85, caesium 137, americium 241, cobalt 60 and prometheum 147. The source activity levels are between a few kilo becquerels and a few giga becquerels. These sources are used for the following purposes:

- atmospheric dust measurement; the air is permanently filtered through a tape running at a controlled speed, placed between source and detector. The intensity of radiation received by the detector depends on the amount of dust on the filter, which enables this amount to be determined. The most commonly used sources are carbon 14 (activity 3.5 MBq) or prometheum 147 (activity 9 MBq). These measurements are particularly used for air quality monitoring by checking the dust content of discharges from plants;
- basis weight measurement: a beta radiation beam passes through the paper and then is received by a detector. The signal attenuation on this detector allows to know the paper density and thus the basis weight. The sources used are generally krypton 85, prometheum 147 and americium 241 with activity levels lower than 3 GBq;
- liquid level measurement: a beam of gamma radiation passes through the container filled with a liquid. It is received by a detector positioned opposite. The signal attenuation on this detector provides the level of filling of the container and automatic triggering of certain operations (stop/continue filling, alarm, etc.). The radionuclides used depend on the characteristics of the container and the con-

tent. As applicable, americium 241 (activity 1.7 GBq), caesium 137 - barium 137m (activity 37 MBq) are generally used;
• density measurement and weighing: the principle is the same as for the above two measurements. The sources used are generally americium 241 (activity 2 GBq), caesium 137-barium 137m (activity 100 MBq) or cobalt 60 (30 GBq);
• soil density and humidity measurement, or gammadensimetry, in particular in agriculture and public works. These devices operate with a pair of americium-beryllium sources and a caesium 137 source;
• logging, which enables the geological properties of the sub-soil to be examined by inserting a measurement probe comprising a source of cobalt 60, caesium 137, americium-beryllium or californium 252.

1 | 1 | 4

Other common applications

Sealed sources can also be used for:
• eliminating static electricity;
• smoke detection (see box);
• calibration of measuring instruments (radiation metrology);

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. At the same time, the ASN has started discussions with the profession, concerning the eventual withdrawal of smoke detectors containing radioactive sources. It is planned to put an end in 2007 to the sale of new devices, except to replace devices for maintenance of detection systems (maintenance means the replacement of existing devices and/or the addition of detectors to an existing line), followed in 2009 by a total interruption of the sale of new devices. From this date, only the reconditioning of old devices would be authorised for two maintenance cycles of a maximum of four years each.

Smoke detector with its radioactive source

• practical teaching work concerning radioactivity phenomena;
• 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;
• detection using X-ray fluorescence devices. This technique is particularly useful in detecting lead in paint (see box).

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 (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. Article 3 of the order of 12 July 1999 concerning diagnosis of the risk of intoxication from the lead contained in paint, implementing article R. 32-2 of the Public Health Code, states that "the lead will preferably be measured using a portable X-ray fluorescence device". This non-destructive analysis method allows instantaneous detection of lead in a coating.

The material to be analysed is excited by an input of energy, to obtain a spectrum in which the presence of the line characteristic of lead can be recognised and quantified. The measurement principle is as follows: the gamma photon emitted by a radionuclide interacts photoelectrically to eject an electron from an atom of the target. De-excitation of the atom to return it to its equilibrium state, leads to emission of an X-ray photon (X-ray fluorescence), the energy of which is characteristic of the element to be analysed (lead). The X-ray photons emitted are counted by a detector and their number is proportional to the number of atoms per unit surface area of the element looked for. Measurement precision is currently 0.058 mg of lead per cm^2 of surface.

The appliances, which are portable, use sources of cadmium 109 (half-life 464 days) or cobalt 57 (half-life 270 days). The activity of these sources is about 400 MBq.

In 2004, a new type of device came onto the market, containing no radioactive source and using an electrical generator working on the same principle as the emission of X-ray fluorescence photons.

These various devices are used by a wide variety of organisations, mainly consulting firms, architects, surveyors, solicitors, real estate agents and building managers. The ASN therefore ensures that the appliances offer radiation protection guarantees appropriate to the conditions of use and sets obligations on the users for handling and storage of these appliances, in order to prevent unauthorised loans and theft.

Portable X-ray fluorescence equipment to detect lead in paint

1 | 2

Unsealed radioactive 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 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.

Uses of radioactivity in molecular biology

Molecular biology is a scientific discipline which studies the molecules carrying the hereditary message:

- deoxyribonucleic acid (DNA). DNA carries genetic information, because it has the particularity of replicating and being transmitted to the descendants. It has a data storage role;
- ribonucleic acid (RNA). RNA plays a key role in synthesising proteins. It is the messenger of the genetic data (gene transcription).

In these molecules, molecular biology analyses the structure of the genome and its alterations (mutations) as well as the mechanisms of the normal and pathological expression of the genes. The term molecular biology is sometimes used to designate gene study techniques.

These techniques include:

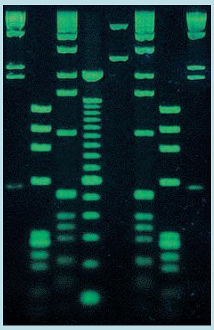
- the Southern technique, developed by the British researcher E. Southern in 1975. It is used to identify and observe a DNA sequence or a gene without isolating it;
- the Northern technique, in which the process - identical to that of the Southern technique - is applied to RNA;
- the Western-Blot reaction which is used to look for antigenic (for example viral) proteins or antibodies, in particular in blood serum.

These techniques use a nucleic probe or an antibody marked with a radioactive isotope allowing identification, visualisation and quantification by autoradiography, in other words by obtaining an image produced on a photographic film (or emulsion) placed in contact with the preparation, through the radiation of the radioactive marker. For example, in the case of marking of a DNA or RNA probe, an atom of radioactive phosphorus (^{32}P or ^{33}P) or radioactive sulphur (^{35}S) is incorporated into a nucleotidic sequence. The activity levels involved are about 2 to 4 MBq;

For in vivo marking techniques, thymidine marked with tritium (^{3}H) is generally used for DNA and uridine marked with tritium for RNA. The activity levels employed are about 10 to 100 MBq.

Although radioactive marking techniques are common, in certain cases, other "cold" marking methods (in other words without radionuclides) can also be used to visualise macromolecules. These are for example fluorescent, chemical or bioluminescent markers, or detection of the {enzyme-substrate} complex using colorimetry.

Example of a workstation



Example of an autoradiography of a "blot"

1 | 3

Electrical generators of ionising radiation

Electrical generators of ionising radiation (generally X-rays) are mainly intended for use in non-destructive structural analyses (tomography, diffractometry, etc.), checks on weld bead quality, or material fatigue inspections (aerospace).

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.

Veterinarians also use these appliances for bone radiography and other common diagnosis procedures.

These appliances are also used for industrial gauging purposes (drum filling measurement, etc.) working on the principle of X-ray attenuation.

Unlike equipment used in the medical field, there is no CE marking obligation allowing free circulation of these appliances throughout the European Union.

1 | 4

Particle accelerators

Finally, certain applications require the use of particle accelerators which produce photon or electron beams.

The inventory of particle accelerators in France, whether linear (linacs) or circular (cyclotrons and synchrotrons), comprises about 50 installations which can be used in a wide variety of fields, as presented in table 1 below.

1 | 5

Activities being phased out, unjustified activities, prohibited activities

Various activities are tending to disappear, mainly because of technological progress: this is the case with determining the dew point, level measurements and density measurements, for which techniques based on X-rays or ultrasounds are tending to replace those based on radionuclides. This is also the case with measuring snow height or the position of cable cars using a radionuclide source incorporated into the splices of the support cable.

The manufacture and sale of lightning arresters containing radionuclides was prohibited by the order of 11 October 1983 concerning the ban on the use of radioelements in the manufacture of lightning arresters and on the sale and import of these lightning arresters, applicable as of 1 January 1987, in response to the concerns mentioned in article L. 1333-2 of the Public Health Code, which specifies that "certain activities and certain processes, devices or substances exposing persons to ionising radiation may, owing to the scant benefits they offer or the degree of harm they cause, be prohibited by the regulations or may be regulated".

No intentional addition of radionuclides in consumer goods and construction products is therefore authorised (articles R. 1333-2 and 3 of the Public Health Code). In this respect, the manufacture, import and trade in irradiated precious stones, which contain residual activity following activation designed to improve their aesthetic quality and sale value, are not authorised.

INDUSTRIES	PROCESSES	PRODUCTS
Chemistry Petrochemistry	Cross-linking Depolymerisation Covalent bonding – Polymerisation	Polyethylene, polypropylene, copolymers, lubricants, alcohol
Coatings Adhesives	Vulcanisation Covalent bonding Polymerisation	Adhesive tapes, coated paper products, ply panels, heat shields, wood-plastic and glass-plastic composites
Electricity	Cross-linking Thermal memory Modification of semiconductors	Constructions, instruments, telephone wires, power cables, insulating tape, shielded cable splices, Zener diodes, etc.
Foods	Disinfection – Pasteurisation Conservation – Sterilisation	Animal feedstuffs, grains, cereals, flour, vegetables, fruit, poultry, meat, fish, shellfish
Health Pharmacy	Sterilisation Modification of polymers	Disposable material, powders, drugs, membranes
Plastics Polymers	Cross-linking Foam manufacturing Thermal memory	Shrink-wrap food packaging, gymnastics appliances, pipes and ducts, moulded packaging, flexible laminated packaging
Environment	Disinfection – Precipitation Organic detoxification Fermentation inhibition DeSOx/DeNOx	Residual sludges for spreading, smoke emission, gases, solvents, water and various effluent, 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: use of particle accelerators

The same applies to accessories such as key-rings, hunting equipment (sighting devices) or equipment for river fishing (floats) fitted with sealed tritium sources.

Case of watches containing tritium

Consideration is being given to the justification for the use of tritiated paint applied to watch faces and hands to make them luminescent or the use of ampoules containing tritium inserted into watch faces or hands. It should be noted that the health impact of watches marked with tritium is very low for their wearers (a few µSv/year) in normal conditions of use and that, for this reason, such watches may be freely purchased in many countries, including in Europe. 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 is worth noting that in France, there are no companies still manufacturing tritium paint.

On this subject, and in the presence of its Swiss counterpart, the ASN met the two leading Swiss companies manufacturing tritiated paint and ampoules. It would appear that tritium paint has been replaced on a massive scale by photoluminescent paint (no radioactivity), but that tritium ampoules, with offer better containment of radioactivity and more persistent luminescence, are still used in numerous applications. The ASN formally reminded these companies of the main requirements of the French regulations, in particular the need for a licence to import any radioactive source from Switzerland.

2 Regulatory provisions concerning industrial and research applications

The provisions concerning the industrial and research applications given in the Public Health Code (articles R. 1333-26 to R. 1333-28) are recalled below.

2 | 1

Licensing procedures for ionising radiation sources used for industrial and research purposes

Table 2 presents the procedures governing the various industrial and research applications, including for veterinary purposes.

Unlike medical applications, industrial and research applications always require licensing, although some of them in certain conditions may be exempted from this licence requirement. The Public Health Code also introduced a licence waiver issued by the Minister for Health for nuclear activities which have already been licensed under the Mining Code, the basic nuclear installations system or that covering installations classified on environmental protection grounds.

Nature of the nuclear activity	Procedure and competent authority	Observations
Manufacture of radioactive sources or devices containing them	Licensing by the Minister for Health (ASN)[1], unless nuclear activity in licensed ICPE comprising section 1700 above notification threshold: prefectoral licence	
Manufacture of products or devices containing radioactive sources		Exemption possible if criteria set in article R.1333-27 of the CSP are met[2]
Use of radioactive sources		
Irradiation of products, including food products		
Use of electrical generators, including particle accelerators	Licensing by Minister for Health (ASN)	Exemption possible if criteria set in article R.1333-27 of the CSP 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 of the CSP are met[2]

Table 2: procedures applicable to industrial or research nuclear activities

(1) The licences issued for nuclear activities subject to the Mining Code or the basic nuclear installations system are equivalent to a licence issued under the Public Health Code.

(2) The criteria for exemption from the licensing procedures apply:

– to radionuclides, if the total quantities involved or their concentration per unit of mass are below the thresholds set in the appendix to the Public Health Code (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.

The maximum validity of the licences is 5 years renewable. The licence which is issued to the head of an installation is personal and non-transferable. Any modification to the licence concerning either its beneficiary, or the installation, or its operating conditions, must be re-examined under article R.1333-36 of the Public Health Code. The licensee must make arrangements to protect, inform and provide radiation protection training for all those likely to be exposed to ionising radiation, specified in articles L. 1333-8 and L. 1333-11 of the Public Health Code.

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. It should be recalled that in 2003, the ASN set up a 24-hour telephone hotline for emergency situations (toll-free number: 0 800 804 135), but which can also be used for any radiological incident occurring in an industrial or research facility using sources of ionising radiation.

Section 3|3 provides details on how to prepare the licence application dossiers mentioned in articles R. 1333-26 and R. 1333-27. A regulation currently under preparation and based on article R. 1333-44, will detail the corresponding procedures.

Particular conditions for the use of radioactive sources

*(the texts marked with * denote the most frequently used)*

- licensing of sealed sources: conditions applicable to the recovery and disposal of expired sources or sources which are no longer used (CPAs)*;
- extension of the licence to use radioactive sealed sources of artificial radioelements beyond the ten-year period stipulated in the CPAs;
- use of natural krypton gas;
- use of gaseous phase leak detectors on underground piping;
- use in hydrology;
- use for measuring air renewal rates;
- use of portable devices*;
- use of adsorbed tritium sources;
- use for ionisation of electron tubes and discharges;
- use for combustion smoke or gas detectors*;
- use of sealed sources for reference, calibration and testing*;
- distribution of laboratory reagents, calibration sources and measuring or analysis instruments;
- use of sources which, in nuclear power reactors are employed as start-up sources, or in fixed radiation protection channels for unit control systems, or in boron meters and power range measurement channel control systems as well as in irradiation specimen capsules.

Table 3: scope of application of the main particular conditions of use for radiation sources

Particular conditions for the 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 (CPEs) 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 decree 2002-460. Table 3 on the previous page presents the areas in which the main CPEs are applied.

The more commonly used of these CPEs will then be transcribed into regulations, while the others will remain particular technical specifications recalled in the individual licences. This is why, given the scale of the risks involved in the practice of gamma radiography, an order was published in March 2004 to update the conditions for use of gamma radiography appliances and cancel the corresponding CPE.

2 | 2

Radionuclide source management rules

These rules, already presented in chapter 3, point 1|2|4, are of course also applicable to the fields of 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;
- preliminary registration of all source movements to the IRSN;
- book keeping by the licensee of detailed accounts for the sources in his possession, and their movements;
- immediate notification to the Prefect and the ASN of any loss or theft of radioactive sources;
- return by the user, at its own expense, to its suppliers - who are then obliged to take them - of sealed sources that have expired, are damaged or are no longer needed.

2 | 3

Licensing procedures

For each nuclear activity mentioned in table 2 above and requiring licensing by the Minister for Health, the corresponding application is examined by the ASN. It must be submitted by the person in charge of the nuclear activity jointly with the head of the establishment or his representative. This dossier should be drawn up on the basis of a form to be collected from the ASN and returned to it, accompanied by all elements requested.

The dossier should establish that radiation protection guarantees are in place and effective and that they were defined taking account of the principles of justification, optimisation and limitation specified in article L. 1333-1 of the Public Health Code. This dossier should therefore comprise elements concerning:
- the justification for the application;
- the conditions of possession and use of the sources;
- the presence of a person with competence in radiation protection;
- the characteristics and performance of appliances containing the sources held and used;
- radiation protection provisions;
- drafting of safety instructions;
- the precautions taken against the risks of theft or fire.

When examining the licensing applications, the ASN may, as it sees fit, call on the expertise of the Institute for Radiation Protection and Nuclear Safety (IRSN) and, if necessary, that of organisations whose competence it recognises in the fields of radionuclide source safety and the safety of electrical generators of radiation.

In 2005, the ASN continued with its actions to promote handling of licensing applications by its regional divisions. The ASN is therefore gradually entrusting the Regional Departments for Nuclear Safety and Radiation Protection (DSNRs) with the examination of certain licences, for example those concerning the possession and use of gammagraphs, gammadensimeters or appliances for detecting lead in paint.

3 INSTALLATIONS INVENTORY AND SOURCE MOVEMENTS

3 | 1

Sources of ionising radiation

3 | 1 | 1

Radionuclides

Tables 4 and 5 specify the number of facilities authorised to use radioactive sources in the applications identified. They illustrate the diversity of these applications.

It should be noted that a given facility may carry out several activities and will therefore appear in the above-mentioned tables 4 and 5 for each of its activities.

Main uses of sealed radioactive sources	2002	2003	2004	2005
Gamma radiography	189	192	147	140
Density measurement and weighing	455	457	337	289
Thickness measurement	229	221	180	156
Dust measurement	96	94	79	70
Thin layer thickness measurement	39	33	23	20
Basis weight measurement	261	271	228	204
Level measurement	467	449	348	289
Humidity and density measurement	363	339	278	269
Logging	10	9	14	13
Elimination of static electricity	26	27	22	21
Smoke detectors	2	2	2	2
Use of neutrons sources	55	55	44	38
Analysis	111	113	87	80
Calibration	846	875	813	806
Teaching	132	148	137	133
Research	19	21	19	19
Chromatography	516	521	477	450
Electron capture detectors	64	69	56	56
X-ray fluorescence analysis	1,037	1,343	1,643	1,848

Table 4: use of sealed radioactive sources

Main uses of unsealed radioactive sources	2002	2003	2004	2005
Research	1,076	1,082	1,047	1,030
Use of tracers	19	21	16	16
Calibration	95	103	92	84
Teaching	25	23	22	19

Table 5: use of unsealed radioactive sources

3 | 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. 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.

Table 6 specifies the number of facilities authorised to use electrical generators of ionising radiation in the listed applications. It illustrates the diversity of these applications.

Main use of electrical generators of ionising radiation	2005
Non-destructive testing (radiography/radioscopy)	33
Cristallography	11
X-ray fluorescence analysis	60
Industrial gauging (level measurement, etc.)	10
Research	2
Calibration	0
Teaching	2

Table 6: use of electrical generators of ionising radiation

3 | 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 or devices is stable in relation to the previous year. Table 7 shows this trend.

Number of suppliers identified per year			
2002	2003	2004	2005
183	202	182	179

Table 7: supplier licences

3 | 3

Radioactive source users and monitoring

In recent years, there has been a rise in the number of licences issued for the possession and use of sealed sources, primarily due to the growth in the number of devices for detecting lead in paint. It should be noted that a licence can cover the simultaneous use of both sealed and unsealed sources. Table 8 shows a slight rise in users of sealed sources and relative stability in users of unsealed sources.

Number of users identified for each type of source per year							
Sealed radioactive sources				Unsealed radioactive sources			
2002	2003	2004	2005	2002	2003	2004	2005
3,554	3,800	4,180	4,277	758	1,165	1,138	1,110

Table 8: users per type of source

3 | 4

Source inventory

3 | 4 | 1

The inventory of radioactive sources

Movements of radioactive sources around the country are illustrated in table 9.

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.

Sealed source movements				
Sealed sources	2002	2003	2004	2005
in circ. as of 31.12	26,018	24,508	19,478	17,428
distributed in	3,195	2,243	2,067	1,756
recovered in	2,365	2,682	1,534	1,297

Table 9: sealed source movements (IRSN data)

3 | 4 | 2

Inventory of 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 notification, were poorly applied. Furthermore, unlike the system put in place for sealed radioactive sources, there was no centralised inventory system supplied with data about transfers between suppliers and users.

However, the creation of a licensing system and the increasing number of field inspections are likely gradually to improve the data available on the generator inventory.

The number of installations using electrical generators of ionising radiation for industrial, research or veterinary purposes is currently estimated at several thousand.

4 PRIORITIES IMPLEMENTED DURING THE YEAR

4 | 1

General actions

In 2005, and in addition to its regulatory preparation work, the ASN initiated or continued with several actions of a more general nature designed to improve awareness of the applicable regulations, rationalise the scope of certain licences concerning a given facility, or promote the drafting of guides of good practice by the professionals.

These informative actions include ASN participation in:
- the "National research laboratories radiation protection prevention days" organised by the INSERM (national health and medical research institute);
- the days organised by the COFREND (French confederation of non-destructive testing), specifically dealing with gamma radiography;
- the SFRP (French radiation protection society) days dealing with radioactive sources;
- several meetings held in universities.

These actions enable the ASN to recall the main applicable regulatory requirements, to specify what they expect and to stress practical aspects for facilitating the smooth running of the licensing process. They are also the opportunity for the ASN to obtain direct feedback from the users concerning any constraints and difficulties they are experiencing. With respect to rationalisation of the scope of licensing, we would also mention:
- the continued process to combine the licences of the Pasteur Institute in Paris, with a view to improved internal supervision of the Institute;
- combination of the licences (in particular for gamma radiography) of several companies with a number of facilities in France and operating with internal rules common to the various sites.

When the company organisation so allows, this approach is designed to reduce the number of licences covering all the company's activities and thus shift overall responsibility to the head of the facility.

Finally, concerning the encouragement given to professionals to define guides of good practice for radiation protection in their daily activities, the ASN in July 2005 suggested to the COFREND that consideration be given to justification of gamma radiography work and production of a document detailing the best practices to be observed, both by the client and by the gamma radiography contractors. Gamma radiography is an area in which the radiation protection stakes are high, as incorrect use of the appliances or loss of a gammagraph source are likely to have serious health consequences. This hazard is indeed illustrated by the accident which occurred on 15 December 2005 in Chile, in which a Chilean worker was seriously irradiated and is currently being treated at the Percy hospital in France. In a letter dated 8 September 2005, the COFREND agreed in principle to such actions.

4 | 2

Suppliers

In 2005, the ASN carried on with priority action initiated in 2003 about the suppliers of radionuclide sources or appliances containing them and used for industrial or research purposes. These companies have considerable responsibility for the safety of source movements, their traceability, the recovery and the disposal of used or unwanted sources. It is therefore important that their situation with regard to radiation protection rules be transparent and unambiguous and that their activities be duly covered by the licence specified in article R. 1333-27 of the Public Health Code.

During the course of 2005, 35 licences were issued to suppliers and 11 licences were revoked. Several dozen dossiers are also being investigated by the ASN.

In this respect, these dossier investigations can last a long time, given the combination of various negative factors, including:

- the problem in identifying the right people to talk to and then obtaining pertinent data about the sources and appliances;
- the complexity of the radiation protection analyses for appliances and radionuclide sources;
- obtaining specific guarantees to ensure effective recovery of used or unwanted sealed sources.

However, the extensive work currently under way on this type of dossier will ease later examination subsequently when renewing licences or when licence modifications are requested.

4 | 3

Users

Examination by the ASN of about 1300 application dossiers for possession and use of radionuclides led to 351 new licences being notified and 209 licences being revoked. About 800 dossiers concerning an industrial or research activity are currently being examined by the ASN. Table 10 shows licence issue and revocation trends over the past four 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 are in accordance with the licences of both user and supplier, it being one of the institute's duties to update the inventory of ionising radiation sources. If the order is correct, the movement is then recorded by the IRSN, which notifies the interested parties that delivery may take place.

2005 saw a fall in the number of dossiers being processed and of notifications issued, chiefly concerning new licences, with stabilisation of renewals and updates.

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 notification.

A number of problems were raised during these investigations. In particular, X-ray generators are working equipment according to the Labour Code. Therefore, they have to comply with construction standard NFC 74-100 (construction and tests) setting technical requirements to be met by the generators and which were made mandatory by the order of 2 September 1991, and standards NFC 15-160 (general rules) and NFC 15-164 (rules specific to industrial radiology devices) referred to by the order of 30 August 1991 concerning installation conditions for these appliances. These requirements were not abrogated with the changing regulations, which modified the annual exposure limits for workers and members of the public and which have switched these appliances from the notification category to that requiring licensing.

The ASN has begun discussions with the Ministry for Labour with a view to changing these regulations and encouraged the UTE (technical union of electricity) to begin to update the above-mentioned standards. The UTE therefore initiated a revision of the NF-C 15-160 standards and the associated specific standards.

However, in 2005, the ASN granted 119 licences for the use of electrical X-rays generators.

The case of sources of ionising radiation used in BNIs

Radioactive source "user" licensing trends				
Years	2002	2003	2004	2005
New licences	407	485	560	351
Renewals – update	1,127	1,165	707	739
Revocations	168	200	209	209

Table 10: radioactive source "user" licensing trends

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 use 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 licence. This approach led the ASN in 2004 and 2005 to send the CEA a list of the licences per facility for possession and use of radioactive sources. The regularisation work is continuing with respect to electrical generators of ionising radiation.

5 CHECKS ON RADIATION SOURCES AND INSTALLATIONS

5 | 1

Checks conducted by the ASN

The checks applied to radiation sources depend on the nature of the source and the stage of production and use reached. They are presented in chapter 4, paragraph 2|2|3.

The ASN pays particularly close attention to the use of gamma radiography appliances. In this respect, the ASN sent out a circular letter to the firms concerned on 26 April 2004, urging them to abide by the main regulatory requirements in force, following the discovery of numerous inadequacies in application of good radiation protection practices, and even some serious breaches of the regulatory requirements stipulated in the Public Health, Labour and Environment Codes. This circular letter was the subject of an information note published on the ASN web site (www.asn.gouv.fr). The ASN made inspection of establishments using gamma radiography appliances once of its priority inspection topics for 2004 and 2005. The main inadequacies concern prior evaluation and optimisation of doses, as well as the conditions for carrying out gamma radiography operations on the worksites. The ASN clearly informed the gamma radiography professionals that they would need to exert greater diligence in the operation and transport of gammagraphs.

5 | 2

Sealed 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 use of the source. On the basis of this document, the source is removed from the user's inventory in the national source inventory managed by the IRSN, but a trace of it is kept in an "archives" 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 further strengthen the guaranteed recovery of radionuclide sources and make the system easier to use, the suppliers set up a non-profit association in 1996, called Ressources, the purpose of which is to create a guarantee fund from which to reimburse ANDRA or any other approved organisation for the cost involved in recovering sources from the user, either because the supplier normally responsible for their recovery has defaulted, or because no supplier can be identified in the case of stray sources.

The Ressources association, which comprises about sixty members, has become the profession's main interface, in that it covers nearly 95% of the market for this activity.

As part of the national radioactive waste management plan (see chapter 16), solutions for the used source disposal are being studied because there is still no disposal channel for them. A draft regulation stipulating the disposal (decommissioning) method for sources is being prepared accordingly. The ASN also gave its agreement in principle for disposal in the Aube repository of sources with a half-life equal to or less than that of caesium isotope 137 (or about 30 years).

5 | 3

The impact of industrial and research installations

The ASN currently has little data to enable it to assess the impact of the uses of sources of ionising radiation for industrial and research purposes, except with respect to worker exposure.

According to the existing data collected by the IRSN concerning exposure of workers active in industry or research, these sectors respectively comprise 36,787 and 11,147 exposed persons who are subject to dosimetric monitoring. In industry, 90% of those monitored (IRSN 2004 figures) received an effective dose over one year of less than 1 mSv and the annual limit of 20 mSv was found to have been exceeded 10 times, while no overshoot was detected in the research sector where nearly all (99.8%) of the staff monitored were not exposed to an effective annual dose of more than 1 mSv. It is worth noting a slight drop in the average dose received by industrial workers, which is about

250 microsieverts, and a relative drop in the number of industrial workers who received an annual dose in excess of 1 mSv (10% above this value in 2004 as opposed to 20% in 2003). The number of occasions on which the 20 mSv limit was exceeded fell significantly, from 40 in 2003 to 10 in 2004.

The impact of non-BNI industrial or research applications on the environment and the general public has not been the subject of any specific monitoring, except special cases. The available information concerns general environmental monitoring as performed by the IRSN, in particular ambient gamma radiation measurement, which on the whole shows no significant level of exposure above variations in background natural radioactivity, except occasionally and momentarily when gamma radiography is detected by the monitoring and alarm system.

The gradual expansion of ASN radiation protection supervision, allied with environmental monitoring targeted on certain installations and the use of appropriate computer models, should provide a more accurate picture of the impact of industrial and research applications. These actions will have to be incorporated into multi-year programmes.

6 Significant events

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.

For the year 2005, there were about twenty, including:
- 15 losses or thefts of sealed sources from their place of use;
- 2 potential over-exposure incidents.

7 Outlook

With regard to supervision of the applications of ionising radiation in industry and research, the ASN continued to define its priorities in order to optimise use of the means available to it. At the same time, the gradual growth in the ASN's resources continued so that within a few years it will be in a position to carry out all of its duties.

The action taken in previous years was also carried on and supplemented by:
- 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;
- application of the licensing system to electrical generators of ionising radiation used in industry and research;
- visits carried out in particular to the users and those in possession of gammagraphs and gammadensity meters;
- rationalisation of licences within the establishments whenever possible, with continuation of this particular objective, which will be made easier by the planned changes to the Public Health Code.

TRANSPORT OF NUCLEAR MATERIALS

1 **GENERAL INTRODUCTION**

1|1 Packages

1|2 Annual traffic

1|3 Industrial participants

1|4 Safety supervision provisions for the transportation of radioactive materials

2 **REGULATIONS**

2|1 International regulations

2|2 National regulations

3 **ASSESSMENT OF SAFETY DOCUMENTS**

3|1 Issue of package designs approval certificates

3|2 The quality assurance approach

4 **INSPECTION AND FIELD SUPERVISION**

5 **INCIDENTS AND ACCIDENTS**

5|1 Nonconformity of container or content

5|2 Package handling events

5|3 Incidents and accidents during actual transport

6 **EMERGENCY RESPONSE PROVISIONS**

7 **OUTLOOK**

CHAPTER 11

The Nuclear Safety Authority (ASN) has since 12 June 1997 been responsible for regulations pertaining to the safe transport of radioactive and fissile materials for civil use and for supervision of their application. Its powers in this field were confirmed by decree 2002-255 of 22 February 2002 which created the Directorate General for Nuclear Safety and Radiation Protection.

It should be noted that the radioactive material transport regulations have two separate objectives:
- security, or physical protection, consists in preventing loss, disappearance, theft and misuse of nuclear materials (usable for weapons), for which the Defence High Official, attached to the Minister of the Economy, Finance and Industry, is the responsible authority;
- for its part, safety consists in supervising the irradiation, contamination and criticality hazards involved in radioactive and fissile material transportation, ensuring that man and the environment undergo no ill effects. Monitoring safety is the responsibility of the ASN.

In application of the decree 2001-592 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).

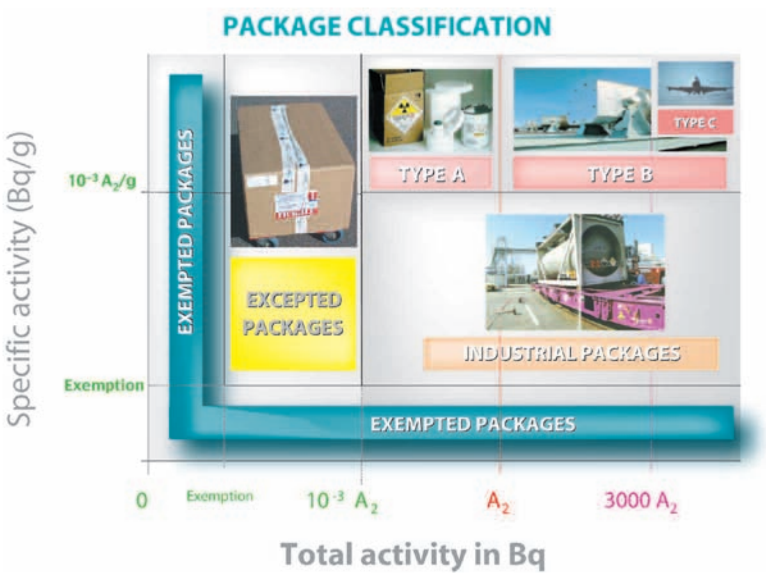
1 GENERAL INTRODUCTION

1 | 1

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.

The adjoining diagram shows the different types of package defined by the regulations.



Type of package depending on total and specific activity

Packages fall into one of the following categories:
- excepted packages: very low activity of contents, below 10^{-3} A1 or 10^{-3} A2;
- industrial packages: low specific activity of contents, below 2.10^{-3} A1/g or 10^{-3} A2;
- type A packages: activity of contents below A1 or A2;
- type B packages: activity of contents above A1 or A2;
- type C packages (air transport): activity of contents above 3000 A1 or 3000 A2.

This package classification only applies to the transportation of materials having specific 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.

Types A and B packages

Example of a type A packaging – Technetium 99 generator

Example of a type B packaging – Gammagraph containing an iridium source

Each type of package is governed by specific safety requirements and test criteria confirming the capacity of the package to withstand normal or accident transport conditions (see box below).

Characteristics of the various types of packages

Excepted packages are subjected to no qualification tests. However, they must comply with a number of general specifications, such as a maximum dose rate at the surface below 0.005 mSv/h. Non-fissile industrial or type A packages are not designed to withstand accident situations. However, they must withstand certain incidents which could occur during handling or storage operations. They must consequently withstand the following tests:

- exposure to a severe storm (rainfall reaching 5 cm/h for at least 1 hour);
- drop onto a rock target from a height varying according to the weight of the package (maximum 1.20 m);
- compression equivalent to 5 times the weight of the package;
- penetration by dropping a standard bar onto the package from a height of 1 m.

These tests should give rise to no loss of material and radiation shielding deterioration must not exceed 20%.

Fissile or type B packages must be designed so that they continue to ensure their containment, sub-criticality and radiation shielding functions under accidental conditions. These accidents are represented by the following tests:

- a series of 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. These accidents are represented by the following tests:

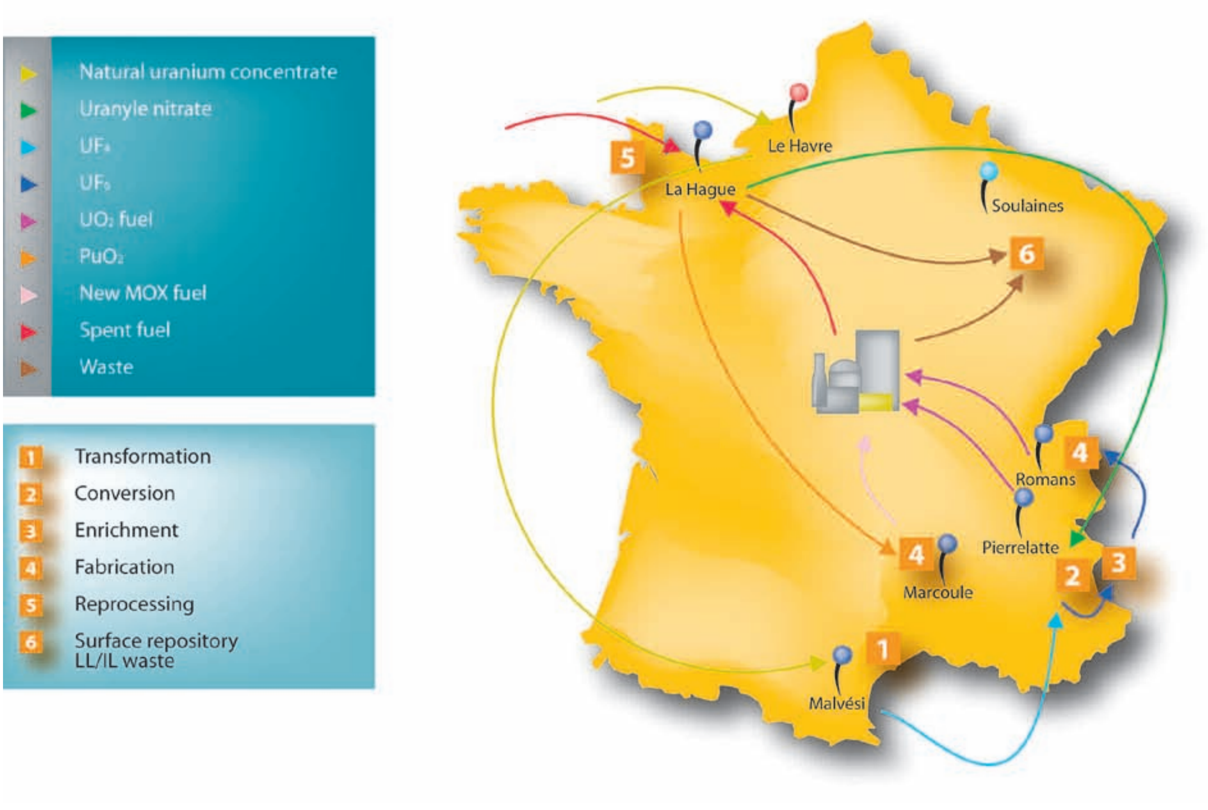
- a series of three consecutive tests:
  - a 9 m drop test onto a rock target,
  - a 3 m drop onto a spike,
  - encircling fire of at least 800 °C for 60 minutes;
- 90m/s impact on a rock target;
- immersion in 200 m deep water for 1 h.

1 | 2

Annual traffic

Several hundred thousand radioactive material packages are transported in France annually, representing a few percent of the dangerous goods traffic. Most (two-thirds) consist of radioisotopes for medical, pharmaceutical or industrial use. The diversity of these packages is considerable. Their radioactivity varies by more than twelve orders of magnitude, or from a few thousand becquerels (pharmaceutical packages) to millions of billions of becquerels (spent fuel), and their weight from a few kilograms to about a hundred tons.

The nuclear power cycle industry gives rise to the transport of many sorts of radioactive materials: uranium concentrates, uranium tetrafluoride, depleted, natural or enriched uranium hexafluoride, fresh or spent fuel assemblies containing uranium oxide or mixed uranium and plutonium oxide (MOX), plutonium oxide, waste from power plants, reprocessing plants, CEA research centres, etc. (see diagram). The largest consignments concern about 300 shipments per year for fresh fuel, 450 for spent fuel, about 30 for MOX fuel and about 60 for plutonium oxide powder.



Transports related to the fuel cycle in France

Since transport provisions are international, France is also a transit country for some of these shipments, for instance for spent fuel packages from Switzerland or Germany, bound for Sellafield in Great Britain, which are taken on board ship at Dunkirk.

Spent fuel transports from Germany stopped at the end of June 2005 in compliance with the agreements between the government and the electricity utilities of this country.

1 | 3

Industrial participants

The main participants in transport arrangements are the consignor and the carrier. The consignor is responsible for package safety and accepts his responsibility by way of the dispatch note accompanying the package remitted to the carrier. Other participants are also involved: the package designer, manufacturer and owner and the carriage commission agent (authorised by the consignor to organise the transport operation).

For a radioactive material shipment to be carried out under good safety conditions, a stringent chain of responsibility has to be set up. So, for major transport operations:

- the consignor as nuclear licensee must be fully aware of the characteristics of the material to be transported, so that he can select packaging and specify transport conditions accordingly;
- the corresponding packaging must be designed and sized in accordance with conditions of use and current regulations. In most cases, a prototype is needed to carry out the tests prescribed by the regulations. Following this phase, the safety file is drawn up and submitted to the competent Authority, to back up the authorisation application;
- in cases where existing containers are used, their conformity with approved models has to be confirmed. In this context, the container owner must set up a maintenance system in conformity with that described in the safety file and the authorisation certificate;
- the container is sent to the consignor's site, where it will be loaded with the material for transportation. The consignor must carry out the inspections for which it is responsible (leaktightness, dose rate, temperature, contamination) on the loaded container prior to entry on a public road or railway track;
- the transport operation itself is organised by the carriage commission agent, who is responsible for obtaining requisite permits and complying with advance notice requirements on behalf of the consignor. He also selects the means of transport, the carrier and the itinerary, in compliance with the above-listed requirements;
- the actual transportation is entrusted to specialised firms, having the necessary permits and vehicles. The drivers of road vehicles in particular must be in possession of the training certificate required by the regulations.

1 | 4

Safety supervision provisions for the transportation of radioactive materials

In the context of supervision of the safe transportation of radioactive and fissile materials, the Nuclear Safety Authority (ASN) is responsible for:

- defining technical regulations and supervising their application;
- accomplishing authorisation procedures (approval of packages and organisations);
- organising and implementing inspection procedures;
- proposing and organising information of the public.

In addition, the ASN acts within the context of emergency plans defined by the authorities to deal with an accident.

In a decision of 1 December 1998, the ministers responsible for nuclear safety set up an Advisory Committee for the transportation of nuclear materials, on similar lines to those which already existed. Depending on the importance of the issue, expert assessment by the Institute for Radiation Protection and Nuclear Safety (IRSN), at the ASN's request, could be supplemented by an Advisory Committee review.

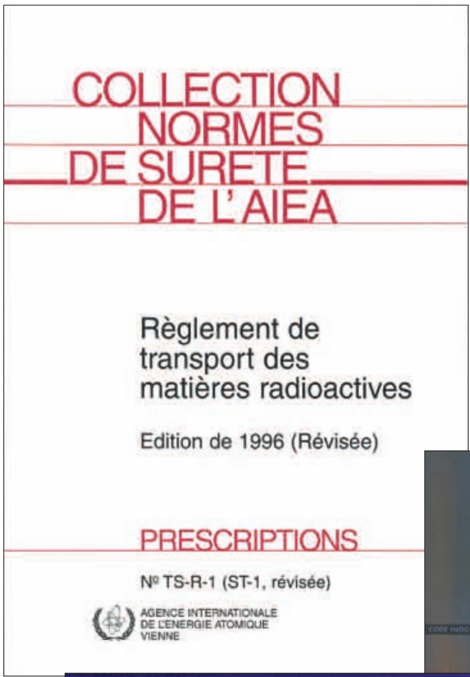
2 REGULATIONS

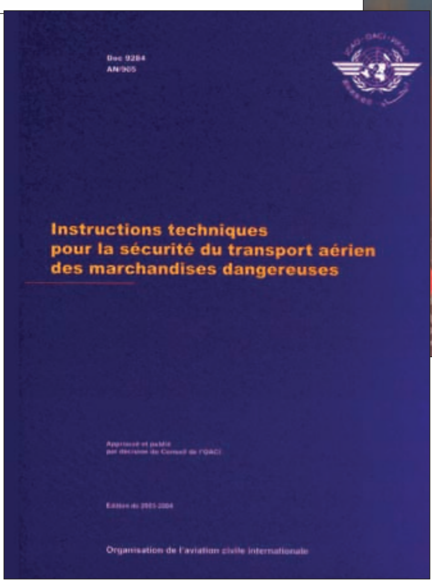
Unlike the technical safety regulations for plants, which are specific to each State, an international basis has been defined by the International Atomic Energy Agency (IAEA) for transportation safety.

2 | 1

International regulations

This basis has been used for the definition of the modal safety regulations currently in force: the ADR agreement (European agreement on the international transport of dangerous goods by road), RID regulations (regulations concerning the international transport of dangerous goods by rail), the IMDG code (international maritime dangerous goods code) 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 and Directorate for Maritime Affairs and Seafarers, combined in 2005 into the Directorate General for Maritime Affairs and Transports, and the General Directorate for Civil Aviation) and has a representative at the Interministerial Committee on the Transport of Dangerous Goods (CITMD).





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 results to be obtained (see point 1|1).

The ASN aims to intervene as early as possible in the drafting of the regulations, jointly with the IRSN, in particular by taking part in the various international or multinational working groups that exist to deal with the transport of hazardous or radioactive goods.

In this context, the ASN is a member of the IAEA TRANSSC Committee (Transport Safety Standards

Committee) and is represented as an expert in many working parties, organised according to transport mode, in cases where radioactive material transport is at issue.

In this way, an ASN representative took part in the TRANSSC committee meeting held from 7 to 11 March 2005 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 regulations (2005 edition) which took place from 5 to 9 November 2005.

The ASN is also a member of the safety of radioactive material transports standing working party of the DG Energy and Transport of the European Commission.

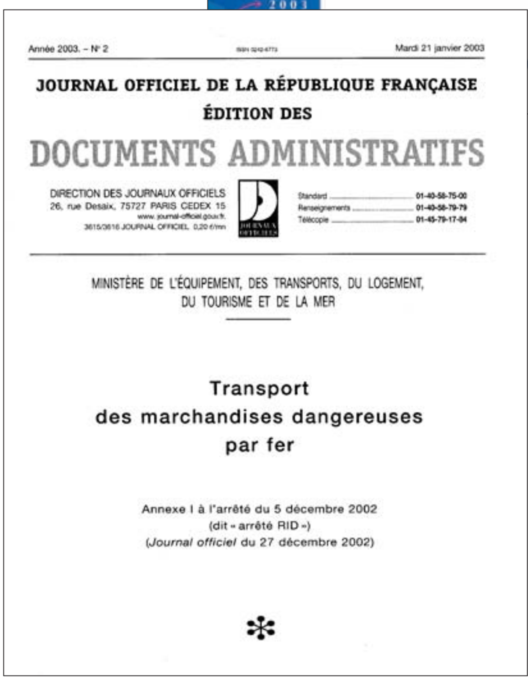
In this capacity, it took part in the meetings of this working party on 2 June and 1 December 2005.

2 | 2

National regulations


LÉGISLATION ET RÉGLEMENTATION

Arrêté du 5 décembre 2002
relatif au transport
des marchandises dangereuses
par route
(dit : arrêté ADR)


Année 2003. – N° 2 Mardi 21 janvier 2003

JOURNAL OFFICIEL DE LA RÉPUBLIQUE FRANÇAISE
ÉDITION DES
DOCUMENTS ADMINISTRATIFS

DIRECTION DES JOURNAUX OFFICIELS
26, rue Desaix, 75727 PARIS CEDEX 15

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 orders applicable to each mode of radioactive material transport are as follows:
- the order of 1 June 2001 as modified concerning the transport of dangerous goods by road (known as the "ADR order");
- the order of 5 June 2001 as modified, concerning the transportation of dangerous goods by rail (known as the "RID order");
- the order of 5 December 2002 as modified, concerning the transportation of dangerous goods by inland waterway (known as the "ADNR order");
- the order of 12 May 1997 as modified, concerning the technical conditions for the operation of aircraft by a public air transport operator (OPS1);
- the order of 23 November 1987 as modified, division 411 of the regulations for the safety of ships (RSN);
- the order of 18 July 2000 as modified, regulating the transport and handling of dangerous goods in sea ports.

These orders transpose in full the requirements of the international agreements and regulations in force.

The new orders, which were signed or co-signed by the DGSNR during the course of 2005 are recalled below in chronological order.

Transports

By delegation of the ministers for the Industry and for Ecology and Sustainable Development, the ASN co-signed the following:
- the order of 8 July 2005 modifying the order of 1 June 2001 as modified concerning the transport of dangerous goods by road (known as the "ADR order");
- the order of 8 July 2005 modifying the order of 5 June 2001 as modified, concerning the transport of dangerous goods by rail (known as the "RID order").

- the order of 8 July 2005 modifying the order of 5 December 2002 concerning the transport of dangerous goods by inland waterway (known as the “ADNR order”);
- the order of 26 April 2005 modifying the order of 21 December 2004, concerning the transport of dangerous goods by rail (known as the “RID order”).
- the order of 12 December 2005 modifying the order of 23 November 1987 concerning the safety of ships.

Certification of organisations

By delegation of the ministers for Industry and the Environment, the ASN co-signed the order of 8 July 2005 approving the Association of independent inspectors with regard to gas containers, tanks intended for the transport of dangerous goods and hoses.

Radiation protection in modal transport regulations

There are a large number of regulations applicable to transport (package approval, labelling, parking, etc.).

Worker and population radiological protection entails compliance with:

- specified levels of radiation in all places normally occupied by a vehicle;
- specified distances between packages, overpacks, containers and tankers and regularly occupied places and workstations; these distances are calculated considering an annual dose of 5 mSv for workers regularly employed in these zones and 1 mSv for the public and areas to which the public regularly has access;
- certain limits, such as the equivalent dose rates on the surface of and in the vicinity of packages, the fixed and smearable contamination limits on surfaces, etc.

All these requirements and limits are specified in the modal regulations for each mode of transport.

These requirements apply without prejudice to compliance with the Public Health Code.

The regulations also require drafting of a radiation protection programme applicable to radioactive material transports.

The purpose of the radiation protection programme is to define and document the supervisory framework to be applied by all parties involved in the transport of radioactive materials, to ensure compliance with the principles of radiation protection.

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).

3 ASSESSMENT OF SAFETY DOCUMENTS

The ASN conducts a critical analysis of the safety documents proposed by the applicants to obtain an approval certificate for their package design.

Certain package designs require the approval of the competent authority before they can be authorised for transport in France:
- radioactive materials in special forms;
- slightly dispersible radioactive materials;
- type B and C packages and all fissile material packages;
- special arrangement shipments (the package fails to comply with all the requisite criteria, but compensatory transport measures have been taken to ensure that transport safety will not be below that of a transport operation involving an approved package).

By delegation from the ministers and after technical review of the documents by the IRSN, the ASN approves the package designs complying with the regulations and validates approvals issued by the competent authorities in other countries for transport in France.

These certificates are usually issued for a period of a few years. At the present time, about 100 applications for approval are submitted annually by the manufacturers to the ASN (new package design, extension of the term of validity, validation of a certificate issued by a foreign authority, special arrangement, extension of a certificate to cover contents other than those initially defined in the safety documents).

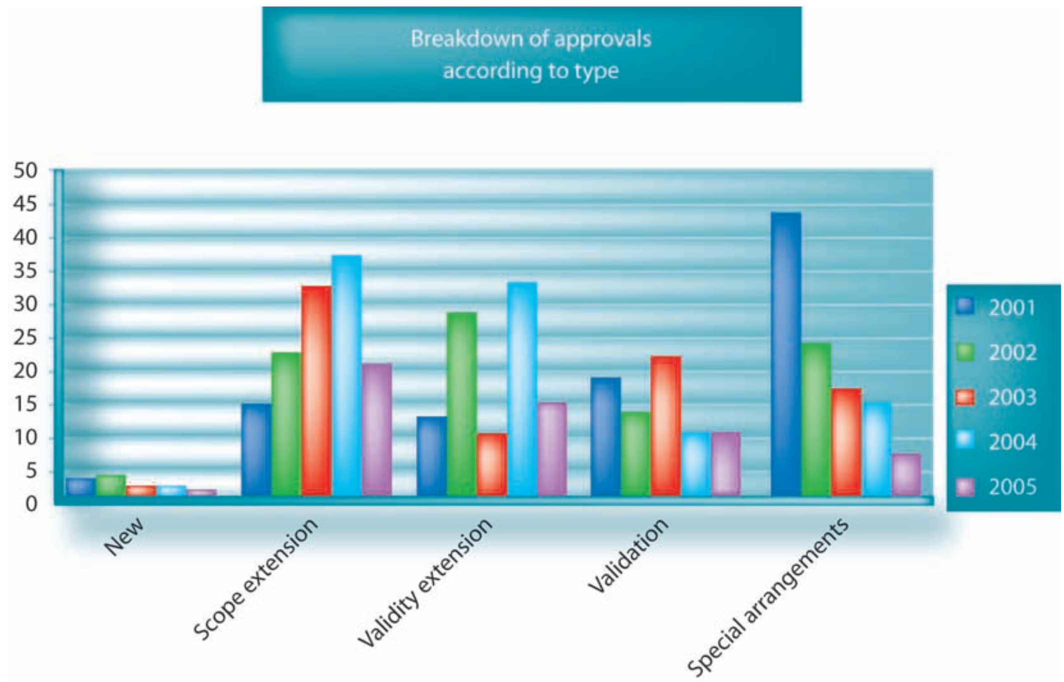
Generally speaking, certificates are issued for package designs and not package by package. However, manufacturing, operating and maintenance conditions are consistently specified.

These certificates are often issued outside the context of specific transport operations, for which no prior notification of the ASN is generally required, but which may be subjected to security checks (physical protection of materials under the control of the Defence High Official at the Ministry for Industry).

3 | 1

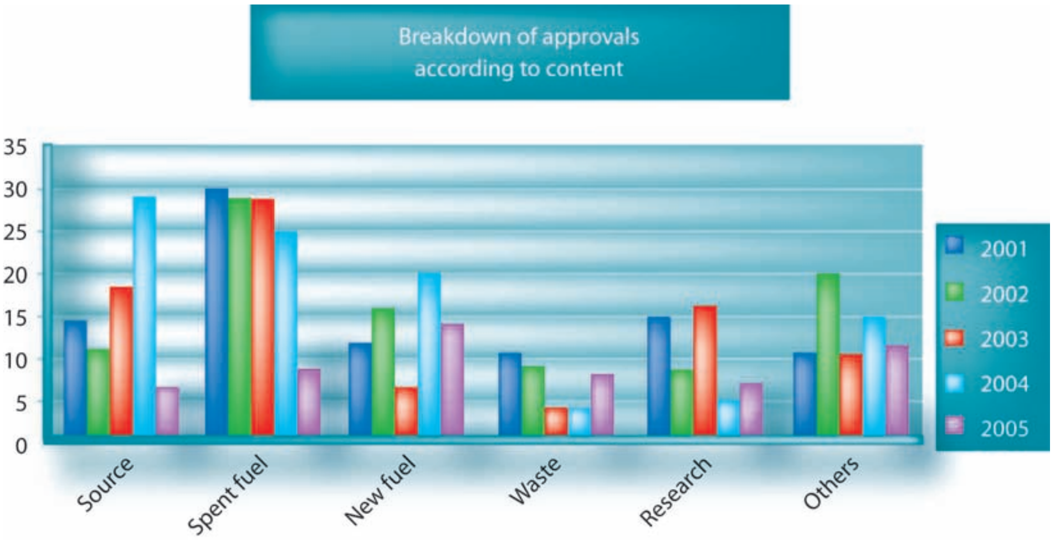
Issue of package designs approval certificates

In 2005, the ASN issued 55 certificates, broken down as follows according to their type:



It is worth noting the significant reduction in special arrangements issued since 1999. This illustrates the effects of ASN actions in this field and the efforts made by the radioactive material transport industry.

The types of transport concerned by these certificates are as follows:



The investigations carried out in 2005 looked in particular at a new packaging concept called "Traveller" designed to transport new fuel assemblies to the nuclear power plants. This is a type A package model containing fissile material. After an in-depth review of the safety analysis file, the ASN approved the application from WESTINGHOUSE and issued approval validation certificate F/660/AF-96 (a). This certificate constitutes French validation of the American approval certificate USA/9297/AF-96 Revision 0, until 31 March 2010.

New Traveller packaging

3 | 2

The quality assurance approach

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 2005 figures show that 17,312 packages were declared, 6,227 of which were used for transport. Packages can be broken down into 89 package models, instead of 85 in 2004. The most widely used packages are the 48Y cylinders designed to transport natural uranium hexafluoride (7,214 packages, of which 5,908 are the property of a single owner, Eurodif Production). Moreover, more than 80% of the type B package owners reported possession of gamma radiography equipment (GAM 80, GAM 120, GAM 400, GMA 2500 and GR 30-50). These devices are intended for the transport of sources in special forms for gamma radiographic non-destructive tests and were the subject of a priority inspection campaign in 2001, which was repeated in 2005 to assess change in this area of activity.

In coordination with the DSND, the ASN asked the licensees as in 2004 to present an annual summary of the radioactive materials transport activities by the basic nuclear installations. The purpose of this summary is to harmonise the information received by the ASN with that from the other nuclear safety authorities. It mainly comprises information concerning transport traffic (internally and on public roads and railways), deviations, events, incidents or accidents and dosimetry records linked to transport activities.

4 Inspection and field supervision

The ASN has implemented inspection provisions involving the Regional Directorates for Industry, Research and the Environment 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 2005. They will be periodically provided to maintain inspector qualification.

From both the regulatory and practical standpoints, it is important to ensure good cohesion with other supervisory authorities responsible, notably, for the inspection of transport vehicles, for labour inspection in the transport sector or for the protection of nuclear materials. These authorities may have to prohibit transport operations further to observation of regulatory non-conformities.

The BNI inspectors' role in monitoring radioactive material transports, was in 2005 based around three key topics:
- gamma radiography;
- gammadensimeters;
- packages not approved by an Authority.

Checks were therefore carried out in particular on the consignors and carriers. At a more general level, inspections also took place at the manufacturers and on the maintenance sites.

A total of 72 inspections was carried out in 2005 in the field of radioactive material transport.

Progress has been made in drafting the radiation protection programmes. The documentation is on the whole available in the nuclear industry but there is still place for improvement with respect to evaluating doses and optimising radiation protection. The inspections conducted outside the nuclear industry in particular show a fairly widespread lack of any radiation protection programmes in companies which had not previously been inspected on this point.

Airport surveillance was also maintained in 2005 with inspections carried out in the Paris airports. These inspections were devoted to checking the requirements applicable to companies working in the cargo area. Progress has been achieved by those companies that had previously been inspected, particularly with respect to the radiation protection programmes. A significant drop in handling incidents involving packages containing radioactive materials was observed in the airports. Surveillance of the Paris airports will be maintained in 2006.

An initial inspection campaign on non-approved packages was carried out in 2005 and mainly concerned type IP-2 packages and type A packages. This inspection showed that the conformity of non-approved packages is generally poor. The inspectors in particular identified the following deviations:
- regulation references are often incomplete or obsolete;
- the allowable contents of the packagings are generally not specified;
- the definition of the packagings (materials, weight, dimension, drawings) is not stringent enough;
- the ability to withstand the routine transport conditions is not proven;
- the penalising nature of the drop tests included in the tests is not proven;
- the radiological protection and containment integrity demonstration is incomplete;
- correct performance of the package between -40 °C and +70 °C is not proven;
- the ability of the containment envelope to retain the radioactive contents in the event of an ambient pressure drop to 60 kPa is not proven.

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:
- organization;
- quality plan, procedures, established practice;
- traceability of checking operations;
- handling of deviations;
- supplier audits.

In order to reinforce the effectiveness of its actions in this field, the ASN sent the licensees a radioactive materials transport quality assurance guide.

With regard to the other fields, the observations mainly concern:
- the training programme for all those involved in transport operations;
- the duties of the security adviser;
- the annual report from the security adviser;
- lack of inspection;
- procedures for declaring events and incidents.

The observations made during the inspections are the subject of follow-up letters published on the www.asn.gouv.fr website. The ASN asks the licensees to forward the information specified in these fol-

ASN inspection at Roissy-Charles-de-Gaulle airport

low-up letters, generally within two months. Progress has been observed in the companies already inspected, although certain licensees do need to improve further.

Within the framework of its special assignment, the 5th sub-directorate of the DGSNR carried out a visit to suppliers chosen by the Framatome company to manufacture the FCC containers designed to transport new fuel for power reactors. The purpose of this visit was to review the extent to which the requests and observations made during the previous inspection in 2003 had been taken into account on the manufacturing stations (straightening and resin pouring), and to check the conformity of the packages manufactured in 2005 with the manufacturing reference framework.

5 Incidents and accidents

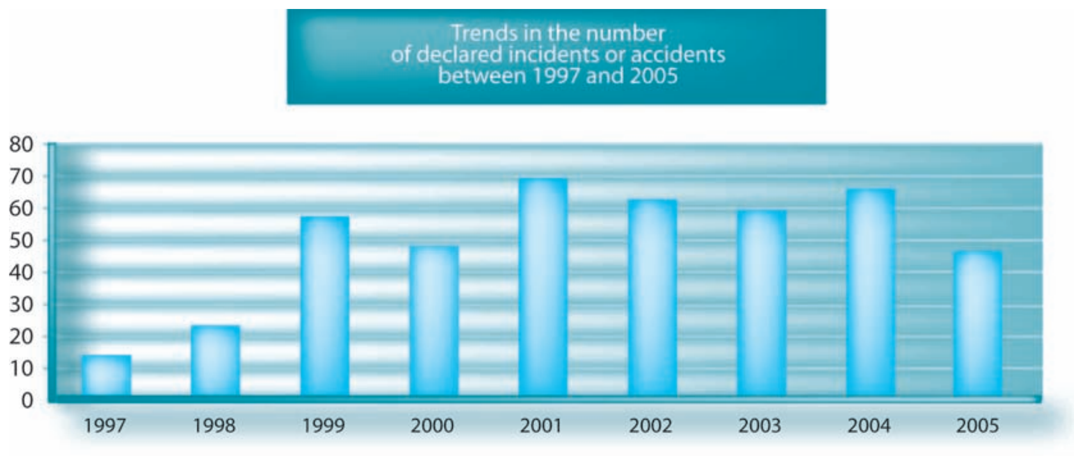
The guide associated with the letter of 24 October 2005, sent out by the ASN to all consignors and transporters, redefines the incident and accident declaration criteria initially sent out in the circular of 7 May 1999 (see chapter 4, point 1|2|2). It also reuses the incident report model proposed in the ADR and RID orders.

All transport deviations are thus to be declared to the ASN. Apart from this declaration, a detailed incident report must be sent to the ASN 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:

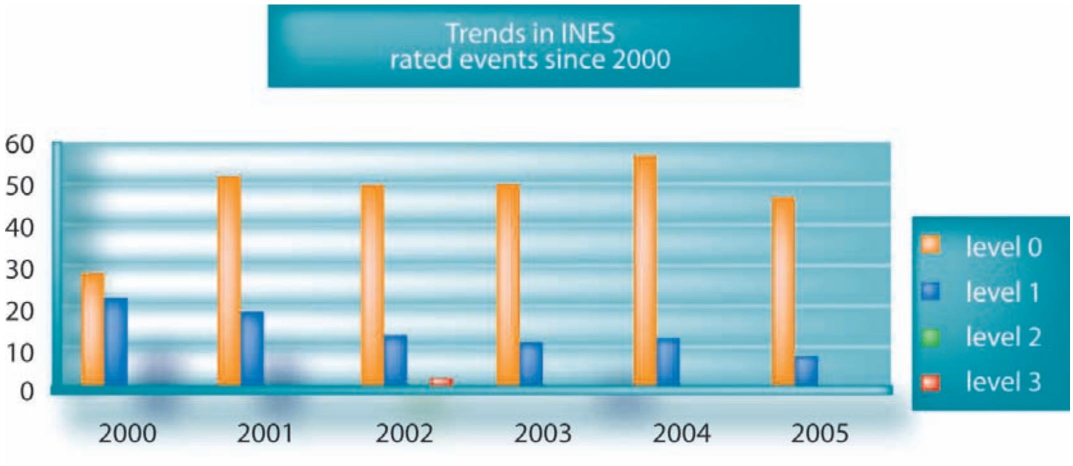
- nonconformity with the requirements of the orders specific to each mode and of the package model approval certificates;
- package handling event;
- incident or accident during actual transport, particularly a stowage fault.

The trend in the number of incidents/accidents reported during the last nine 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 events notified since 1 October 1999 were rated on the INES scale, which the ASN has decided to apply to transport operations. A new version of the INES scale, applicable to transport, has been produced by the IAEA and a letter was sent out to all consignors and carriers to ask them to apply it and to inform them that the French translation was available on the ASN's website.

In 2005, 41 incidents were rated at level 0, and 7 level 1. The following graph shows the trends since 2000.



5 | 1

Nonconformity of container or content

Contamination of spent fuel convoys

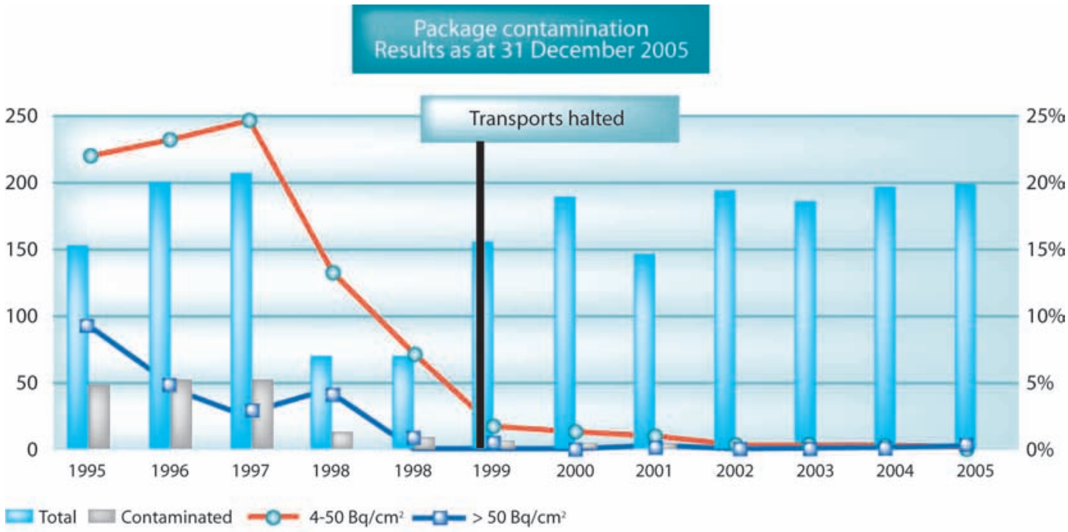
Transport of spent fuel from the EDF sites to the COGEMA La Hague plant continued in 2005.

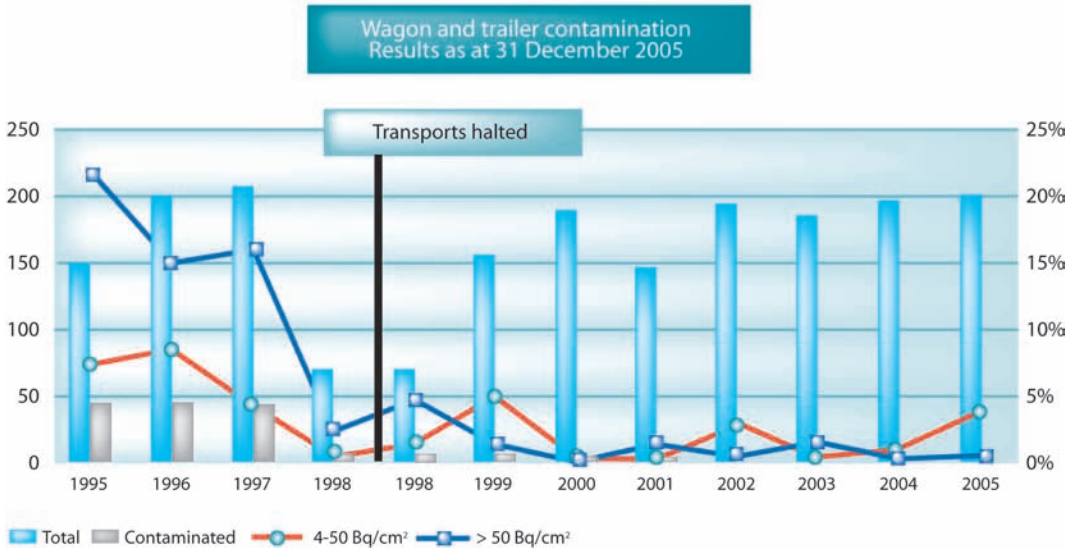
This year, the contamination thresholds were found to have been exceeded on several occasions at the Valognes rail terminal or in the EDF plants. These overshoots were generally very slight with respect to the regulatory limits. Only two events led to level 1 rating on the INES scale applicable to transport. These two events are presented below.

In the light of this increase, the ASN sent out a letter to EDF management on 25 October 2005, recalling the regulation contamination requirements and asking that corrective measures be taken to prevent such deviations happening again. In the letter of 20 December 2005, EDF stated that it had taken immediate steps to improve the radiological cleanness of the premises, specifying that it had carried out an in-depth analysis of the deviations, which could lead to further steps being taken. By the end of June 2006, EDF will submit a summary of the results obtained following implementation of all these measures.

Spent fuel is continuing to be transported normally from foreign countries to La Hague and to Sellafield (Great Britain).

The following two graphs show the trend since 1995 in the contamination levels on packages and themeans of transport used to carry spent fuel from the EDF plants to the La Hague reprocessing plant.





Contamination incident on 5 October 2005

On 5 October 2005, two packages loaded with spent fuel transported on sealed rail wagons left the Golfech nuclear power plant for the La Hague reprocessing plants via the Valognes rail terminal.

In accordance with the procedures, radiological inspections were carried out by the nuclear power plant and an independent organisation in turn, prior to departure of the convoy. No contamination point higher than the regulation limits was identified on this occasion.

These same procedures require a further radiological inspection when the convoy reaches the Valognes terminal, prior to any handling of the packaging for transfer to a road trailer. This inspection detected a contamination point higher than the regulation limits on a package, in an area that was inaccessible during transport. As soon as it was detected, this area was cleaned up.

There were no consequences for the environment, the personnel or the public.

Owing to the surface contamination identified on the packaging, and at the proposal of the Golfech nuclear power plant operator, the ASN decided to rate this event at level 1 on the INES scale.

Contamination incident of 28 November 2005

A spent fuel package was being transported on 28 November 2005 and following package transfer from the road trailer to a rail wagon, the radiological inspections carried out at the Ferté-Saint-Aubin rail terminal revealed a smearable surface contamination point of 5,790 becquerels per square centimetre on the road trailer. This contamination was far higher than the regulation limit value of 4 becquerels per square centimetre. It was situated on the front-left part of the trailer, on the tarpaulin rail, an area that is not accessible to any third party in normal transport conditions. If one assumes this contamination to be fixed, owing to the difficulty involved in decontaminating the trailer, the contact dose rate of 11 microsieverts per hour exceeded the regulation limit of 5.

The trailer immediately underwent clean-up. This event had no consequences for the environment, the personnel or the public.

Owing to the fact that contamination was able to leave the Saint-Laurent-des-Eaux sites and the given the level of this contamination, this event was rated 1 on the INES scale.

5 | 2

Package handling events

Airport handling incidents

Handling incidents at airports, involving radioactive material packages, are considered to be transport incidents. Transport in fact comprises all operations and conditions associated with the movement of radioactive materials, especially loading, routing, including interim storage, and unloading.

In 2005, 9 incidents of this type were recorded at Roissy-Charles-de-Gaulle and Orly airports. These incidents concerned type 1 or excepted packages, which were damaged to varying extents.

Photo of a damaged package

Jointly with the DGAC (civil aviation authority) and the air transport police the ASN carried out a number of air cargo inspections. The carriers were reminded of the need to implement a radiation protection programme appropriate to the transport activities, to correctly secure the packages and make the personnel aware of the hazard of ionising radiation.

On 15 April 2005, an excepted type package fell from a pallet during handling in the cargo area of Roissy-Charles-de-Gaulle airport.

The package had not been tied down and was crushed by a fork-lift truck, leading to leakage of the radioactive content. The liquid was completely absorbed by the absorbent material contained in the packaging.

The radiological measurements confirmed that there was no contamination of either the floor or the fork-lift truck. The package and its content were reconditioned and returned to the consignor.

Owing to the loss of containment of radioactive material, the ASN rated this incident at 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.

Theft of a scooter containing a lead detector.

PROTEC LPA1 – lead analyser

On 4 October 2005, the ASN was informed of the theft in Marseille (Estaque district) on 21 September 2005 of a portable lead paint detector equipped with a cobalt 57 radioactive source with an activity level of about 444 megabecquerels. This equipment was being transported on a scooter, which is a means of transport explicitly prohibited by the regulations for this type of device.

In normal conditions of transport and use, the assembly consisting of the device and the source presents no particular hazard for anyone in the immediate vicinity. However, this equipment is not exempted from the regulations concerning the transport of dangerous goods by road (ADR order) and as such, it should have been transported in a four-wheeled vehicle.

The loss of the package and the conditions of transport involving a two-wheeled vehicle, led the ASN to rate this event at level 1 on the INES scale.

6 EMERGENCY RESPONSE PROVISIONS

Nuclear safety is not only directed towards preventing accidents, but also towards limiting their consequences. To this end, in conformity with the defence in depth principle, the necessary provisions must be made to bring even an improbable accident situation under control. These “ultimate” lines of defence comprise specific organisational structures and emergency plans, involving both the consignor and the authorities.

The details of emergency assistance in the event of an accident are defined in special emergency response plans for radioactive material transport accidents, in accordance with decree 88-622 of 6 May 1988, implementing law 87-565 of 22 July 1987. These actions are supervised by the Directorate for Civil Defence and Security at the Ministry for the Interior, which the ASN assists.

The ASN took part in the work of the interministerial committee entrusted with preparing a guidance circular to assist the Prefects in drafting the PSS-TMR (specialised emergency plan for the transport of radioactive materials).

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 2005, the emergency response provisions put in place by the ASN, the Val d’Oise prefecture and the other national organisations, in particular the DDSC, were tested during an emergency exercise

COGEMA logistics equipment for heavy package recovery

in the Val d'Oise *département*[1]. This exercise concerned an accident occurring during road transport of low specific activity effluent destined for incineration and originating from the Paluel nuclear power plant. The consignor was EDF and the carriage commission agent and carrier was COGEMA Logistics. A further exercise will be organised in 2006.

2005 emergency drill

1. Administrative division of the size of a county.

7 OUTLOOK

In 2005, the ASN continued to strengthen the radioactive material transport inspections that has been carrying out since 1997. It continued the inspections conducted of the radioactive material packaging designers, manufacturers, carriers and consignors; it once again tested its emergency response procedures to an accident involving the transport of radioactive materials.

The inspections carried out in 2005 show that progress has been made, in particular in drafting the radiation protection programmes that have been mandatory since 2001, but that there is still place for improvement. The ASN will be continuing its inspections in 2006.

Given the rise in the number of occasions the regulation contamination limits were exceeded during spent fuel transports, the ASN also asked EDF to take corrective steps to prevent such deviations happening again. EDF took immediate steps and initiated an in-depth analysis of the deviations, which could lead to additional measures. The results of these measures will be transmitted by the end of June 2006.

Finally, the ASN continued the technical background work prior to issue certificates approval: periodic safety reviews of existing package models and the approval of new models incorporating innovative design features contribute to the overall upgrading of transport safety. This work in particular led to a highly significant drop in the number of special arrangements delivered (about fifty in 2000, less than ten in 2005).

All these actions taken together have led to improvement in and reinforcement of the safety culture among the transport operators.

EDF NUCLEAR POWER PLANTS

CHAPTER 12

1 GENERAL INFORMATION ON EDF NUCLEAR POWER PLANTS

1|1 Description of a nuclear power plant
1|1|1 General presentation of a pressurised water reactor
1|1|2 Core, fuel and fuel management
1|1|3 Primary and secondary systems
1|1|4 Reactor containment building
1|1|5 The main auxiliary and safeguard systems
1|1|6 Other systems

1|2 Operation of a nuclear power plant
1|2|1 EDF organisational structures
1|2|2 Operating documents
1|2|3 Reactor outages

2 THE NUCLEAR SAFETY AND RADIATION PROTECTION IMPROVEMENT POLICY

2|1 Organisations, safety, competitiveness
2|1|1 Supervision of organisational and human factors
2|1|2 Skills and qualifications management within EDF
2|1|3 Monitoring the quality of subcontracted operations
2|1|4 Safety and competitiveness
2|1|5 Internal authorisations

2|2 Continuous safety improvements
2|2|1 Anomaly correction
2|2|2 Review of experience feedback from reactor operations
2|2|3 Periodic safety reviews
2|2|4 Modifications made to the equipment and to the operating rules

2|3 Nuclear power plant ageing
2|3|1 A relatively young population of nuclear power plants
2|3|2 The main factors in ageing
2|3|3 Strategy to deal with equipment ageing
2|3|4 ASN policy

2|4 The EPR project
2|4|1 The public debate concerning the EPR "first-off" reactor
2|4|2 Technical examination
2|4|3 Cooperation with foreign nuclear safety authorities

2|5 Research into pressurised water reactor nuclear safety and radiation protection

3 PLANT SAFETY

3|1 Construction supervision

3|2 Operation and control
3|2|1 Normal operating conditions
3|2|2 Incident and accident operation

3|3 Maintenance and tests
3|3|1 Maintenance practices
3|3|2 Industrial code changes
3|3|3 Qualification of inspection methods
3|3|4 Periodic tests

3|4 Fuel
3|4|1 Fuel management trends
3|4|2 Fuel assembly modifications
3|4|3 Fuel handling operations

3|5 The primary and secondary systems
3|5|1 System surveillance
3|5|2 The use of nickel-based alloys
3|5|3 Reactor vessels
3|5|4 Steam generators
3|5|5 Main secondary systems protections valves
3|6 Containment
3|7 Protection against external hazards
3|7|1 Earthquakes
3|7|2 Flooding
3|7|3 Fire and explosion risks
3|7|4 Other hazards
3|8 Other subjects
3|8|1 Pressure vessels
3|8|2 Risks in the workplace

4 RADIATION PROTECTION AND ENVIRONMENTAL PROTECTION
4|1 Radiation protection of persons working in nuclear power plants
4|2 Discharges from nuclear power plants
4|2|1 Discharge licence revision
4|2|2 Procedures carried out in 2005
4|2|3 Radioactive discharge values
4|3 Technological waste management
4|4 Protection against other risks and nuisances
4|4|1 The microbiological risk
4|4|2 Prevention of water pollution
4|4|3 Noise

5 SUMMARIES
5|1 Summary of incidents
5|1|1 Summary of incidents in 2005
5|1|2 Statistical analysis of the incidents in 2005
5|2 Significant events site by site

6 ASSESSMENT AND OUTLOOK
6|1 ASN assessment of the past year
6|2 Outlook

This chapter is devoted to pressurised water reactors (PWRs). 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 review the physical phenomena related to reactor operation and safety. These reactors are operated by Electricité de France (EDF). One particularity in France is the standardisation of plants, with a large number of technically similar reactors, justifying a "generic" presentation in this chapter. However, a table at the end of the chapter gives the significant events on each site. Additional information can be obtained from the DRIRE for each individual site.

1 GENERAL INFORMATION ON EDF NUCLEAR POWER PLANTS

Overall, the 19 French nuclear power plants are similar. They each comprise from 2 to 6 PWRs, which all together comes to 58 reactors. For each of them, the nuclear part was designed and built by Framatome, with EDF acting as industrial architect.

The thirty-four 900 MWe reactors can be split into:

- the CP0 plant series, comprising the 2 Fessenheim reactors and 4 Bugey reactors (reactors 2 to 5),
- the CPY series, comprising the other 900 MWe reactors, subdivided into CP1 (18 reactors at Dampierre, Gravelines, le Blayais and Tricastin) and CP2 (10 reactors at Chinon, Cruas and Saint-Laurent-des-Eaux).

The twenty 1300 MWe reactors comprise:

- the P4 series, comprising the eight reactors at Paluel, Flamanville and Saint-Alban,
- the P'4 series, comprising the twelve most recent 1300 MWe reactors at Belleville, Cattenom, Golfech, Nogent-sur-Seine and Penly.

Finally, the N4 series comprises 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.

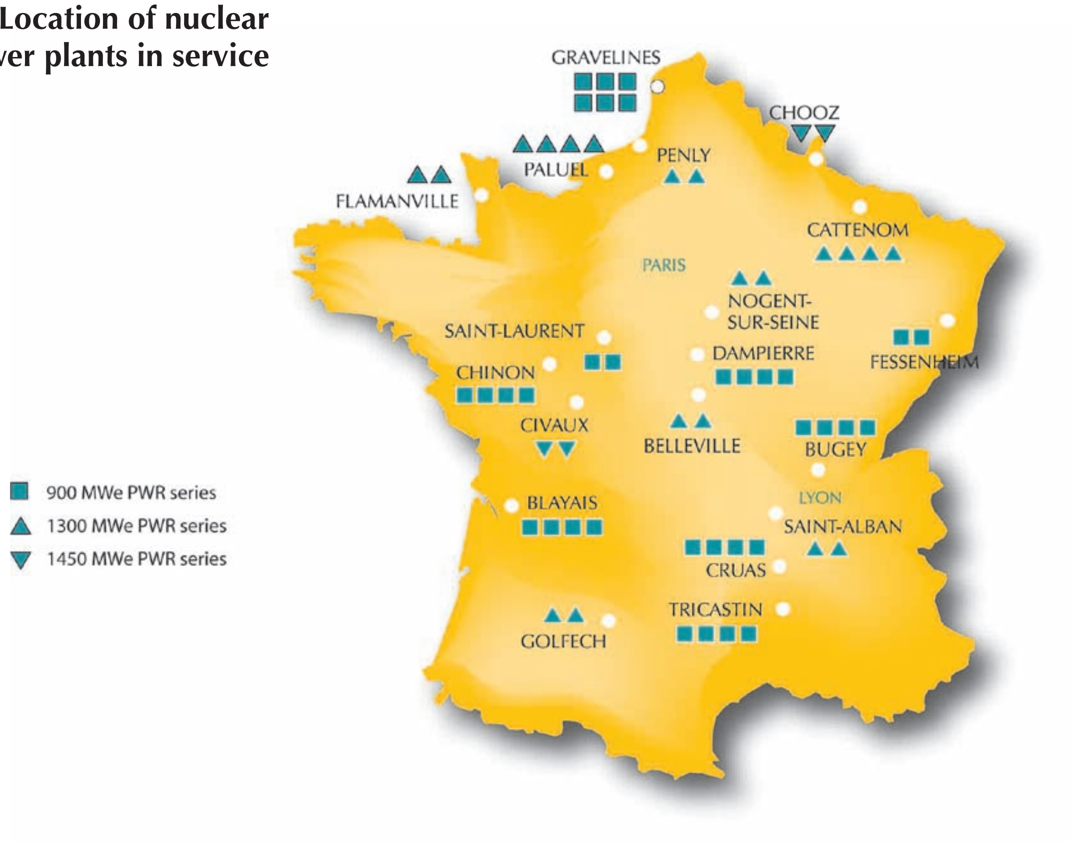
The CPY series differs from the Bugey and Fessenheim reactors in building design and the addition of an intermediate cooling system between that used for containment spraying in the event of an accident and that containing river water, along with more flexible operation.

The design of the 1300 MWe reactor systems, 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.

Location of nuclear power plants in service



1 | 1

Description of a nuclear power plant

1 | 1 | 1

General presentation of a pressurised water reactor

In passing heat from a “hot source” to a “heat sink”, all thermal electric power plants produce mechanical energy, that they then transform into electricity. Conventional plants use the heat given off by the combustion of fossil fuels (fuel oil, coal, gas) and nuclear plants that resulting from the fission of uranium or plutonium atoms. The heat produces steam. This latter is then expanded in a turbine which drives a generator producing 3-phase electric current with a voltage of 400,000 V. After pressure reduction, the steam then flows into a condenser where it cools in contact with tubes containing circulating cold water from the sea, a river or a cooling tower.

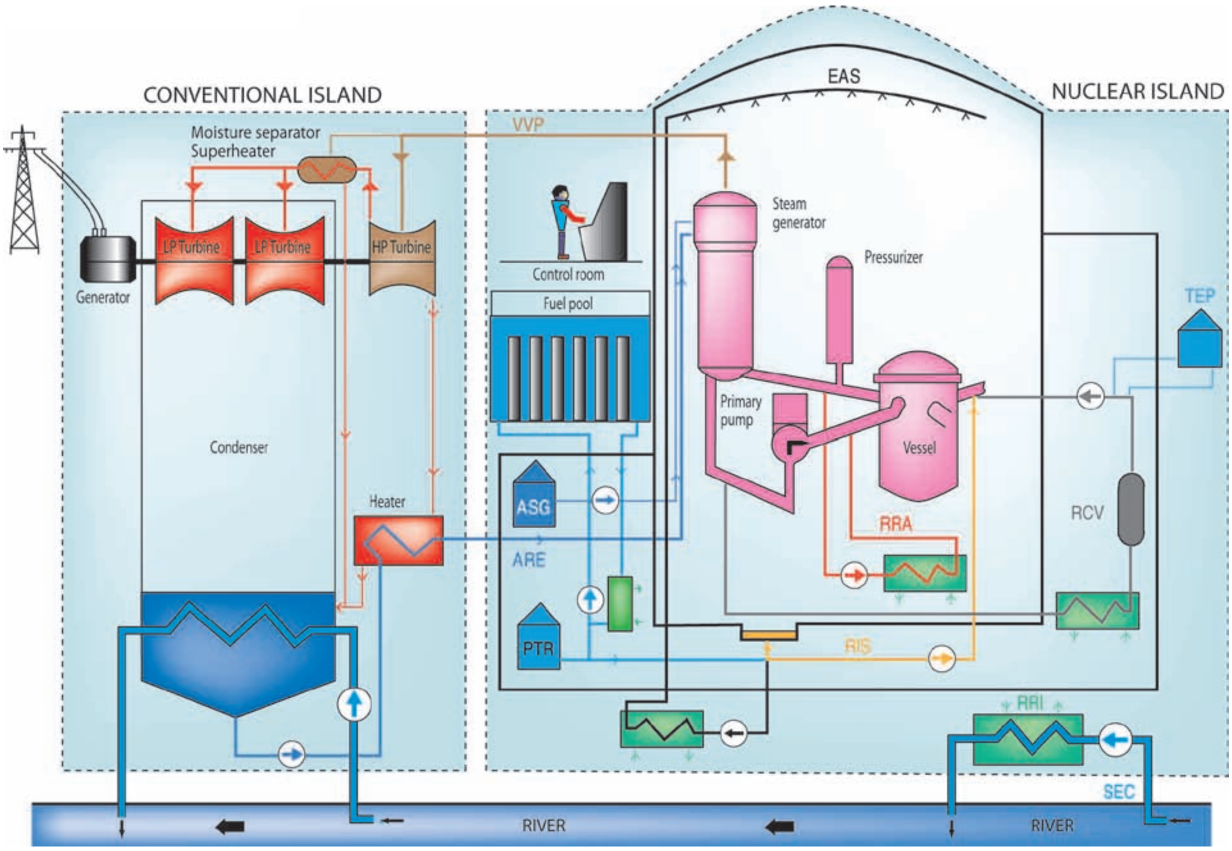
Each reactor comprises a nuclear island, a conventional island, water intake and discharge infrastructures and possibly a cooling tower.

The nuclear island mainly consists of the nuclear steam supply system comprising the primary system and the systems designed for reactor operation and safety: the chemical and volume control, residual heat removal, safety injection, containment sprinkling, steam generators feedwater, electrical, I&C and reactor protection systems. Various “support” function systems are also associated with the nuclear steam supply system: primary waste treatment, boron recovery, feedwater, ventilation and air-conditioning, backup electrical power (diesel generating sets). The nuclear island also comprises the systems removing steam to the conventional island as well as the building housing the spent fuel interim storage pit.

The conventional island comprises among others the turbine, the AC generator and the condenser. Some of this equipment contributes to reactor safety.

The secondary systems belong partly to the nuclear island and partly to the conventional island.

PWR flowchart



ABBREVIATIONS USED IN THE PWR BLOCK DIAGRAM

ARE	steam generator feedwater flow control system
ASG	steam generator auxiliary feedwater system
EAS	containment spray system
PTR	spent fuel pit cooling and treatment system
RCV	chemical and volume control system
RIS	safety injection system
RRA	residual heat removal system
RRI	component cooling system
SEC	essential service water system
TEP	boron recycling system
VVP	main steam system
LP Turbine	low-pressure turbine
HP Turbine	high-pressure turbine

1 | 1 | 2

Core, fuel and fuel management

The reactor core consists of rods containing uranium oxide pellets or 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.

At the beginning of an operating cycle, the core represents a considerable reserve of energy, which gradually decreases during the cycle as the fissile nuclei disappear. The chain reaction, and hence the reactor power, is controlled by:

- the rod control cluster assemblies which penetrate the core and contain elements capturing the neutrons. These enable the reactor to be started and stopped and its power level to be adjusted to the quantity of electricity to be produced. Falling of the clusters under the effects of gravity triggers automatic reactor trip;
- varying the boron (also an absorber of neutrons) content in the primary system water. The high initial reactivity is offset by the boron - in the form of boric acid - dissolved in the primary system water, since boron has neutron absorbing properties. Its concentration in the water is adjusted during the cycle according to the gradual depletion of the fissile material in the fuel.

The operating cycle ends when the boron concentration approaches zero. An extension is however possible, if the temperature and possibly the power level are brought below their nominal values. At the end of the campaign, the reactor core is unloaded for renewal of part of the fuel.

EDF uses two types of fuels in its pressurised water reactors:

- a uranium oxide (UO_2) fuel initially enriched with U-235. Most of this fuel is manufactured by FBFC, a subsidiary of Framatome and COGEMA. 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 UO_2 fuel using natural uranium is limited to 4.2 %;
- fuels made from a mixture of plutonium and depleted uranium oxides (MOX). 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.

Fuel management is different in the various reactor series. It can in particular be characterised by:

- the nature of the fuel used and its initial fissile content;
- the maximum degree of fuel depletion at removal from the reactor, characterising the quantity of energy extracted per ton of material (expressed in GWd/t);
- the length of the burnup cycle (generally given in months),
- the number of new fuel assemblies loaded at each reactor refuelling outage (1/3 or 1/4 of the total number of assemblies);
- the reactor operating mode, with or without major power variation, characterising the stresses to which the fuel is subjected.

1|1|3

Primary and secondary systems

The primary and secondary systems are used to transport the heat released in the core to the turbine, which produces electricity, without any of the water in contact with the core leaving the containment.

The primary system extracts the heat released in the core by circulating pressurised water, known as the primary water, in the cooling loops (3 loops for a 900 MWe reactor, 4 loops for a 1,300 MWe or 1,450 MWe reactor). Each loop, connected to the reactor vessel containing the core, comprises a circulating, or primary pump, and a steam generator. The primary water, heated to more than 300 °C, is kept at a pressure of 155 bar by the pressuriser, to prevent it boiling. The entire primary system is located inside the containment.

In each steam generator, the primary system water transfers the heat produced by the reactor core to the water in a secondary system, without coming into contact with it.

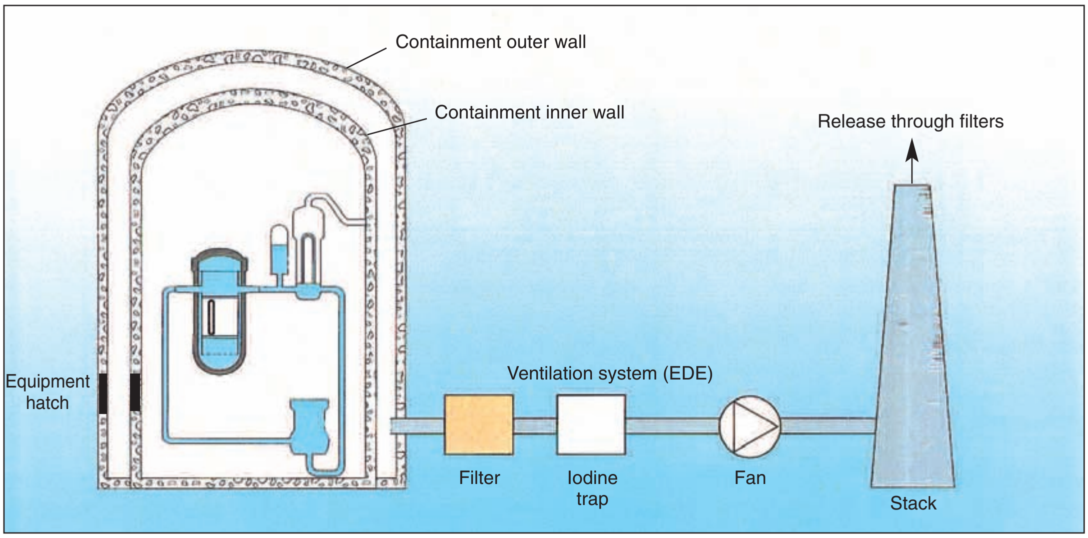
The steam generators contain thousands of tubes through which the primary water circulates. These tubes are immersed in the water of the secondary system and boil it.

Each secondary system primarily consists of a closed loop through which water runs in liquid form in one part and as steam in another part. The steam produced in the steam generators is partly expanded in a high-pressure turbine and then passes through superheater separators before final expansion in the low-pressure turbines, from which it is then routed to the condenser. The condensed water is sent back to the steam generators by the extraction pumps relayed by feed pumps through low and high pressure reheaters.

1|1|4

Reactor containment building

The PWR containment building has two functions:
- protection of the reactor against external hazards;
- confinement, thereby protecting the public and the environment against radioactive products likely to be dispersed inside the containment in the event of an accident. The containments are therefore



Block diagram of a 1300 MWe PWR containement building

designed to withstand the pressure and temperature that could be reached in an accident situation, and offer satisfactory leaktightness in such conditions.

There are two types of PWR containments:
• 900 MWe type containments, which consist of a single pre-stressed concrete wall. This wall provides mechanical resistance to the most severe design accident pressure and structural integrity against an external threat. Leaktightness is assured by a thin metal liner on the inside of the concrete wall;
• the 1,300 MWe and 1,450 MWe PWR containments, comprising two walls, an inner wall made of pre-stressed concrete and an outer wall made of reinforced concrete. Leaktightness is provided by the inner wall and the ventilation system (EDE) which, in the annular space between the walls, collects any leakage from inside the containment. Resistance to external threats is mainly provided by the outer wall.

1 | 1 | 5

The main auxiliary and safeguard systems

The residual heat removal system (RRA) functions during normal reactor outages to remove the heat from the primary system and the after-power from the fuel and then to keep the primary system water at a low temperature as long as there is fuel in the core. Once the chain reaction stops, the reactor core in fact continues to produce heat for a certain time. This after-power therefore has to be removed to avoid damaging the fuel. The RRA system is also used to drain the reactor cavity after refuelling.

The chemical and volume control system (RCV) is used during nuclear steam supply system (NSSS) operation:
• to adjust the mass of primary system water according to temperature fluctuations;
• to maintain primary system water quality, by reducing the corrosion and fission products content and by injecting chemical products (corrosion inhibitors for example);
• to collect and compensate for normal leakage from the primary pump seals;
• to regulate the boric acid concentration.

The purpose of the safeguard systems is to control incidents and accidents and mitigate their consequences. This primarily concerns the safety injection system (RIS), the reactor building 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 flow rates and release pressures for different types of accident situations. In the event of an accident, these pumps start by taking in water from a tank of about 2000 m^3, the PTR tank. When the tank is empty, they are connected to the reactor building sumps, where the EAS spray water is collected, together with any water that has escaped from the primary system in the event of a leak on this system.

In the event of an accident leading to a pressure and temperature rise in the reactor building, the EAS system sprays water containing additional soda, in order to restore acceptable ambient conditions, protect the integrity of the containment and flush onto the floor any radioactive aerosols in the air.

The ASG system is used to maintain the secondary water level in the steam generators and thereby cool the primary system water in the event of failure of the normal feedwater system (ARE). It is also used in normal operation and during reactor shutdown and restart phases.

1 | 1 | 6

Other systems

The systems necessary for reactor operation and important to its safety also include:

- the ventilation systems, which play a vital role in containing radioactive substances by depressurising the premises and filtering all discharges;
- the fire-fighting water systems;
- the reactor cavity and spent fuel pit cooling and treatment system (PTR), used notably to remove after-power from irradiated fuel elements stored in the spent fuel pit;
- the component cooling system (RRI), which cools a number of nuclear equipment items and operates in a closed loop between the auxiliary and safeguard systems and the systems carrying water pumped from the river or the sea;
- the essential service water system (SEC), which uses the heat sink (sea or river) to cool the RRI system.

1 | 2

Operation of a nuclear power plant

1 | 2 | 1

EDF organisational structures

Within the EDF Engineering and Production Branch, created in 2004, a difference is made between the function of operator and that of investing owner. Whereas the owner is responsible for the development and long-term exploitation of its asset as well as for its dismantling once operations are completed, the operator is in charge of the short and medium term performance of the production plants and of safety, radiation protection and environmental issues on daily basis.

The responsibility of operator is assumed by the Nuclear Generating Division (DPN). Day to day operation of the nuclear power plants, including safety, radiation protection and security, along with availability and costs, are its duties. The Director of the DPN has authority over the nuclear power plant directors and also has at his disposal Head Office departments, comprising expert assessment and technical support services responsible for defining DPN policy and participating in the improvement of plant operation.

Within the DPN, the operating plant support centre (CAPE) is required to provide the plants with help in attaining their safety and performance targets and to help the DPN with plant oversight and monitoring implementation of technical decisions. This unit offers expertise in the nuclear energy production trades, including safety, the environment, maintenance, process engineering, risk prevention and radiation protection. The national engineering unit for operating plants (UNIPE) performs national engineering tasks concerning technical and documentary upgrades, reactor fuel management, and the national emergency response procedures. In particular, its duties are to implement modifications to the installations decided on at a national level and to produce generic operating and maintenance documents. For all the plants, the Operational Technical Unit (UTO) works on generic maintenance, subcontracting policy and buying policy. Finally, the IN (Nuclear Inspection) teams, on behalf of the DPN authorities, carry out verification assignments on the entire division.

Within the nuclear power plants, the departments are organised according to professional fields, for performance of safety and radiation protection, production and maintenance functions. Cross-functional project teams are set up for specific activities such as unit outages. The production and maintenance activities can also call on an engineering department.

EDF's Nuclear Production Division's organisation

The roles of owner and designer lie with the Nuclear Engineering Division (DIN). In this respect, the DIN is responsible for the facilities design reference framework. It performs engineering activities about the future issues, in other words, studies, draft projects and long-term upgrade projects for the facilities which go beyond the natural scope of the operator's work. Finally it has oversight for projects designed to maintain the assets, primarily concerning design aspects, in particular the periodic safety reviews.

Among the DIN's engineering centres, the design department for thermal and nuclear projects (SEPTEN) is responsible for upstream studies and draft projects. The National Centre for Nuclear Equipment (CNEN) is more particularly responsible for equipment design and modification in the nuclear island of the N4 plant series and the EPR (European Pressurized water Reactor) project. The Engineering Centre for Operating Plants (CIPN) works on the nuclear islands for the 900 and 1300 MWe plant series. The National Centre for Electricity Production Equipment (CNEPE) deals with the conventional islands of all the plants. The dismantling and waste management activities are handled by the Engineering Centre for Dismantling and Related Environmental Issues (CIDEN). Finally, the Production and Operation appraisal and inspection centre (CEIDRE) is particularly responsible for in-service inspection of equipment and for conducting appraisals.

Within the framework of its supervisory activities at the national level, the Nuclear Safety Authority (ASN) deals mainly with the DPN. The ASN's contacts are the head office departments with regard to generic matters, in other words those that concern some or all of the plants reactors; the ASN deals directly with the plant management for questions specifically concerning their own particular reactors. As regards equipment design and study documents, they are discussed in the first place with the DIN. Those concerning fuel and fuel management are also discussed with a third division which has more specific responsibility for these questions, the Nuclear Fuel Division.

1 | 2 | 2

Operating documents

Day to day operation of the nuclear power plants relies on a set of documents. Those concerning safety are given particularly close attention by the ASN.

First among these documents are the general operating rules (RGE) which present the provisions implemented during operation of the reactors. They supplement the safety report which mainly deals with the steps taken at the design of the reactor, and translate the conclusions of the safety studies into operating rules.

The RGE comprises several chapters, among which those having particular safety implications are carefully reviewed by the ASN.

Chapter 3 describes the “Technical Operating Specifications” (STE), which specify the reactor’s normal operating range and in particular the allowable range for the operating parameters (pressure, temperature, neutron flux, etc.). The STEs specify the operating steps to be taken if these limits are exceeded. The STEs also define the equipment required according to the status of the reactor and state what to do in the event of a malfunction or failure of one of these equipment items.

Chapter 6 contains the operating rules to maintain or recover safety functions (reactivity control, core cooling, radioactive product containment) under incident or accident conditions and revert to a safe reactor configuration.

Chapter 9 defines the routine test and inspection programme for safety-related equipment. In order to check the availability of this equipment, and notably the safeguard equipment to be used in the event of an accident, tests are periodically carried out to ensure that these systems are working properly. In the event of an unsatisfactory result, the course of action to be followed is stipulated in the technical operating specifications. This type of situation may sometimes require the licensee to shut down the reactor in order to repair the faulty equipment.

Chapter 10 finally defines the physical test programme for reactor core loads. It contains the rules defining the programme for core requalification during reactor restart and for core monitoring during reactor operations.

Secondly, there are documents describing the in-service monitoring and maintenance actions required on the equipment. On the basis of the manufacturer’s recommendations, EDF defined periodic inspection programmes for the components (or preventive maintenance programmes), based on the knowledge of the potential degradation that could be suffered by the equipment.

In particular for pressurised equipment, this may entail non-destructive testing methods (radiography, ultrasounds, eddy current, dye penetrant, etc.) which are entrusted to specially qualified staff.

1 | 2 | 3

Reactor outages

Owing to the gradual depletion of the fuel, reactors have to be periodically shut down so that the fuel can be renewed. At each outage, one third or one quarter of the fuel assemblies is replaced. The frequency of the outages depends on the fuel management policy.

These outages mean that parts of the installation which are normally closed off during operation become accessible. This is thus an opportunity to verify the condition of the installation by carrying out checks and maintenance as well as any scheduled modifications. Article 14 of the order of 10 November 1999 concerning monitoring of main primary and secondary system operations in particular requires that the licensee carry out periodic checks on these systems (partial and complete inspections).

There are several types of outage:
- simple refuelling outage and partial inspection outage: these outages last a few weeks and are devoted to renewing part of the fuel and conducting a limited scope programme of verification and maintenance;

Replacing a steam generator

• ten-yearly outage: this outage entails a wide-ranging verification and maintenance programme. This type of outage, which occurs every 10 years, is also an opportunity for the licensee to carry out major operations such as a complete inspection or a hydrotest on the main primary system, a reactor building containment test or incorporation of design changes decided on in the periodic safety reviews (see point 2|2|3).

These outages are scheduled and prepared by the licensee several months before their scheduled start date, in order to optimise the large number of tasks involved. The ASN checks the steps taken by the licensee to guarantee safety and radiation protection during the outage, and the safety of operation during the coming cycle(s).

The main points of the check carried out by the ASN concern the following:
• during the outage preparation phase, the conformity of the reactor outage programme with the applicable reference system. The ASN will give its opinion on this programme;
• during the outage - at the regular information meetings and scheduled, unannounced or post-incident reactive inspections - the handling of the problems encountered;
• at the end of the outage - when the licensee presents the reactor outage summary - the condition of the reactor and its suitability for restart. After this check, the ASN issues the criticality authorisation;
• after criticality, the results of all tests carried out during the outage and after restart.

2 THE NUCLEAR SAFETY AND RADIATION PROTECTION IMPROVEMENT POLICY

The ASN's policy is to ensure that nuclear safety and radiation protection progress and not simply to maintain them at existing levels. This means that the ASN requires that the licensee permanently look for potential areas for improvement and implement these improvements.

This progress can be achieved in two main areas:

• the reactor material status: barring exceptions, the safety improvements affecting equipment are reviewed and implemented during the ten-yearly periodic safety reviews rather than as and when they are conceived, to ensure that the facility is not constantly under modification, which could only be prejudicial to safety;
• the working of the organisations involved in the design, construction or operation of the reactor: they can be the subject of a more continual improvement process.

This policy implies the coexistence of facilities with differing levels of safety, with the safety of the older units being upgraded to keep pace with the more recent ones.

Research is also one source of progress in nuclear safety and radiation protection area.

2 | 1 Organisations, safety, competitiveness

2 | 1 | 1 Supervision of organisational and human factors

Supervision of "organisational and human factors" (OHF) in a high-risk system such as a nuclear power plant, implies taking into account anything that could help ensure that human intervention on the system is as effective and safe as possible.

Human intervention must be considered at several levels: first of all that of the individual performing a given task (drafting an operating procedure, testing correct operation of a PCB, closing a valve, and so on), or taking a decision. The second level is a collective one (small group, shift team, workshop, etc.), comprising all the individuals concerned by the task (the I&C specialist, his colleague who helps him and the operator who checks the information in the control room). The next higher level is that of the organisational set-up (departments, divisions, units, etc.).

For too long considered to be the weak link and the error-prone cause of technical system failures, man is an essential component of the safety chain, primarily through his ability to adapt, question and react to unexpected situations. His role in running, supervising and maintaining the facilities is vital.

A number of factors determine human performance and thus the ability of the staff to perform their functions efficiently and safely: characteristics linked to human capabilities and limits, skills, working of the groups and the organisations, operating procedures and instructions, quality of the man-machine interface on the technical equipment in the facility and the working tools, constraints inherent in the working environment.

Including organisational and human factors in safety therefore requires consistent action in a number of areas, such as the training and skills of the staff working in the facilities, the ergonomics of the facilities and the operating documentation, individual and group working methods, organisation and management.

The action of the ASN is therefore based on the following general principles:

• the responsibility of the licensee: within the framework of general safety objectives, it is the role of the licensee to define organisational provisions and then adapt them whenever necessary, to take the necessary steps for incorporating human factors into the design and operation of the systems and to ensure adequate training of its staff. The ASN where appropriate analyses and approves certain provisions but prescribes no standardised organisational arrangements for nuclear licensees. Similarly, it is up to the licensee to train its staff and assess their ability to perform their duties;

N4 reactor control room

• monitoring; the inspections carried out on licensee sites are frequently an opportunity to examine how the organisations work and enable the extent to which human and organisational aspects are taken into account in nuclear facilities to be assessed;

• experience feedback: incident analysis should enable the licensee to improve how the working groups function, in other words those groups of staff involved in the performance of a task, such as an operating team. The unsolicited transmission of information should be aimed more at improving safety than looking for a culprit;

• defence in depth: to enable man to play his safety role, human and 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.

In 2005, EDF presented to the ASN its new operational nuclear safety management policy and the policy implementation guide, which was sent out to all sites. This policy interlinks the general safety policy as previously defined, quality management policy and the safety management tools set up by the DPN since 1997 to improve safety and operational stringency in the field.

The observations made during the various checks conducted by the ASN in this area showed that this policy has indeed been deployed on the sites, but not always in the same way. Efforts have been made to improve operational communication, in particular including use of the simulator to train staff in communication, particularly when several departments have to cooperate. Weaknesses nonetheless remain in certain nuclear power plants, for example with risk analysis, which is a tool required by the DPN as part of its safety management policy.

A new operation organisation has also been in place on all sites for several years now. This new organisation is primarily characterised by the creation of the position of Operations Shift Manager and by taking the safety and radiation protection engineer out of the shift team. His assistance and analysis duties are now no longer carried out in real time and he is given an additional verification role. The ASN asked EDF to submit experience feedback on the workings of this organisation in 2006.

2 | 1 | 2

Skills and qualifications management within EDF

With regard to staff training and qualification, EDF policy is now based on decentralising training out to the sites and introducing the notion of competence. This policy gives the nuclear power plants (NPPs) greater freedom of organisation and action and should lead to greater involvement by the local hierarchy in managing skills, in particular through their assessment and by identifying needs.

The programme to deploy a simulator in each nuclear power plant was completed on all plants at the end of 2004. The effect of this should be to increase simulator availability for the operating teams, as well as to offer simulator access to the staff in charge of maintenance or testing. Simulator training now includes situations involving cooperation between several departments, in order to train the staff in operational communication.

As increasing numbers of staff retire, with the corresponding high influx of new personnel, the DPN in 2003 set up a human resources policy giving it a multi-year view of jobs and skills. The goal is to ensure availability of the resources necessary to guarantee the long-term safety and performance of the nuclear power plants.

Since 2001, staff qualification measures have been strengthened through the use of assessments following the national training courses intended for the more sensitive professions. This is already underway for the classroom courses and is gradually being implemented on the simulator courses. The situation with respect to local training courses varies according to the sites.

Overall, the observations made during the various inspections by the ASN in the field of skills management and qualifications show a situation that is satisfactory. However, efforts are still needed in radiation protection and fire training.

The ASN asked the Advisory Committee for nuclear reactors to carry out in 2006 an assessment of the skills management and staff qualification process used by EDF in its nuclear facilities.

2 | 1 | 3

Monitoring the quality of subcontracted operations

Maintenance of the reactors in the French nuclear power plants is to a large extent subcontracted by EDF to outside companies. This activity, which is highly dependent on the scheduling of nuclear power plant outages, concerns about 20,000 people.

Implementing an industrial policy such as this is left to the initiative of the licensee. In application of the order of 10 August 1984 concerning the quality of the design, construction and operation of basic nuclear installations (BNIs), the ASN is responsible for checking that EDF meets its obligations with respect to the safety of its installations by implementing a quality approach, and in particular checks on the subcontracting conditions.

The use of subcontractors requires that the ASN monitor the following aspects, which also constitute the basis of the “progress and sustainable development charter” signed by EDF and its main contractors.

Choice and surveillance of contractors

In order to comply with the requirements of the above-mentioned order of 10 August 1984, EDF implemented a system for qualifying its contractors, based on an assessment of their technical competence and their quality organisation. In addition, EDF is required to monitor its contractors or have them monitored and use experience feedback for a continuous assessment of their qualification.

In 2005, the ASN carried out inspections in all EDF plants and in the head office, focusing on monitoring of work, whether carried out by EDF entities or by outside contractors. It also checked the definition and implementation of a consistent industrial policy designed both to maintain in-house skills in the plants and outsource certain work.

With regard to contractor monitoring, the ASN considers that EDF has made significant progress in the plants, both in preparation and monitoring of the work and in the level of supervision in the field. This progress is to a large extent linked to the approach initiated by EDF head office. However, experience feedback has not yet been analysed concerning working methods and human resources. The ASN will be vigilant in this respect.

Outage activities

With regard to performance and preparation of outage activities, the ASN once again this year confirmed the improvement in early service ordering by EDF and the greater visibility of their workload afforded to the contractors, although EDF's target of 100% of orders placed 4 months before the beginning of outage has not yet been met.

Radiation protection and conventional safety

In terms of radiation protection for workers involved in outage activities, the ASN focused its attentions on enforcing the Labour Code through inspections conducted during the reactor outages. It was in particular able to check that monitoring of worker exposure to ionising radiation was conducted with an equivalent quality level, regardless of whether the person concerned was employed by a subcontractor or by the licensee.

The contractor market

The decision made by EDF to outsource part of its reactor maintenance work must not create a situation of dependency in which it relinquishes control over the planning or quality of the work done.

EDF has set up a structure for monitoring the contractor market and supervising the available resources. The ASN is keeping a close watch on the subject through its inspections in the plants and in head office.

2 | 1 | 4

Safety and competitiveness

The law 2000-108 of 10 February 2000 regarding the modernisation and development of the public electricity service considerably modifies the domestic electricity market in France. Whilst stipulating EDF's public service commitments, the law, which transposes a European directive on the internal electricity market, in particular places EDF in competition for the production and supply of energy to the main customers.

EDF underwent a change of status in 2004, becoming a limited company. At the end of 2005, the company was floated, with the State retaining an 86% stake. The law stipulates that the State must keep at least 70% of the equity and voting rights.

Cost control concerns are now more clearly apparent in the licensee's dialogue with the ASN. Technical discussions with EDF have clearly become tougher with regard to economic feasibility aspects, or to the justification for certain requests or certain deadlines, and in the handling of very short-term subjects during unit outages.

A broader discussion has begun and is continuing on the potential safety impact of electricity market trends and the new practices implemented or foreseen by the licensee, and on the actions that could be taken by the ASN in this field. The ASN has already initiated work in several areas.

The first area of work is to develop monitoring tools to provide early warning of any drift: the economic situation, spending trends, workforce management and licensee organisational changes are all the subject of closer scrutiny. The ASN has thus questioned EDF about its 2005 budget and asked for a periodic safety and radiation protection summary of certain steps taken to improve the economic performance of the nuclear power plants, such as cycle extensions, or reliability centred maintenance. Spending trends show regular investment in maintaining the nuclear power plants and a more or less constant R&D effort over the period 2002-2005. Overall, the 2005 review showed no worrying drift. However in the future, the ASN will be keeping a close watch on the consequences of any reorganisation within EDF designed to attain its economic performance targets.

The second area of work is to set up a more open and responsible dialogue with the licensee about economic issues. One instrument used in this dialogue is the system of analyses offsetting the cost against the safety benefits, so that for a given financial resource level the actions offering the highest safety gains can be chosen. At the end of 2004, EDF presented these analyses to the ASN to provide a ranking of the modifications currently being defined as part of the periodic safety review for the third ten-yearly outages on the 900 MWe reactors.

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. Deciding to act immediately, the ASN set up a system of decisions and formal notices and began drafting a number of general technical regulations.

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 licensee internationalisation and the arrival of a competitive, interconnected electricity market. The work done within the WENRA association, in which the ASN plays an active role, contributes to this.

In this context, the Director General of the ASN, in a letter dated 20 September 2005 (available on the www.asn.gouv.fr website), drew the attention of EDF's Chairman to the changes experienced by the nuclear industry in Europe and their short and medium term repercussions with respect to nuclear safety and radiation protection, in particular:

- the growing importance of the international dimension in nuclear safety issues and safety harmonisation work;
- the need for a broader view of safety, including radiation protection and environmental protection concerns, technical aspects, but also human and organisational factors;
- in the context of an increasingly competitive electricity market, the need to preserve the goal of constantly improving safety.

2 | 1 | 5

Internal authorisations

As part of its nuclear installations safety supervision role, the ASN can make certain reactor operations dependent on its prior approval. In certain cases, prior authorisations were imposed on the licensee following significant incidents. Generally however, the ASN considers that the prior authorisation system must remain limited to the cases which specifically require it, either because stipulated in the regulations or because of the safety, radiation protection or environmental protection issues. Actually, such a system could encourage the licensee to shift the burden of validating its operations or documents onto the ASN and thereby pay less attention to their quality, which runs contrary to the principle of the licensee's prime responsibility for nuclear safety.

According to experience feedback in recent years, the ASN considers that some of the prior authorisation requirements could be lifted, provided that EDF reinforces monitoring of the activities and implements an appropriate supervisory organisation:
• lowering the primary system water level to the "low operating range" of the RRA system with core loaded (transient commonly called "mid-loop operation");
• reactor restart after outages without significant maintenance.

Since January 2005, the authorisations in these two areas have been issued by the DPN management or by the management of the plant concerned, after review by an internal commission independent of the decision-making chain and comprising safety and quality experts. EDF also checks the working of these processes and reports on them to the ASN.

During the course of 2005, the ASN conducted an inspection within the DPN to check compliance with the new provisions. In 2006, the ASN will conduct an inspection in each plant on the subject of internal authorisations.

2 | 2

Continuous safety improvements

2 | 2 | 1

Anomaly correction

In recent years, a number of anomalies have been detected in EDF nuclear power plants, to a large extent as a result of the systematic conformity checks required by the ASN, but also because of the questioning attitude of the licensee, which tracked down these anomalies at its own initiative. The ASN requires that those anomalies with potential safety consequences be corrected within a time commensurate with their significance.

The ASN considers that the checks conducted are the guarantee that a good safety level is maintained and that a facility on which nothing is done to find anomalies would only give the illusion of being safer than one on which the licensee looks for, finds and corrects conformity discrepancies.

Systematic checks: conformity reviews

The ASN requires that conformity reviews be conducted as part of the periodic safety reviews. The conformity reviews consists in comparing the state of the facility with the design safety requirements, taking account of changes made since construction, and listing any anomalies. These anomalies can be of various origins: design errors, construction defects, discrepancies introduced during maintenance, deterioration due to ageing and so on.

This review includes a check on the conformity of the steps taken to protect against external hazards, including extreme weather conditions and earthquakes, and against internal hazards such as high-energy pipe breaks, as well as a check on the ability of the equipment to operate in the degraded ambient conditions likely to exist in the event of an accident (known as "qualification for accident conditions"). To this must be added a "programme of additional investigations", the aim of which is to check the parts of the facility which are not covered by maintenance schedules because access to them is too difficult.

The conformity review on the 900 megawatt reactors ran from 1997 to 2001, while that for the 1,300 megawatt reactors started in 1999 and ended in 2003.

"Real time" checks

In addition to the process of systematic anomaly searches, a questioning attitude on the part of the licensee's staff is another means of detecting conformity discrepancies: routine field inspections or even a critical review of older design studies in the engineering centres can contribute to this. Several anomalies were discovered in this way and the ASN considers EDF's attitude in this area to be positive.

Informing the ASN and the public

A specific procedure was set up to inform the ASN about the conformity anomalies discovered by EDF. When there is any doubt as to the conformity of an item, EDF notifies the ASN and undertakes a process of "characterisation" which aims to determine whether there is a real deviation from the design safety requirements and if so, to specify the equipment affected and assess the consequences of the anomaly for safety. The ASN is informed of the characterisation results and a significant safety event declaration is sent out to it as necessary.

The most significant conformity anomalies (INES scale level 1 and higher) are posted on the ASN's website.

This procedure guarantees transparency both to the ASN but also to the public.

The ASN's remediation requirements

The ASN examines the remedial measures proposed by EDF, in particular the lead-times, taking account of the safety consequences of the anomaly.

Any conformity deviation which significantly impairs safety must be corrected rapidly, even if the remedial measures entail a large volume of work. The facility may have to remain shut down until the repairs are made if the risk involved in operating it is considered to be unacceptable and if there are no possible palliative measures. Conversely, repair of a less serious anomaly may be spread over a longer period of time if particular constraints so warrant.

For earthquake resistance anomalies, one factor in assessing the urgency of the repair is the seismic level for which the equipment in question is designed. In cases in which there is only a need to restore a safety margin for equipment items which can already withstand a large-scale earthquake, longer repair lead-times may be granted.

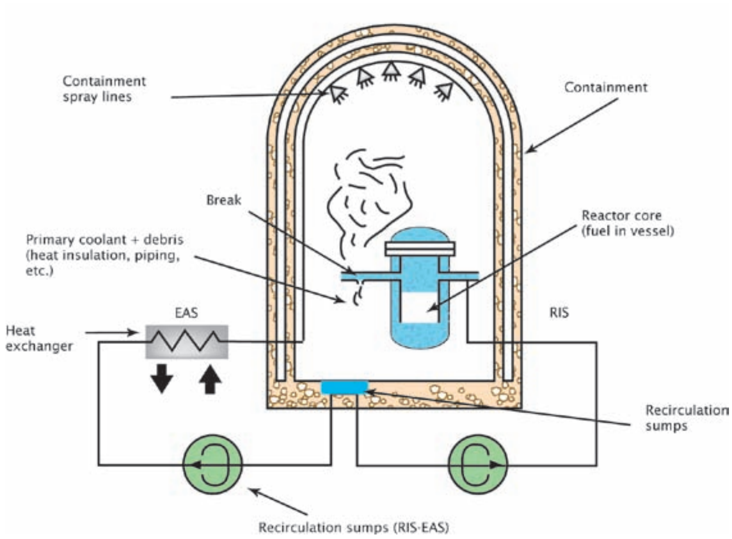
Examples of anomalies currently being handled

– The recirculation sump filters clogging risk

In the event of a pipe break accident on the primary system inside the reactor building, the safety injection system (RIS) and containment spray system (EAS) are automatically triggered. These sys-

N4 plant series reactor sumps

tems inject water which is first of all pumped from a tank. When this tank is empty, the water from the leak and the water already sprayed is collected in sumps at the bottom of the reactor building. This water is then reinjected into the primary system by the RIS LP pumps and dispersed into the containment via the EAS system pumps, thus reducing both pressure and temperature.



PWR recirculation function

The main purpose of this reinjection of water into the primary system is to allow continued cooling of the reactor core, thus avoiding a serious core melt accident.

This system is called the recirculation function and constitutes a fundamental "line of defence" in preventing a core melt accident in pressurised water reactors.

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. This results in a risk of sump clogging and of foreign bodies entering the systems, with possible malfunction of the recirculation function. These physical phenomena were indeed taken into account in nuclear reactor design. However, experience feedback and studies conducted at an international level for the past ten years or so have led the ASN to question the pertinence of the rules used for the design of the filtration systems.

According to initial results from the experimental research programme initiated by the IRSN on this subject, the ASN in October 2003 asked EDF for its opinion regarding the risk of failure of the 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 discounted for less serious breaks. All French nuclear reactors are concerned to various extents, with the older ones apparently being the most prone to this phenomenon, as they offer a smaller filtration surface area. The ASN required EDF to review and propose solutions to remedy the anomaly. Given its potential impact on the safety of the facilities, EDF declared a significant safety event on 31 December 2003, rated level 2 on the INES scale, and the ASN issued a press release in early January 2004.

It is worth noting that the anomaly potentially concerns all of the world's pressurised water reactors (the most widely used technology). Some countries, such as Sweden or Finland, consider that they have solved the problem by extending to PWRs those modifications made on their boiling water reactors following the Barsebäck incident. Other countries, such as the United States and France, initially focused their efforts on studying the phenomena and the real impact of the anomaly. After concluding that the anomaly was indeed a potential problem, they are currently working on corrective action.

In order to characterise the anomaly correctly and design a lasting solution, EDF drew up a "studies reference system" which in particular defines the scenarios employed for analysis of the sump filter clogging phenomena. There are many parameters that can influence the phenomena and the physical processes involved are complex, hard to model and as yet insufficiently well understood.

Having received the opinion of the Advisory Committee for nuclear reactors, which reports to it, the ASN in April 2005 considered that additional studies were needed to confirm certain assumptions, but without this standing in the way of a rapid start to the work to correct the anomaly.

As of 2004, EDF began to look at solutions likely to deal with the anomaly. In 2005, EDF replaced the sump filters on three 900 MWe reactors. Experience feedback from this initial work still needs to be analysed before the modifications can be deployed to all the reactors concerned.

Furthermore, while reviewing the design reference system for the EPR reactor, the ASN asked EDF to take all steps to "practically eliminate" the risk of clogging of the water intakes for the safety injection, containment spraying and corium recovery cooling systems. These provisions are currently undergoing technical review, with consultation of the Advisory Committee for nuclear reactors. In compliance with the principle of defence in depth, this review looks at:
• the underlying factors involved in the risk of clogging of the water intakes, in particular the selection of the materials used in the reactor building (choice of heat insulation, paint, etc.);
• the countermeasures which, if conditions are degraded, prevent clogging of the water intakes (sizing of filter surfaces, possibility of filter cleaning by reverse recirculation of water over the screens).

New sumps installed by EDF in 2005

– Anomaly concerning certain EDF 900 MWe reactor safety pumps

On 9 December 2005, EDF informed the ASN that an anomaly rated level 2 on the INES scale had been detected on the pumps of the low-pressure safety injection systems (RIS LP) and containment spray systems (EAS) in the 900 MWe reactors. In the same way as the sump filter clogging anomaly, this concerned the water recirculation function used to cool the reactor in the event of a primary system leak. This anomaly was the subject of an ASN press release on 14 December 2005.

At commissioning of the 900 MWe reactors, vibration of the RIS LP and EAS pumps had been observed. Modifications were made between 1983 and 1987 to attenuate these vibrations and keep them at an acceptable level.

However, EDF took its investigations further in order to gain a better understanding of the phenomena involved and carried out full-scale testing on a test bench, for the first time using water at the same temperature as that liable to be circulating through these pumps in the event of an accident. These tests revealed abnormal vibration of the pump motors, related to the water temperature. More precisely, the vibrations were caused by lifting of the pump motor transmission shaft owing to expansion induced by the temperature of the water circulating through the pipes.

Investigation of the pumps which had been tested showed no signs of damage. However, EDF considers that owing to the high level of vibration, the reliability of these pumps cannot be guaranteed for more than about thirty hours in certain accident situations.

According to EDF, only the pumps on the RIS LP and EAS systems in the 900 MWe reactors are affected by this anomaly, as the 1300 MWe reactor pumps are equipped with a device to compensate for thermal expansion of the transmission shaft, while those in the 1450 MWe reactors use a different technology.

In an accident situation such as that described above, if there is a leak from the primary system, and because of the high temperature of the water circulating through the RIS and EAS systems, the anomaly is liable to cause malfunction of the RIS LP and EAS pumps and thus eventually lead to loss of the recirculation function.

The anomaly has no impact on normal operation of the reactors.

EDF informed the ASN that the anomaly could be corrected, in particular by replacing the pump motor upper bearing by a double-thrust bearing which would prevent the motor rotor from lifting under the effect of thermal expansion. EDF aims to carry out these replacements on all 900 MWe reactors before 31 March 2006.

2 | 2 | 2

Review of experience feedback from reactor operations

At the ASN's request, the Advisory Committee for nuclear reactors in 2005 examined experience feedback from operation of pressurised water reactors over the period 2000-2002. An initial meeting of the Advisory Committee was given over to examination of generic topics. A second meeting was devoted to analysis of topics concerning plant organisation and operating practices.

Investigation of the incidents listed for the period 2000-2002 highlighted the fact that a large number of the significant events was caused by the periodic test programmes. The ASN asked EDF to initiate actions to remedy the weaknesses identified in the periodic test and restart test preparation and performance processes and to submit a review of the improvements resulting from the action taken.

In addition, nonconformity with the technical operating specifications accounts for more than one-third of the significant safety events. The ASN asked EDF to initiate or continue with proactive steps to reduce the number of events involving these fields, in particular to improve how human and organisational factors are considered in the design of the technical operating specifications, and to analyse and monitor any failures to comply with these specifications.

Review of the risk analysis approach and how it is implemented operationally revealed problems with analysing cross-functional risks involving several professions, as well with involving contractors in the risk analysis process. The ASN asked EDF to improve its handling of these aspects as well as its in-depth analysis of significant safety events in order to identify those factors leading to inadequacies in the risk analyses.

Finally, in experience feedback analysis, the ASN wishes to see greater importance attached to studies concerning lessons learned from events occurring abroad.

2 | 2 | 3

Periodic safety reviews

In France, the ASN carries out a complete "check-up" on each NPP at intervals of 10 years, called the periodic safety review. This is an opportunity for in-depth inspection of the installations to check that they comply with all the safety standards. It is also an opportunity to compare the safety level of the installations with the more recent installations and to make the modifications considered to be necessary with a view to improving safety. In this respect, the safety reviews are one of the cornerstones of ASN policy, which is to ensure that not only does the licensee maintain the level of safety of its installations, but also improves it.

The safety reviews therefore have two primary objectives:
• firstly, to compare the level of safety of the facilities with their initial "safety reference framework" in order to identify any deterioration over time, as well as the faults and weaknesses of the safety analysis. This is the conformity review;

• secondly, to compare the safety of the facilities with the most recent safety standards, in order to improve the level of safety. This is the safety review. This review aims to identify modifications likely to bring about a significant improvement in the safety level and establish a new "safety reference framework". Advantage is taken of the 10-yearly reactor outages (see 1|2|3) for deployment of these safety improvements.

The review process comprises an orientation phase, setting the topics and scope of the conformity and review studies, a study phase, the aim of which is to determine the modifications to be made, and a modifications review phase. After the study phase, the choice of topics for the reactor conformity review is finalised. Each of the phases in principle comprises a proposal from the licensee, consultation of the Advisory Committee for nuclear reactors and a position from the ASN. Before the first ten-yearly outage associated with the safety review, the review must rule on the acceptability of the new safety reference framework and the continued operation of the reactors following their ten-yearly outage.

The twenty-year safety review for the 900 MWe reactors

Implementation of the modifications arising from this safety review continued during the course of 2005 on the occasion of the second ten-yearly outages at Blayais 4, Cruas 1 and Saint-Laurent B1, and will end in 2010 with Chinon B4. Among the modifications made by EDF could be mentioned those aimed at improving the reliability of the backup turbine generator, the steam generators auxiliary feedwater system and the ventilation systems in premises housing safeguard equipment.

The thirty-year safety review for the 900 MWe reactors

After defining the guidelines for this periodic safety review in 2003, the ASN consulted the Advisory committee for nuclear reactors at the end of 2004 and in the first half of 2005 concerning the various study topics, in particular serious accidents, containment of radioactive materials, fire, explosion risks and the use of probabilistic safety studies. Subsequent to these consultations, the ASN requested modifications and additional studies for possible design or operation changes. Implementation of the modifications arising from this safety review is scheduled for the third ten-yearly outages on the 900 MWe reactors, from 2008 to 2020.

The twenty-year safety review for the 1300 MWe reactors

Review of the modifications resulting from this periodic safety review was completed in 2005 in accordance with the investigation process established by the ASN.

Implementation of the modifications resulting from this periodic safety review began in spring 2005 during the second ten-yearly outage of Paluel 2. It will continue on the other 1300 MWe reactors until 2014. Of the modifications implemented by EDF, particularly noteworthy are those designed to improve the fuel handling operations during refuelling outages, or activation of the backup pumps from the control room if the reactor's external electricity supply is lost.

2|2|4

Modifications made to the equipment and to the operating rules

As part of the process of continuous improvement of the safety of its reactors, but also to improve the industrial performance of its production tool, EDF periodically makes changes to equipment and operating rules. These changes can be the normal result of the correction of conformity deviations, periodic safety reviews, or taking account of experience feedback, such as that arising from the 2003 heat wave.

The ASN has set up a process to approve these modifications, compatible with the reactor safety issues.

For equipment changes, the first part of this process aims to adapt the level of review to the relevance for safety, by classifying the changes in 3 groups according to safety criteria. Only modifications belonging to groups 1 and 2, which have the most pronounced safety impact, require prior ASN approval. The second part of the process specifies the nature of the information the ASN expects from the licensee by stipulating the content and transmission frequency of certain information documents.

In 2005, ASN approvals primarily concerned the balance of the equipment modifications implemented on the occasion of the second ten-yearly outages of the 1,300 MWe reactors and the "commissioning completion package" lot for the 1450 MWe reactors.

Documentary changes are subject to prior approval by the ASN when they affect chapters III, VI, VII, IX and X of the RGE (see 1|2|2). For these changes, the ASN asked EDF to draw up a preliminary note on the safety issues of the main changes to the operating rules.

Since 2004, this has in particular led to an improvement in the time taken to review operating rule changes.

2 | 3

Nuclear power plant ageing

Nuclear power plants, like all industrial installations, are subject to ageing. The role of the ASN is thus to ensure that EDF's general operating strategy takes account of all ageing-related phenomena, in order to guarantee a level of safety compatible with the regulations, throughout the plant's operating lifetime.

2 | 3 | 1

A relatively young population of nuclear power plants

The nuclear power plants currently in operation were built in a very short space of time: 45 reactors, representing 50,000 MWe, or three quarters of the nuclear power plants, were commissioned between 1979 and 1990, with an additional 10,000 MWe between 1990 and 2000.

In December 2005:
- the average age of the thirty-four 900 MWe reactors was 24 years (between 18 and 29);
- the average age of the twenty 1,300 MWe reactors was 18 years (between 13 and 21).

The French nuclear power plants are also the youngest of all the plants in the major nuclear countries, with the exception of China.

2 | 3 | 2

The main factors in ageing

To understand the ageing of a nuclear power plant, other than simply the time that has elapsed since it was commissioned, a number of factors must be looked at.

The lifetime of non-replaceable items

In the design, a certain number of reactor components were designed on the basis of a predetermined operating period. These items are therefore subject to close supervision to ensure that their condition and the trends involved are as expected. This is in particular the case with the reactor vessel, sized to withstand the effects of embrittlement due to neutron irradiation of the core zone steel for a period of 40 years (equivalent to continuous operation for 32 years). The reactor vessel is checked by monitoring “control samples” of metal and appraising them at regular intervals.

Deterioration of replaceable items

These are phenomena such as wearing of mechanical parts, hardening and crazing of polymers, corrosion of metals, etc. The equipment requires particularly close attention during the design and manufacturing stages (particularly the choice of materials) along with a monitoring and preventive maintenance, repair or replacement programme as necessary. It must also be possible to demonstrate the feasibility of possible replacement.

Equipment or component obsolescence

The availability of spares which have been qualified for installation in the reactors is highly dependent on any changes occurring within the suppliers’ industrial situation.

Should the manufacturer cease to make certain components, or simply go out of business, this could create spare procurement problems for certain systems.

New spares would then require safety justification before they could be installed in the reactors.

Given the length of this procedure, the licensees must adopt a vigorous forward-looking policy in this area.

The ability of the facility to follow changes in safety requirements

Greater knowledge and technological improvements, as well as changes in the social acceptability of risk are also factors which can lead to the decision that an industrial facility requires extensive renovation work or - if this cannot be done at an acceptable cost - to closure at a time in the future to be defined.

2|3|3

Strategy to deal with equipment ageing

This “defence in depth” type strategy is based on three lines of defence.

Including ageing in the design

The design and manufacture of components, the choice of materials and the installation arrangements must be tailored to the intended operating conditions and take account of the known or presumed deterioration processes.

Monitoring and anticipating ageing phenomena

Deterioration phenomena other than those included in the design may be brought to light during the course of operation. Monitoring and preventive maintenance programmes and conformity reviews (see 2|2|1), or review of experience feedback are ways of detecting these phenomena.

Repairing, modifying or replacing equipment likely to be affected

This type of action has to be planned in advance, given the procurement lead-times for new components, the maintenance preparation time, the risk of obsolescence of certain components and the risk of gradual loss of staff technical skills.

2|3|4

ASN policy

From a strictly regulatory standpoint, in France there is no limit on the time that a nuclear power plant is authorised to operate.

However, the ministers with responsibility for nuclear safety may at any time ask a licensee to conduct a safety review of its facility. The practice in France is thus to conduct a safety review every 10 years. These reviews are a particularly good opportunity for an in-depth examination of the effects of ageing, but also of the need for and feasibility of modifications to be made if the facility is to keep pace with changes in the safety requirements (see 2|3|2).

In preparation for the 900 MWe reactors third ten-yearly outages, the ASN therefore in 2001 asked EDF to present a precise account of the ageing status of each reactor concerned and demonstrate the possibility of continuing with operation beyond 30 years in satisfactory safety conditions.

In reply to this request, Electricité de France drew up a programme of work which was examined by the Advisory Committee for nuclear reactors in December 2003. The organisation set up by EDF under the terms of this programme, and the methodology used to take account of ageing were considered on this occasion to be satisfactory. In 2005, EDF sent the ASN the initial data resulting from implementation of this programme. These data will be reviewed on a number of occasions by the Advisory Committee for nuclear reactors and the Standing Nuclear Section (SPN) of the Central Committee for Pressure Vessels. At the end of this examination process, the ASN will adopt a stance for each individual reactor regarding continued operation beyond the third ten-yearly outages.

2|4

The EPR project

2|4|1

The public debate concerning the EPR “first-off” reactor

EDF has stated that it wishes to build a new electricity generating unit using a third-generation nuclear reactor, the EPR, on the Flamanville site (Manche).

In accordance with the Environment Code, EDF referred the issue to the National Public Debates Committee (CNDP) on 4 November 2004. The CNDP decided to hold a national public debate on the EPR project and handed the matter over to a Special Public Debates Committee (CPDP). The aim is to ensure that all the stakeholders concerned (owner, public authorities, elected officials, associations, experts, local residents, general public, etc.) are informed and can express themselves as extensively as possible during the project preparation phase.

The four-month long debate is being held both locally where project construction is planned, and nationally. The ASN is involved in the public meetings held to deal with the various topics. At the end of this debate, EDF will take a decision on whether or not to build an EPR reactor in Flamanville.

2 | 4 | 2

Technical examination

In 2005, ASN review of the detailed studies concerning the EPR reactor project continued apace. The ASN received the opinion of the Advisory Committee for nuclear reactors and the SPN of the Central Committee for Pressure Vessels (SPN) on about fifteen subjects, including:

- worker radiation protection;
- the corium recovery system (core-catcher);
- dealing with heatwave situations;
- design of the rod cluster control mechanisms;
- assumption discounting the possibility of a primary and secondary pipe break;
- steam generator design.

With regard to worker radiation protection, in 2004 the ASN considered that the target was not ambitious enough. The new dossier presented this year by EDF demonstrated a real effort to optimise the work sites which make a significant contribution to the collective dose. This now means that EDF can aim for a collective dose that is significantly lower than the lowest value obtained by the French nuclear power plants in service. At this stage in the design, this point is considered to be satisfactory by the ASN.

With regard to the core-catcher, the ASN considers that the design modifications and additional technical justifications presented are such as to demonstrate correct operation of the system. At this stage in the design, this point is considered to be satisfactory by the ASN.

Concerning heatwave situations, the ASN considers that the design measures for dealing with extreme climatic situations and which take account of the expected climate change over a timeframe of a century, are satisfactory. However, given the uncertainties surrounding this subject in the light of current knowledge, the ASN asked that in addition to the design measures adopted, facilities for in-service adaptation also be designed-in, should actual climate change prove to be greater than originally anticipated.

The planned rod control cluster mechanisms for the EPR reactor are appreciably different from those used in the existing EDF reactors, but similar to those fitted to the German Konvoi type reactors. The manufacturer plans to assemble two stainless steels of different grades to produce the mechanism's envelope structure. The ASN expressed reserves regarding the manufacturer's choice of these materials and the number of welds needed to make each envelope structure.

With regard to the primary and secondary piping, the EPR reactor designer envisages ruling out the possibility of pipe break in the safety demonstrations. The ASN reviewed the demonstration of this "break preclusion" concept, considering that it constituted the first level of a "defence in depth" type approach. On the basis of the SPN's recommendation, it clarified the technical design, manufacture and operational requirements which would confirm the highly improbable nature of a pipe break.

The design choices for the steam generators were evaluated in the light of the new nuclear pressure vessel regulations (see point 3.1 below and chapter 3 point 2|2|1). The design of the EPR reactor steam generators benefits from the experience acquired with the N4 type reactor, the design of which had already taken account of the damage observed on the 900 and 1,300 MWe series steam generators. However, the ASN considers that the data presented at this stage cannot confirm that the geometrical characteristics chosen actually meet the requirements of the new regulations.

The Flamanville nuclear site was chosen by EDF at the end of 2004 for siting of the EPR reactor if it were to be licensed. The ASN is preparing to review the studies concerning specific aspects of the chosen site (seismic activity, flooding risk, design of the pumping station, etc.).

2 | 4 | 3

Cooperation with foreign nuclear safety authorities

After signing a contract with Areva at the end of 2003 for the construction of an EPR reactor, TVO - a Finnish electricity production utility - submitted a construction permit application in early 2004. Construction of the Olkiluoto EPR reactor has begun and the "foundation stone" was officially laid in September 2005. The Finnish and French nuclear safety authorities therefore made the perfectly natural decision to work together closely on this matter. The ASN in particular gave the Finnish nuclear safety authority (STUK) access to all documents dealing with the reviews carried out since 1993 and a Finnish expert was appointed to the Advisory Committee for nuclear reactors.

Several meetings were held in 2005 between the Finnish and French nuclear safety authorities, in order to review the progress of the respective technical investigations on the projects.

The ASN and its technical support organisation, the IRSN, also presented the EPR reactor project and authorisation decree process to the Chinese nuclear safety authority in March 2005 and the Canadian nuclear safety authority in December 2005.

2 | 5

Research into pressurised water reactor nuclear safety and radiation protection

Fundamental and applied research is one of the keys to progress in the field of nuclear safety and radiation protection, for several reasons:
• development and validation of innovative technical solutions allow the emergence of new products or operating and maintenance processes and their use in place of techniques or processes offering a lesser degree of protection;
• certain research work aims to improve knowledge of the risks, which will help define the protective measures needed or even shed light on risks hitherto poorly evaluated: this is for example the case with experiments on PWR sump clogging phenomena, or studies into human reliability helping to better quantify the role of human factors;
• finally, research is useful in developing high level skills in the field of nuclear safety and radiation protection, thus helping to ensure that there is a ready supply of specialists.

The fact of being familiar with the latest research results and knowing which questions are still to be answered, means that supervisory organisations know how far a licensee can be pressed to implement safety or radiation protection improvements. The ASN therefore remains abreast of research work in order to make its supervisory actions more pertinent. Moreover, the ability of the supervisory organisations - or the experts on which they rely - to initiate research also sometimes enables them to identify safety questions that were wrongly considered to have been resolved. For example, interpretation of the experiments conducted by the IRSN brought the risk of nuclear reactor sump clogging back into the spotlight.

It is also important for the licensees to make a significant contribution to the nuclear safety and radiation protection research effort, using the results to make their facilities even safer. The ASN thus asked EDF to send it an annual statement of the budget and workforce assigned to nuclear safety and radiation protection research, so that it could examine the corresponding trends. The ASN's findings show that EDF's budget in this field has remained at a high level, even if there has been a slight downward trend in recent years. It also observes with satisfaction that research in this area is still driven by a number of factors:
• future reactor projects: the EPR project has led to R&D work into new technical solutions, some of which could be implemented on existing reactors;
• the desire of industry to improve the performance of its facilities: for example, EDF's intention to increase nuclear fuel performance in particular generated work on cladding materials and the design

codes. This work is also a means of increasing the available knowledge and in some cases advancing the safety level, for example by highlighting weaknesses in the methods previously used;

• the reactor lifetime issue. EDF's wish to continue with operation of the existing plants initiated research into materials ageing and the evolution of structures and components, particularly the performance of the concrete containments and the properties of steel under the effects of irradiation;

• taking account of experience feedback from incidents; for example the research into the risk of flooding or modelling of oil slick drift.

Finally, the ASN has drawn up an initial inventory of PWR nuclear safety and radiation protection research in France. A significant part of this effort is devoted to serious accidents, in other words with core melt, and the means of minimising the consequences. Conversely, far less research is devoted to human and organisational factors. This research could be boosted given that human factors are still a major contributory factor in incidents.

3 PLANT SAFETY

3 | 1

Construction supervision

Until the end of 2005, the construction of PWR pressure vessels containing radioactive fluids was regulated by the order of 26 February 1974 and basic safety rule II.3.8 for the main primary and secondary systems and the decrees of 1926 and 1943 for the others (see chapter 3 point 2|2|1). Responsibility for the construction, covering design, industrial manufacture and on-site installation lies with the manufacturer (Framatome ANP or EDF). It is up to the manufacturer to demonstrate the conformity of the equipment it designs. It chooses the manufacturing processes, the checks to be used and the acceptance criteria for the results of these checks. To do this, it usually relies on industrial codes, some of which may be specific to the nuclear industry, in particular the RCC-M code (see chapter 3 point 2|2|3). It is also up to the manufacturer to supervise its suppliers and subcontractors.

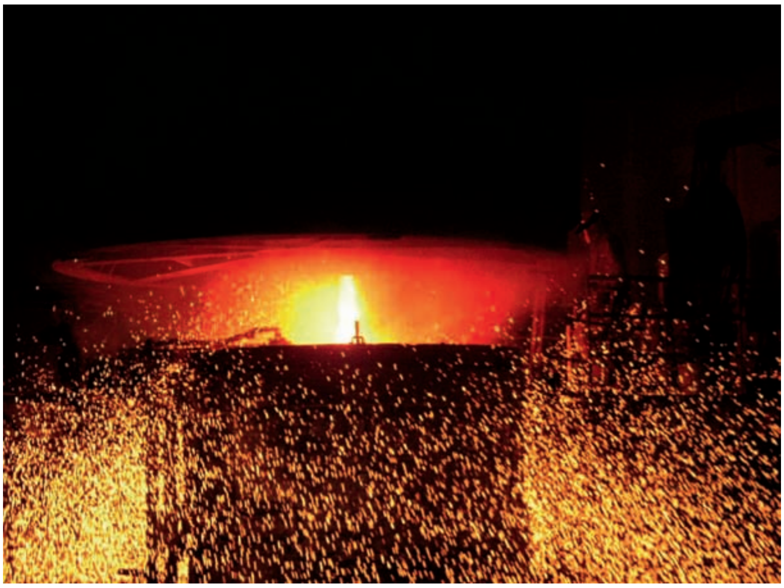
Throughout this process, the ASN checks that the manufacturer complies with the regulations and correctly carries out the tasks under its responsibility.

This construction supervision takes place:

• during design, on the basis of the justification files provided by the contractor. These files describe the equipment and its components, the loads to which they are subjected in normal operation or would be subjected to in an accident situation, their mechanical behaviour in response to these loads, the characteristics of the materials used, the manufacturing processes and their supervision;

• during manufacture/installation: on the one hand prior to the beginning of these operations, based on documents describing the technical options adopted by the contractor, and on the other hand during execution, via checks in the field and in the factory, to ensure compliance with the stipulations of the files concerning equipment dimensions, materials used, manufacturing processes employed and their qualification, the supervision carried out and its results. It ends with hydrostatic testing. The ASN is responsible for overseeing the hydrostatic test, which is the final full-scale strength and tightness test, decides on its outcome and issues the test report, without which no pressurised equipment can be brought into service.

This process is specific to France, even if in other countries the differences are minimal. For pressurised equipment which is not designed to contain radioactive fluids, there is a European directive which harmonises construction and inspection practices. While maintaining the responsibility of the manufacturer, the directive stipulates essential safety requirements for which compliance must be checked by one of the independent organisations notified by the Member States.



Casting of steel intended for a steam generator tubesheet at the JSW foundry, Muroran, Japan

With a view to improving safety, while incorporating the technical advances of the directive, the ASN has prepared a new regulatory text. For nuclear pressure vessels, it specifies construction rules and inspection procedures similar to those of the European directive, but which are supplemented to take account of specifically nuclear aspects. This text, an order of 12 December 2005, will apply as of 2006 to the construction of nuclear pressure vessels, in particular those intended for the EPR reactor, should it be built (see point 2|4).

3 | 2

Operation and control

3 | 2 | 1

Normal operating conditions

Technical operating specifications (STEs)

The general operating rules (RGEs) contain the reactor's technical operating specifications (chapter III of the RGEs). Their role is:
- to define the normal operating limits of the facility if it is to remain in conformity with the reactor design basis scenarios;
- depending on the state of the reactor in question, to define the safety functions necessary for the monitoring, protection and safeguard of barriers as well as implementation of incident and accident operating procedures;
- to specify the course of action to be followed if a normal operating limit is exceeded or if a required safety function is unavailable.

Permanent modifications to the STEs

EDF may be led to modify the STEs for various reasons: to take account of experience feedback, to improve safety, to improve reactor economic performance, or to take account of the consequences of changes made to the equipment. These changes in the STEs require prior authorisation by the ASN on the basis of safety justifications provided by EDF.

In 2005, the ASN reviewed a number of "amendment documents" modifying the STEs, which were approved or are the subject of additional justification requests. These include:

- an amendment document which concerns the 900 MWe series reactors and aims to modify certain requirements of the STEs to allow a rapid restoration of the national electricity transport grid in the even of a "generalised grid incident" (IRG);
- an STE amendment document concerning the 1,300 MWe series reactors and which aims to meet the ASN's requests concerning risks during reactor outages

The ASN also reviewed the STE revision for the CPY and N4 plant series.

The ASN considers that EDF's document support policy, in particular through highlighting the proposed changes, facilitates analysis and review.

Temporary STE modifications

When a licensee 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 ASN for a waiver, on a case by case basis. The ASN then analyses this request and may accept it, if necessary provided that compensatory measures are taken.

The ASN keeps a close watch over the number of waivers granted. EDF is therefore required:

- periodically to re-examine the reasons for the waiver requests in order to identify those which would justify adaptation of the STEs;
- to identify "generic" waivers, in particular those linked to implementation of national modifications and periodic tests.

The number of waivers examined in 2005 was 148, or an average of about 2.5 per reactor, per year. The three most commonly evoked reasons for waiver requests in 2005 are linked to:

- the unavailability of reactor systems and electrical sources during modification work or owing to maintenance on the sources themselves;
- unavailability of equipment linked to the safety injection system, as a result of remedial maintenance work;
- maintenance on the nuclear auxiliaries building ventilation system.

Although most waiver requests are granted, the ASN's waiver approvals sometimes stipulate additional requirements owing to the inadequacy of the palliative measures proposed by the licensee.

Field inspection of normal operation

During site inspections, the ASN checks:

- compliance with the STEs and, as necessary, with the palliative measures associated with the waivers;
- the normal operating document quality such as operating instructions or certain alarm sheets;
- consistency between the normal operating documents and the STE;
- staff training in handling certain "sensitive" reactor transients, such as mid-loop operation (PTB RRA).

3 | 2 | 2

Incident and accident operation

In the event of a reactor incident or accident, the operation teams have specific operating documents at their disposal, designed to enable them to keep the reactor in or return it to a stable condition.

Incident and accident operation today uses the state-based approach (APE). The APE consists in applying operating strategies which are designed according to the identified physical state of the nuclear steam supply system, regardless of the events that led to this state. Should the state deteriorate, a permanent diagnosis enables the procedure or sequence in progress to be aborted and a more appropriate procedure or sequence to be applied.

The operating documents used in incident and accident situations are developed on the basis of incident and accident operating rules which constitute chapter VI of the general operating rules. These rules, which describe operating strategies in the event of an incident or accident, must be approved by the ASN.

During 2005, the ASN continued to review changes to the operating rules proposed by EDF and in particular approved:
• the creation of new reactor operating rules to deal with fire situations, called "operator fire action sheets" (FAIOp), for the 1,300 MWe, P'4 and CP0 plant series. Production of the FAIOp operating rules is part of the fire action plan that EDF was committed to implementing on the 900 and 1,300 MWe reactors before the end of 2006;
• a modification to the operating rules in the event of a black-out, to make it easier to restart the reactors and reconnect them to the national electricity transport grid;
• evolution of the N4 series rules, in particular comprising the creation of APE rules for states when the reactor is not closed, in place of the "event-based" rules currently applied.

Generally speaking, the documents submitted by EDF to the ASN for approval are of high quality, even if progress is still needed with respect to the traceability of the origin and the end-purpose of the modifications submitted for approval.

Regular inspections are held on the subject of incident and accident operation. These inspections in particular review the management of incident and accident operation documents (transcription of reference national documents into local documents, reproduction, distribution, etc.), management of specific equipment used in accident operation conditions, and training of operation staff. The inspections performed in 2005 highlighted no major issues. Overall, the ASN considers that the sites have satisfactorily assimilated incident and accident operation rules (transcription into local documents, distribution and training of staff).

Reactor operation in severe accident situations

If the reactor cannot be brought to a stable condition after an incident or accident and the scenario resulting from a series of failures leads to core damage (core melt), the reactor is said to be entering a severe accident situation.

For this type of very hypothetical situation various steps are taken to enable the operators, supported by the emergency teams, to manage reactor operation and ensure containment of radioactive materials in order to minimise the consequences of the accident. The emergency teams may in particular use the serious accident response guide (GIAG). EDF revised this guide in 2005, primarily to take account of installation of the hydrogen recombiners. The new versions are currently being reviewed by the ASN and its technical support organisation.

In December 2004 and March 2005, for the periodic safety reviews included in the third ten-yearly outages of the 900 MWe reactors, the ASN consulted the Advisory Committee for nuclear reactors concerning the modifications to be made to these reactors in order to improve consideration of the risks associated with serious accidents.

Following this consultation, the ASN in particular asked EDF to install a device to detect corium (mixture of molten fuel and core structure) in the reactor pit on all 900 MWe reactors. The ASN also asked EDF to review the possibility of installing instrumentation for a real-time assessment of the evolving risk of hydrogen explosion in the containment, to help provide data on the progress of the accident.

EDF has also made a commitment to assessing the risks linked to a steam explosion in the event of a vessel puncture in a vessel pit already flooded and, on the occasion of the third ten-yearly outages of the 900 MWe reactors, to install a reliable device for depressurising the primary system, even if electrical power is completely lost.

Finally, and following an ASN request to optimise definition of all serious accident safety requirements, EDF proposed a draft “serious accidents” reference system. This was reviewed by the Advisory Committee for nuclear reactors in 2005. It will need to be revised, particularly to take account of the conclusions of the 900 MWe reactors periodic safety review associated with the third ten-yearly outages, as well as of long-term accident management.

3 | 3 Maintenance and tests

3 | 3 | 1 Maintenance practices

Deregulation of the electricity market leads EDF to control its expenditure. Optimising maintenance costs is one way for EDF to improve its competitiveness. EDF has therefore developed a “maintenance reduction” project which aims to concentrate maintenance on equipment which would constitute a safety, radiation protection or operational risk in the event of failure, and is relying on maintenance methods which do not require equipment disassembling.

A first change occurred in the mid-90s with implementation of the “reliability centred maintenance” (RCM) method. This is the result of a functional analysis which determines the type of maintenance to be carried out according to the consequences of equipment failure on the system concerned, rather than simply according to their causes, as in the previous approach. The ASN considered that this approach did not compromise safety. Further to requests from the ASN and to take account of experience feedback from the plants, EDF revised the RCM method to deal with redundancy loss and common mode failures, as well as failure modes that could not be detected from the control room.

Taking advantage of standardisation of the NPPs in France, EDF is developing the concept of “pilot equipment” based maintenance, creating technically homogeneous families of similar equipment operated in the same way. The selection and close monitoring of a limited number of these items - which then act as pilot items within these families - could, if no deterioration is detected, spare systematic monitoring of all the items.

The ASN is closely monitoring how EDF takes account of experience feedback about the behaviour of the equipment concerned by these maintenance methodology changes, in particular with regard to the content and frequency of the inspections.

3 | 3 | 2 Industrial code changes

The scientific applications contributing to the safety demonstrations are subject to the requirements of the order of 10 August 1984 concerning the quality of the design, construction and operation of BNIs (see chapter 3, point 2|2|1). One of the key requirements is qualification, which consists in ensuring that the application can be used in complete confidence within a specific field.

On the occasion of the inspections into this subject, the ASN observed significant shortcomings concerning the inventory of scientific applications used in the safety demonstrations, the production of qualification files and the supervision of these files, particularly in the case of subcontracted studies.

In 2005, the ASN asked EDF to take the necessary corrective action. In response, EDF proposed an organisation common to the various entities for implementation of the scientific applications used in the studies supporting the safety demonstration. The ASN will examine implementation of this organisation scheduled for 2006, in particular through inspections.

3 | 3 | 3

Qualification of inspection methods

During the periodic equipment inspections stipulated by the above-mentioned order of 10 November 1999 (see point 1|2|3), the licensee uses "non-destructive testing" to look for possible defects on the equipment and the reactor main primary and secondary systems. International work has come to the conclusion that there is a need for systematic demonstration that these inspection methods are able to detect the types of damage looked for.

Ultrasound inspection of a welded joint

Article 8 of the order of 10 November 1999 specifies that "the non-destructive testing processes employed operationally on the equipment must be qualified prior to use". The same article states that this qualification will be granted by a qualification board set up within the licensee's structure and recognised as competent and independent of both those directly operating the reactors and those directly involved in developing the processes.

This board, chosen by EDF, is accredited by the French Accreditation Committee (COFRAC) and assesses the extent to which the mock-ups used for the demonstration and the defects introduced into them are representative. On the basis of the qualification results, it then confirms that the testing method does indeed achieve the planned level of performance. 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.

At an international level, the qualification requirements differ appreciably from one country to another, with regard to both the procedures and the levels of the testing methods concerned. The licensees are also granted transitional periods of varying lengths for implementation of their respective programmes.

In France, the decision was taken to apply this qualification process to all non-destructive testing procedures used in the main primary and secondary system inspection programmes. This today represents 144 applications which, given their technical similarities, are covered by 76 qualification files.

The large volume of demonstrations linked to these files and the technical difficulties involved, led EDF to ask for additional time for certain files and to propose palliative measures. After analysis of these proposals and on the advice of the Central Committee for Pressure Vessels, the ASN agreed to postpone the deadline to 31 December 2005, with these particular files being the subject of particular scrutiny.

3 | 3 | 4

Periodic tests

In order to check the availability of safety-related equipment, in particular the safeguard systems to be used in the event of an accident, good operation tests are periodically carried out.

In 2005, the ASN continued to review changes to the periodic test programmes. This chiefly involved:
• review of changes to the periodic test programmes for the reactors of the CP0 plant series with "PTD lot VD2" status;
• approval of the periodic test programmes for the CPY plant series with "PTD lot 93-2000" status;
• review of changes to the periodic test programmes associated with the second ten-yearly outages for the 1300 MWe reactors;
• review of changes to the periodic test programmes for the 1,450 MWe reactors with "PTD end of series" status.

The ASN also continued to look at how to change procedures for approval of the periodic test programmes.

3 | 4

Fuel

3 | 4 | 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 fuel management.

Since 1996, extending cycle lengths has been a major factor in optimising reactor fuel and operations. This extension is combined with increased fuel enrichment, but the quantity of energy released nonetheless remains limited to an average of 52 GWd/t per fuel assembly, which is the maximum authorised value. The ASN keeps a close watch to ensure that changes to fuel management methods are accompanied by a reactor safety demonstration based on the scenarios specific to each type of fuel management. When a management change leads EDF to revise an accident study method, prior examination of it is required and it cannot be implemented without the approval of the ASN.

EDF plans to use M5 alloy in place of Zircaloy 4 alloy as the cladding and structural material for the fuel assemblies in all the new types of management. In 2005, the ASN sent EDF a number of preconditions for generalised use of M5 alloy in all nuclear power plants.

MOX-parity

MOX-parity management concerns the twenty 900 MWe reactors authorised to recycle plutonium. It is characterised by a higher burnup fraction of the MOX fuel assemblies as a result of the higher number of irradiation cycles (4 reactor cycles instead of 3) and a change in their initial plutonium content (average of 8.65% instead of 7.1%). The purpose of this latter change is to compensate for the isotopic degradation of the plutonium resulting from reprocessing of fuels for which the burnup fraction was raised and to ensure that MOX fuel offers equivalent energy to UO_2 fuel enriched 3.7% with uranium 235. The purpose of this management is also to help control the quantities of plutonium generated by the French nuclear power plants.

In 2005, the ASN continued to investigate the following aspects of this type of management: normal operation, accident studies, incident and accident operating rules, refuelling safety.

GALICE

As of 2006, EDF envisages replacing the existing GEMMES management, operational on the 20 reactors of the 1300 MWe series, with GALICE management. The uranium 235 enrichment of the fuel assemblies would rise from 4% to 4.5%. The maximum fuel burnup fraction would then be 62 GWd/t and refuelling would be hybrid: some assemblies would undergo three cycles and others four.

The average cycle length would still be 18 months, but could eventually be modulated between 15 and 21 months, in order to offer a degree of flexibility when planning refuelling outages.

Preparation of the safety analysis file for this type of management has been postponed by EDF.

ALCADE

ALCADE management is envisaged as of 2007 for the 4 reactors of the N4 series.

In order to extend the operating cycles for these reactors from 12 to 17 months, uranium 235 enrichment of the fuel assemblies would be raised to 4%. The maximum burnup fraction authorised for these assemblies would however remain unchanged at 52 GWd/t.

Analysis of the feasibility file was completed in the summer of 2005. As with GALICE management, it showed that the justifications for a certain number of points related to the nature of the fuel rod cladding material were still inadequate and that the loss of coolant accident (LOCA) study method required further examination.

3 | 4 | 2

Fuel assembly modifications

EDF is continuing several experimental programmes aimed at improving both fuel safety and performance levels. The avenues for improvement explored are numerous and concern both the composition and shape of the metal parts of the assembly (clad, skeleton assembly, nozzles, etc.) and the fuel pellet matrix.

M5 alloy fuel cladding

In 2005, the ASN authorised burnup of a load of AFA3GLrAA fuel (clad and structure made of M5 alloy) in several reactors (Cattenom 3, Nogent 2 and Civaux 2).

A certain number of questions concerning the loss of coolant accident, pellet-clad interaction and the impact of M5 on the fuel cycle will require answers from EDF before this type of assembly can be deployed for general use.

Westinghouse RFA fuel loads

Westinghouse RFA type assemblies are characterised by technologies for holding the rods in their skeleton assembly which are different from those used by Framatome. In 2005, the ASN authorised the introduction of new RFA fuel loads in six 900 MWe reactors. The four reactors already authorised in the past introduced their second refuelling load.

Rod cluster control assembly drop time

Since 2002, fuel assemblies with a reinforced structure (see above) have gradually been introduced into the reactors by the licensee, in order to limit irradiation induced deformation and improve the overall RCC assembly drop time. Based on this favourable experience feedback, the ASN in 2004 relaxed the requirements concerning measurement of the RCC assembly drop time during the cycle.

This favourable trend continued and in 2005, the ASN authorised the licensee to load fuel under RCC assemblies during their final irradiation cycle and put an end to the obligation to carry out RCC assembly drop time tests during the course of the cycle. Requirements concerning RCC drop time tests at the end of the cycle and the particular fuel assembly deformation measurements are for their part maintained for all reactors in order to consolidate experience feedback.

3 | 4 | 3

Fuel handling operations

Fuel handling in vessel

Refuelling operations, during which end of life fuel assemblies are replaced by new assemblies, take place with the reactor shutdown and vessel open. Refuelling requires underwater handling of fuel assemblies between the fuel building pit and that in the reactor building, so that they can be positioned in the reactor vessel in accordance with predetermined reloading sequences.

Since the loading incident at Dampierre in 2001, EDF has gradually implemented measures designed to improve the organisation and monitoring of handling operations and licensee criticality risk training.

Implementation of the initial measures was not in itself enough to prevent further positioning errors involving a few assemblies, so in 2004 the ASN once again asked EDF to bolster its provisions for preventing fuel assembly positioning errors in the reactor.

At the beginning of 2005, EDF took additional steps, in particular to ensure that each fuel assembly is pre-positioned at the correct location in the reactor before it is actually reloaded. Furthermore, the organisation of the teams in charge of fuel handling was modified in order to further reinforce the checks on correct performance of the fuel reloading operations. Finally, surveillance of criticality risk control was redefined in order to anticipate the risk of primary coolant dilution during fuel handling operations in the reactor.

These measures meant that the fuel handling operations performed in 2005 were more reliable.

3 | 5

The primary and secondary systems

The reactor main primary and secondary systems (CPP and CSP), collectively referred to as the nuclear steam supply system (NSSS) and presented in point 1|1|3, are fundamental components of a reactor. They operate at high temperature and high pressure and as they contribute to all safety functions - confinement, cooling, reactivity control - they are the subject of extensive supervision and maintenance by EDF and in-depth monitoring by the ASN. Surveillance of the operation of these systems is regulated by the order of 10 November 1999, mentioned in point 2|2|1 of chapter 3.

In 2005, the ASN's actions primarily concerned assessment of the EDF demonstration of the 900 MWe reactor vessels' service life. On the whole, the ASN considered that the condition of the CPP and CSP in the French nuclear power reactors gave no cause for concern in the short term but that the known ageing and deterioration phenomena needed to be taken into account and it asked for appropriate measures in preparation for the third ten-yearly outages of the 900 MWe series.

3 | 5 | 1

System surveillance

When designing the systems, the manufacturer must assess how the NSSS will be damaged by the situations it will experience during operation. Sufficient margin must therefore be designed-in so that the various types of damage identified, particularly fatigue-related phenomena, do not impair NSSS safety.

In order to ensure that the licensee operating a nuclear power plant has assimilated the manufacturer's recommendations and adapted its operating conditions accordingly, the regulations require the creation of "reference files" for the systems.

The licensee must also supervise the systems during operation and set up a documentary system containing the reference files and all events marking the life of the NSSS.

The reference files

The above-mentioned order of 10 November 1999 thus requires that the licensee gather and update all system design, manufacturing and operating data which contribute to justifying system integrity. For reactors already in operation at the time the order was published, a time was allocated for compilation of these files.

Owing to the uniformity of the French reactors, EDF chose to create "plant series" reference files for all the reactors of each series (900 MWe, 1300 MWe and 1450 MWe) with separate "unit" files for each individual reactor. These "unit" files contain data concerning maintenance, faults and events which have occurred on this particular reactor. In 2005, through inspections or meetings, the ASN was able to check that nearly all the plants had set up an organisation and created a plan of actions for compiling and updating these files.

In May 2005, the ASN asked the Standing Nuclear Section (SPN) of the Central Committee for Pressure Vessels for its opinion on the first part of the "plant series" reference files. The SPN considered that on the whole these files were satisfactory but did state that additional data was needed. EDF will in particular be required to guarantee that the operating parameters considered encompass all possible values, and to classify the system zones with respect to the risk of fatigue or sudden failure. These data will need to be provided in time for the next maintenance document update.

ASN review of a second part of the reference files will continue in 2006.

Situations counting

The purpose of situations counting is to ensure that the NSSS design margins are maintained throughout the life of the reactor.

During reactor operations, the licensee must therefore check that the NSSS components do not encounter conditions harsher than those provided for in the design. It must in particular record in its documentary system those situations effectively encountered by the systems.

Counting of these situations is important to the ASN because it is a key factor in demonstrating the robustness of the equipment over its entire lifetime. The ASN carries out periodic inspections on this subject. The points tackled concern plant organisation, verification of activities, records and associated resources, archival, experience feedback, situations counting contractors, etc.

The ASN considers that this situations counting activity was not sufficiently stringent until 1997, at which point it asked EDF to take corrective measures. In 2002, the ASN began a tour of inspection, to be completed in 2006, to obtain an overview of how EDF now carries out this situation counting. The ASN has already observed an improvement but considers that further progress is still required. The level of quality differs from one site to another and much could be gained from harmonising the practices employed.

3|5|2

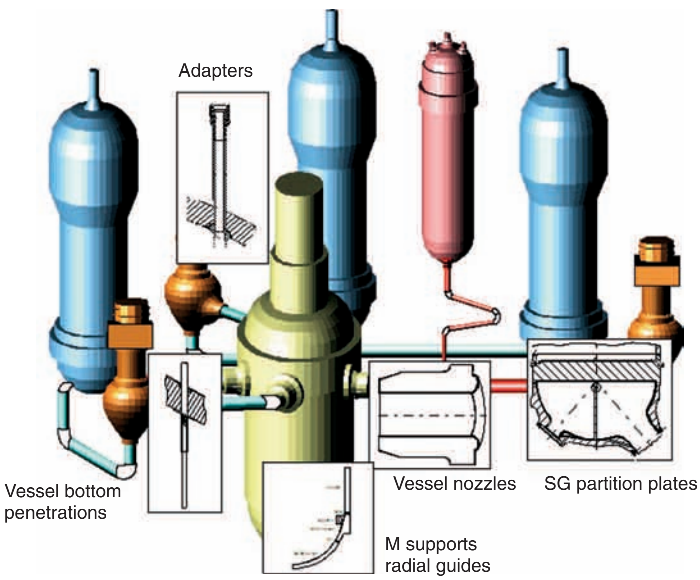
The use of nickel-based alloys

Several parts of PWR reactors are made of nickel-based alloys: in the steam generators, the tubes, the partition plate, the coating of the primary side of the tubesheet; in the vessel, the vessel head adapters, the vessel bottom head penetrations, the internals lower guide support welds, the repaired nozzle areas.

The use of this type of alloy is justified by its resistance to generalised or pitting corrosion. However, in reactor operating conditions, one of the alloys adopted, Inconel 600, proved to be susceptible to stress corrosion. This particular corrosion phenomenon occurs when there are high levels of mechanical stress. It can lead to the appearance of cracking, sometimes rapidly as is the case on the steam generator tubes in the early 1980s, or on the 1,300 MWe reactors pressuriser instrumentation taps at the end of the 1980s.

The ASN asked the licensee to adopt an overall surveillance and maintenance approach for the zones concerned. Further to its decision 010067 of 5 March 2001 (available on the www.asn.gouv.fr website), a number of main primary system zones made of Inconel 600 alloy are now subject to particularly close inspection. For each one, the in-service surveillance programme, defined and updated annually by the licensee, has to meet requirements concerning the inspection objectives and frequencies. In addition, steam generators and vessel closure heads are covered by a major replacement programme (see 3|5|3 and 3|5|4).

In 2004, cracks attributable to stress corrosion were discovered on the partition plate in a steam generator which hitherto had not been considered by EDF to be susceptible to this type of damage. The ASN therefore asked EDF to adapt its maintenance strategy to take account of this unexpected damage. EDF made a number of commitments, in particular to develop automatic tools for inspecting and repairing these zones more easily. This was partially completed in 2005. A process for ultrasound characterisation of crack geometry was developed and deployed on several steam generators for a trial period.



Inconel alloy zones on main primary system

3 | 5 | 3

Reactor vessels

The vessel is one of the essential components of a PWR. This component is 14 m. high, 4 m. in diameter and 20 cm. thick. It houses the reactor core and its instrumentation and in normal operation is completely filled with water, bringing its weight to 300 t. It can withstand a pressure of 155 bars at a temperature of 300 °C.

Vessel being manufactured

Regular and precise monitoring of the state of the reactor vessel is essential for the following two reasons:
• vessel replacement is not envisaged, for reasons of technical feasibility and economics;
• rupture of the vessel is an excluded accident, so its consequences are not included in the reactor safety evaluation. Validating this assumption however means that appropriate design, manufacturing and operating measures be taken.

In normal operation, the vessel gradually deteriorates as the neutron radiation from the reactor's fissile core embrittles the vessel metal. This embrittlement makes the vessel particularly sensitive to pressurised thermal shocks or to sudden pressure surges when cold. The presence of a crack would then be potentially damaging.

To prevent against all risks of this type, the following measures were taken as of commissioning of the first EDF reactors:
• a program to monitor the effects of irradiation: capsules containing test specimens made of the same metal as the reactor vessel were placed inside the reactor, near the core. Some of these capsules are regularly extracted and subjected to mechanical testing. The results of these tests give a good picture of how the vessel metal is ageing, and in fact even give advance "early warning" as the capsules are situated close to the core and receive more neutrons than the actual vessel itself;
• periodic ultrasonic testing: this check is used to monitor any defects located under the vessel's inner stainless steel lining.

The ASN reviewed the vessel files forwarded by EDF on the occasion of the second ten-yearly outages. It considers that a 30-year lifespan for the 900 MWe reactor vessels has been demonstrated.

The ASN however thinks that EDF must still demonstrate the life of its vessels beyond 30 years. To do this, EDF provided answers to the questions asked following the session of the SPN of the Central Committee for Pressure Vessels, held in 1999. These answers are given in a summary file which is currently being examined and which was reviewed by the SPN's experts during its 18 October and 13 December 2005 sessions.

Following this examination and in the light of the results of the checks carried out during the reactors' third ten-yearly outage, the ASN will define its position regarding the vessel operating conditions beyond 30 years.

3 | 5 | 4

Steam generators

The steam generators are exchangers of heat between the water of the primary system and that of the secondary system. The exchange surface consists of a tube bundle comprising about 3,000 to 6,000 tubes, depending on the model. These tubes contain the primary system water and exchange heat while preventing any contact between the primary and secondary fluids.

The integrity of the steam generator tube bundle is a major factor in safety, as any deterioration of the tube bundle could lead to a leak from the primary system to the secondary. Furthermore, a break in one of the bundle tubes in an accident scenario would thus bypass the reactor containment, which is the third confinement barrier. These steam generator tubes are subject to a variety of deterioration phenomena: wear, corrosion, and so on.

The steam generators are covered by a specific in-service surveillance programme drawn up by EDF and revised every 3 years. The current version of this programme was reviewd by the ASN in 2003 and accepted by DGSNR decision n° 030472 on 1 December 2003 (available on the website www.asn.gouv.fr). Following the checks, those tubes which show excessive levels of damage are plugged to remove them from service.

Since the early 1990s, EDF has been conducting a replacement programme for steam generators with the most heavily damaged tube bundles. This programme will continue at the rate of one reactor a year. In 2005, the steam generators at Dampierre 2 were replaced and currently twelve of the first thirty-four 900 MWe reactors are still equipped with Inconel 600 alloy steam generator tube bundles which were not heat treated (600 MA), and which are the main victims of stress corrosion induced cracking (see point 3|5|2).

Installing tubes in a steam generator being manufactured

In addition to in-service surveillance, the steam generators undergo a hydrostatic test every 10 years: during the reactor ten-yearly outage (see point 3|2|3), the primary system undergoes an overall pressure test subjecting it to a pressure higher than its normal operating pressure. On the occasion of the second ten-yearly outages for the 900 MWe reactors, which began in 2002, major leaks were found on some of the steam generators most heavily affected by stress corrosion.

On the advice of the SPN of the Central Committee for Pressure Vessels (see chapter 2, point 2|1|5 b), the ASN asked EDF to take particular measures for inspection and maintenance of these steam generators. EDF proposed an early replacement programme scheduling replacement of the steam generators in the twelve 900 MWe reactors still equipped with Inconel 600 MA tube bundles no later than the third ten-yearly outage.

In 2006, EDF also launched a study and appraisal programme for the 900 and 1,300 MWe reactors equipped with steam generators with heat treated Inconel 600 alloy (600 TT) tube bundles, to gain a clearer understanding of their performance during the hydrostatic test and determine how to avoid leaks during the tests.

3 | 5 | 5

Main secondary system protection valves

Each main secondary system (CSP) on the EDF reactors is protected by seven safety valves installed on the main steam lines. Apart from their CSP protection function, these valves also constitute one of the limits of the third containment barrier.

Since the 1990s, cracks have been discovered on certain CSP protection valve nozzles. After carrying out a series of investigations – mainly on the Paluel site, which was the most seriously affected by this type of damage - EDF proposed a maintenance strategy comprising in-service checks, installation modifications and a programme to repair the damaged valves.

These justifications were submitted to the experts in the SPN of the Central Committee for Pressure Vessels during the first quarter of 2005.

The SPN considered that the maintenance and in-service inspection strategy proposed by EDF for the nuclear power plant CSP valves, and in particular those at Paluel, was acceptable provided that a certain number of recommendations were taken into account.

The main recommendations, reiterated by the ASN, are as follows:

- maintaining a valve complete inspection interval of 7 years, as in the programmes currently in force;
- scheduling repair of damaged valves as rapidly as possible according to the availability of repair resources and the availability constraints associated with these devices.

3 | 6

Containment

The containments undergo inspections and tests with the aim of checking that they indeed meet the safety requirements and in particular that their mechanical performance is satisfactory and guarantees correct tightness when the pressure in the reactor building is higher than atmospheric pressure, which can be the case in certain types of accidents. These tests, particularly at the end of construction and then during the ten-yearly outages, include a pressure rise up to the inner containment design pressure.

Flamanville (Manche) nuclear power plant

The containments of the 900 MWe reactors consist of a single wall of pre-stressed concrete with an interior metal liner. Until now, the leak rates from these containments during the ten-yearly inspections were in conformity with the regulatory criteria. Their ageing was reviewed in 2005 as part of the 30-year periodic safety review, in particular with respect to leaktightness and mechanical strength for a further 10 years. This review brought to light no particular problem liable to compromise the length of the service life.

The containments of the 1,300 MWe and 1,450 MWe reactors comprise two concrete walls. A change in the leak rates from the inner wall of some of these containments, mainly under the combined effects of concrete creep and the loss of pre-stressing of certain cables, has been observed in recent years. Although account was taken of these phenomena at the design stage, they were sometimes underestimated. In an accident situation therefore, certain areas of the wall could find themselves under traction, a stress condition favourable to cracking and therefore leaks. To take account of this phenomenon, EDF has implemented a preventive repair programme aimed at restoring the tightness of the most heavily affected areas. On the basis of a recommendation of the Advisory Committee for nuclear reactors which met to discuss the subject in early 2002, the ASN gave EDF its approval of this strategy. This work is done at each ten-yearly outage and by the end of 2005, 18 of the 24 units had been dealt with. All the reactors concerned will have undergone the necessary maintenance work by 2011.

3 | 7

Protection against external hazards

3 | 7 | 1

Earthquakes

The buildings and equipment in NPPs which are important for safety are designed to withstand earthquakes of an intensity higher than all the earthquakes that have already occurred in the vicinity of the site, plus an additional safety margin. The rules for dealing with the seismic risk are regularly updated in order to take account of new data with retroactive application on a case by case basis during the periodic safety reviews. The conformity reviews are also an opportunity for detailed checks. Although when compared with other countries France is not particularly seismic, considerable efforts are devoted to this subject by EDF and close attention is given by the ASN.

Updating of the design rules

After the 2001 update of the basic safety rule covering how to determine the seismic risk for the safety of surface BNIs (RFS 2001-01), the ASN in 2005 continued its work to update the RFS dealing with the construction rules to be used to protect against the effects of an earthquake (RFS V.2.g). The current rule dates from 1985 and the new data available in this area must be taken into account.

This new "seismic design" guide will detail the main steps in the design of the civil engineering structures with regard to earthquakes, from a statement of the basic principles underpinning this design, to determination of the spectra to be used for sizing of the equipment anchored to the civil engineering part. It will apply to all surface BNIs. A draft guide will be discussed at a meeting of the Advisory Committees in 2006.

Seismic design reviews

Within the framework of the current periodic safety reviews, the seismic design review in particular consists in updating the level of the earthquake to be taken into account, under application of the above-mentioned RFS 2001-01.

For the 30-year periodic safety review on the 900 MWe reactors, the ASN asked EDF to review in particular the seismic design of the electrical buildings of the CPY series of reactors (Gravelines, Saint-Laurent-des-Eaux, Dampierre, Cruas, Tricastin, Chinon). To date, these studies have shown no need to reinforce the buildings. For the reactors of the CP0 series, the ASN asked EDF to study the seismic design of the nuclear island buildings and the turbine hall.

With regard to the 20 year safety review for the reactors of the 1300 MWe series, EDF reviewed the seismic stability of the turbine halls in the P'4 type reactors (Cattenom, Nogent-sur-Seine, Belleville, Golfech, Penly) and the strength of the civil engineering structures in the electrical and the safeguard auxiliaries buildings in the P4 type reactor (Flamanville, Paluel, Saint-Alban). These studies revealed that the original design would guarantee that these reactors could withstand the design basis earthquake reassessed in accordance with RFS 2001-01.

3 | 7 | 2

Flooding

Further to flooding of the Blayais site in December 1999, EDF undertook steps aimed at reassessment and protection of the sites against external flooding hazards. This reassessment particularly concerns the revision of the maximum design flood level, or CMS (maximum water level used in the design of the plant protection structures), the additional events which could lead to flooding of the sites, such as particularly heavy rainfall, a break in the water storage tanks, a rise in the water table, as well as the course of action to be followed in the reactors if the water level were to rise. A file was produced for each site and protection improvement works have been defined.

The work made necessary by the flood risk reassessment is in progress and EDF has undertaken to complete work concerning the risk of water ingress by the end of 2007. In particular, the building permit for a peripheral protection dyke around the Belleville plant was issued and construction should begin in the first quarter of 2006. Construction of a peripheral wall around the Bugey site is also in progress and should be completed at the end of 2006.

Protective dyke surrounding the Le Blayais plant (Gironde)

The ASN considers that the progress of studies and work is as expected. Nonetheless, for the particular case of the Tricastin NPP, the CMS review studies are not yet complete. Additional studies to check the strength of the infrastructures located on the Rhone river upstream of the plant are nearing completion. The results of these studies are expected for early 2006.

At the end of 2004, the ASN asked the Advisory Committee for nuclear reactors and the Advisory Committee for laboratories and plants for their recommendation in order to rule on the overall approach to the external flooding risk affecting EDF reactors. The situation of the other nuclear installations will be reviewed on this same occasion, which justifies a joint meeting of the two Advisory Committees.

At the same time, a first meeting of the working group for revision of RFS I.2.e to deal with the flooding risk, was held in 2005. This group consists of experts, licensee representatives and the ASN. The new BNI flooding risk protection guide will cover the choice of unexpected events likely to lead to flooding of the site, and the methods used to characterise such events. It will apply to all BNIs.

3 | 7 | 3

Fire and explosion riks

Fire risk

The fire risk in EDF's nuclear power plants is dealt with using the principle of defence in depth, based on:

– prevention, primarily consisting in:
• ensuring that the type and quantity of combustible materials present in the premises remains within the sectoring design limits (fire doors and walls, etc.);
• identifying and analysing the fire risks. In particular, a fire permit must be issued and protective measures taken for all work likely to start a fire;

– the design of the installations, which must prevent a fire spreading and minimise the consequences. This is chiefly based on:
• the principle of splitting the installation up into sectors designed to contain the fire within a given perimeter;
• protection of redundant equipment which performs a safety function;
• firefighting, which should enable a fire to be tackled and extinguished within a time compatible with the duration of the fire and the fire-resistant capability of the fire sectors.

Prevention

With regard to prevention, EDF has implemented its new system of "fire permits" in the plants.

The ASN has noticed improvements since 2004 in the drafting of the fire permits and their actual use in the plants. It does however feel that the steps taken must be actively pursued, in particular with respect to risk analysis and identification and implementation of protective measures.

In 2005, the ASN checked the progress of the work being done to identify the areas storing fire loads during reactor outages and will analyse all the corresponding studies with the assistance of its technical support organisation. Inspections will be scheduled by the ASN in order to check the conditions in which these premises are used.

Design

With regard to design, EDF is continuing to deploy the fire action plan (PAI), to ensure the conformity of and improve fire protection for the 900 MWe and 1,300 MWe reactors. During the course of the 2005 inspections and six-monthly meetings with EDF, the ASN considered that the PAI was being satisfactorily assimilated and that EDF was on-track to meet the completion dates set for the end of 2006 by the decision of 12 September 2000.

As part of the thirty-year safety review of the 900 MWe reactors, the ASN in March 2005 consulted the Advisory Committee for nuclear reactors about the modifications to be made to these reactors in addition to the current design:
- through the use of the results of fire probabilistic safety studies (EPS), to supplement the deterministic studies,
- through evaluation of the existing design margins of the fire-resistant items, in the light of the fire durations estimated for the premises.

The ASN considers that the results of the probabilistic studies are satisfactory and that the fire EPS approach should be continued by EDF for the 900 MWe reactors.

Furthermore, with regard to evaluation of the existing margins, the ASN considers that the modifications presented by EDF would be such as to improve the safety of the 900 MWe reactors. EDF will complete its evaluation by ensuring that the inventory of premises checked is exhaustive and that there is no snowball effect in relation to the margins chosen.

The order of 31 December 1999 which lays down the general technical regulations designed to prevent and mitigate detrimental effects and external risks resulting from the operation of BNIs, also defines stipulations regarding fire protection. In 2005, the ASN drafted an application guide for the above-mentioned order dealing with the fire risk and prepared a draft order modifying and improving the previous one.

Firefighting

With respect to firefighting, the ASN asked EDF in May 2001 to conduct an overall review of its policy. In response to this, EDF developed a new doctrine, which it put into practice in July 2003. The ASN duly noted this change and considered that it offered a better answer to what it wanted to see in terms of firefighting. It reckons in particular that the part about increased skills is just as important as that concerning organisational improvements.

At the request of the ASN, EDF further reinforced its doctrine in 2004, in particular by aiming for faster activation of the response teams as of the fire alarm, rather than after the fire has been confirmed. On certain sites, this will require drafting of a fire detection improvement plan. This plan is being gradually put in place as of 2004.

In 2005, the ASN reviewed the effectiveness of the plan of action proposed by EDF for deployment of this new doctrine and improvement of the reliability of fire detection. It considers that the firefighting response times have progressed on those sites which immediately deploy the response teams as soon as the alarm is sounded but that EDF does still need to focus on the actual duties of the response teams and on improving interfacing with the off-site emergency services.

In 2005, the ASN also ordered an assessment of the firefighting team response from an independent firm. It will include the conclusions of this assessment in the requests it submits to EDF in 2006.

Explosion risk

On the basis of the conclusions of the 2002 inspections on this subject, the incidents and the anomalies detected in the plants, the ASN asked EDF to improve the way in which the risks of explosion of internal origin are taken into account. It in particular asked EDF to look again at the existing systems for protection against the effects of an explosion of internal origin as part of the periodic safety review of the 900 MWe plant series on the occasion of the third ten-yearly outages and to initiate a similar approach for the other plant series.

The Chinon in-depth inspection on the topics of fire and explosion

Further to the inadequacies detected during the inspections carried out in 2003 and 2004 on these topics, the ASN carried out an in-depth inspection on fire prevention and firefighting on the Chinon site, from 7 to 11 March 2005. During the course of this inspection, the ASN had fire exercises performed, one of which involved participation by the *département* fire and emergency services (SDIS) with activation of the on-site emergency plan.

This inspection was equivalent to about fifteen "routine" site inspections.

In-depth inspection at Chinon, March 2005

As a result of its investigations, the ASN observed that EDF had made efforts to reduce the fire risk, to improve response team training and to reach the goals associated with their duties on this site. However, it considered that continued efforts were required, in particular by improving the stringency of fire risk management and the application of fire doctrines..

The methodology developed by EDF, and in particular the application of this methodology to the hydrogen-related risk of internal explosion within the nuclear island buildings was analysed in 2005 by the Advisory Committee for nuclear reactors.

With regard to the risk of explosion originating outside the buildings, the ASN considers that EDF's overall approach is satisfactory. It however considers that this approach should be supplemented by a probabilistic approach and by a study of the safety consequences of the scenarios adopted.

Furthermore, with regard to the risk of explosion originating inside the buildings, EDF should complete its studies with review of gases other than hydrogen and by extending its analyses to buildings other than the reactor buildings.

In 2005, EDF continued to draft the studies reference system concerning the prevention of explosion risks, and the ASN has already formulated a number of remarks concerning it. The goal is for this reference system to be applied to the 900 MWe reactors' third ten-yearly outage.

3 | 7 | 4

Other hazards

Lightning

Further to the ASN request of 15 October 2002, EDF forwarded the "lightning studies" defining the work needed before 31 December 2003 to ensure conformity with the above-mentioned order of 31 December 1999. EDF also completed conformity work on the plants concerned (Penly and Cruas) on 31 December 2004.

The ASN notified EDF of its additional requests, including a study of the impact of the lightning risk on the safety of the facilities. The ASN considers that the lightning risk studies transmitted by EDF are of high quality and in conformity with the applicable standards.

Heavy loads carried over the reactor vessel

During exceptional maintenance operations such as vessel head replacement and more conventional maintenance operations such as "tightening-loosening" vessel studs, handling of associated elements may require them to be carried over the vessel with the core loaded. These operations may also take place with the containment's equipment hatch open. The general operating rules (RGE) prohibit fuel handling when the reactor building is not correctly isolated from the outside.

At the request of the ASN, EDF conducted on all its nuclear power plants an analysis of these cases of equipment being carried over the loaded core vessel, whether or not the vessel head is in place. The analysis looked at ways of limiting these movements and, for those which remain necessary, how to prevent a load dropping and if it did, minimising its consequences.

The conclusions of this analysis led EDF to modify its practices to limit these handling situations and to submit a proposal to the ASN for modification of the general operating rules, particularly in order to define containment configurations for which these load movements over the reactor vessel remain authorised. Review of this subject began in 2005. The ASN asked EDF to apply additional constraints for certain types of load handling operations.

Heatwave and drought

Following the heatwave EDF had to deal with in 2003, steps were taken to ensure an appropriate response to any similar situation during the summer of 2004. 2005 was marked by a severe drought, although this had no safety or environmental protection consequences as a result of discharges from the nuclear power plants.

In 2005, in compliance with requests for changes to the general operating rules, EDF reassessed the maximum temperature limits allowable in premises containing equipment important for safety. Some of these requests are still being reviewed and the licensee will be required to submit additional safety justifications. The renewal of the discharge and water intake licence for the Nogent-sur-Seine nuclear power plant at the end of 2005 was also an opportunity to include the possibility of higher temperature discharges in certain climatic and power demand conditions, as with the Bugey, Golfech and Tricastin NPPs.

3 | 8

Other subjects

3 | 8 | 1

Pressured vessels

Owing to the energy that they could release in the event of failure, regardless of the possible risk related to the fluid (liquid, vapour or gas) that would then be released, pressurised equipment entails risks that must be controlled.

This equipment (containers, exchangers, piping, etc.) is not solely limited to the nuclear industry and is present in numerous industries such as chemical industry, oil processing, papermaking, refrigeration industry. It is therefore subject to regulation set by the minister for industry, who imposes the requirements with a view to guaranteeing its safe manufacture and operation.

Application of the regulations concerning the operation of pressurised equipment in nuclear reactors is monitored by the ASN. In particular through actions on the site, this consists in checking that the licensee, who has prime responsibility for the safety of its equipment, applies the requirements imposed upon it. It must in particular:

- collect and update the information needed for safe operation of its equipment;
- maintain, monitor and repair as required to ensure that the safety level of its equipment is as required, and conduct the periodic inspections at the specified intervals on the relevant equipment;
- remove from service equipment for which the safety level is impaired;
- install and maintain protective devices designed to ensure that the maximum temperature and pressure limits are not exceeded during operation;
- submit the relevant equipment to periodic re-qualification (inspection, testing and check on safety accessories) and to inspections following significant repairs. These operations must be carried out by duly qualified independent bodies.

The ASN also examines any request for waiver to the regulations and supervises the qualified bodies intervening in the NPPs. It is represented on the Central Committee for Pressure Vessels (see chapter 2, point 2|1|5 b) and in this capacity takes part in the drafting and updating of the pressure vessel regulations.

3 | 8 | 2

Risks in the workplace

Nuclear power plants are the source of a number of risks to the workers, which are not always linked to the nuclear aspect of the activity. These “conventional” risks are for example linked to the electrical installations, the equipment containing pressurised gas or steam, to the hydrogen systems (explosion risk), to the nitrogen systems (anoxia), to work at height or to handling of heavy loads.

These risks must be dealt with in the first place by the licensee, through application of the regulations in force in any industry, through analysis of the risk inherent in the equipment or the activities, and through implementation of appropriate technical, organisational and human measures.

It should be noted that the steps such as to guarantee personnel safety may in certain cases contribute to nuclear safety: this is for example the case with preventing the risk of explosion, of pressurised equipment bursts or falling loads.

Verification of application of these regulations is the job of “labour” inspectors who, in the particular case of nuclear power plants, operate within the DRIRE and for the most part are also inspectors of BNIs. The inspections in this area are carried out in accordance with the directives of the Directorate for energy demand and energy markets of the General Directorate for energy and raw materials (DGEMP).

4 RADIATION PROTECTION AND ENVIRONMENTAL PROTECTION

4 | 1

Radiation protection of persons working in nuclear power plants

In a nuclear power plant, ionising radiation comes from a variety of sources, including:
- the fuel;
- equipment activated by the neutron flux;
- the particles resulting from reactor primary system corrosion and conveyed by the primary fluid.

About 80% of worker dosimetry is received during reactor outage maintenance work.

EDF policy

In 1999, EDF undertook to improve radiation protection and establish a level of requirements for it, comparable to that for safety, in particular by:
- defining a new radiation protection organisation;
- setting up forums for exchanges and decision-making;
- creating a radiation protection reference system designed to improve control of regulatory aspects and set up a framework for various subjects linked to radiation protection (radiological cleanness, optimisation, metrology, and so on).

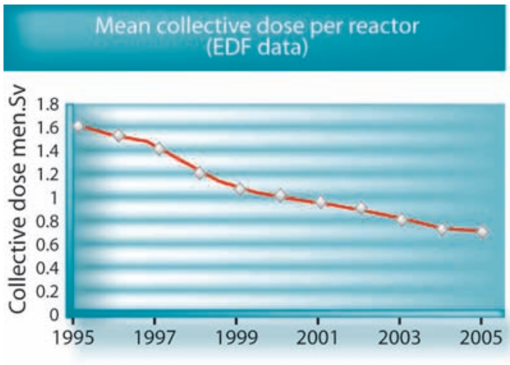
The ASN considers that this process, which has been in progress for 6 years, is now able to remedy the problems encountered by the plants. It has led to a significant reduction in worker dosimetry, in particular collective dosimetry, as illustrated by the following graphs.

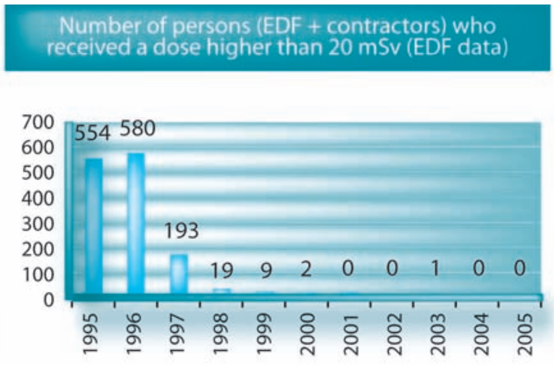
ASN assessment and actions taken

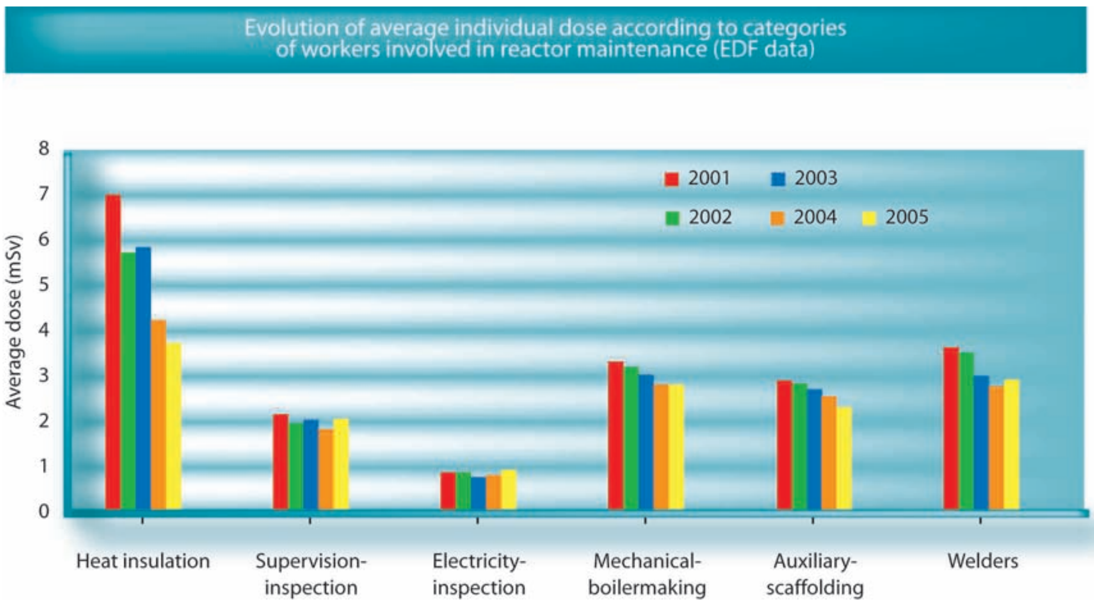
In 2005, the ASN checked that EDF had correctly taken account of the requests made further to the assessments and inspections carried out between 2002 and 2004 on the pressurised water reactors. The results of these actions and the corresponding conclusions are presented in section 6.1 of this chapter.

At the same time, the ASN has made changes to its supervision of worker radiation protection in nuclear power plants. The main efforts in this field chiefly concerned:
• more inspections on radiation protection and the associated tools;
• improved supervision of radiation protection during reactor outages;
• supervision of radiation protection at the EDF contractors;
• creation of a system for sharing experience among the various ASN entities concerning radiation protection issues in pressurised water reactors;
• analysis of radiation protection optimisation for the operations defined by the EDF head office.

An example of this last point is the analysis in 2005 of a particular operation which showed that application of the optimisation approach was satisfactory. However, the ASN asked that the dosimetric model used to estimate the doses prior to the work be improved, along with EDF's ability to put to good use the lessons learned from previous worksites.







Finally, the ASN initiated work in 2005 to compare radiation protection assessment methods in PWRs, through exchanges with the Spanish, American and Belgian nuclear regulators.

Particular points

The ASN supervised an experiment carried out by EDF and authorised in 2004, to inject zinc into the water of the primary system. This is part of an overall process to reduce collective dosimetry based on changes to the chemistry of the primary fluid in order to reduce the quantity of radioactive particles in the reactor systems.

Incidents

A specific analysis of significant radiation protection incidents declared is presented in point 5|1|2. A detailed analysis is given per origin and per subject.

4 | 2

Discharges from nuclear power plants

4 | 2 | 1

Discharge licence revision

Under application of decree n° 95-540 of 4 May 1995 concerning discharges of liquid and gaseous effluent and intake of water by BNIs, the ASN in 2005 continued to examine applications for renewal of the water intake and non-radioactive liquid effluent discharge licences for nuclear power plants. These licences, issued at prefectural level under the previous regulations in this respect, comprise a stipulated validity limit. At the request of the ASN, the applications submitted by EDF concern water intake and all discharges, be they liquid or gaseous, radioactive or non-radioactive. These dossiers are subject to a public enquiry. The ASN's goal is for most of the existing licences to be reviewed in the next few years, in order to harmonise the specifications applicable to the various sites.

The renewals currently being examined were presented by EDF as soon as the previous licences reached their expiration dates. In particular, for sites where the authorisation deadline was imminent, the ASN fixed deadlines for the submission of licensee application dossiers by a decision of 4 July 2001. Thus, at the end of 2005, eleven nuclear power plants were covered by a new effluent discharge and water intake licence. Submissions of applications for the other plants will be staggered until 2009.

These renewals enable the ASN to group in a single document all the requirements previously specified by different ministerial or prefectural orders, according to the type of discharge concerned. These requirements in particular specify the quantities, concentrations and surveillance procedures for the pollutants likely to be found in the discharges and in the environment, in accordance with the order of 26 November 1999 laying down the general technical specifications concerning the limits and sampling procedures of the discharges subject to licensing carried out by BNIs. In this context, the ASN decided to modify the terms and conditions regulating discharge according to the following principles:
- with regard to radioactive discharges, the real discharges from NPPs are constantly falling and are well below current limit values, so the ASN is reducing these limit values. For each of the 900 and 1,300 MWe plant series, it has set new limit values based on the experience feedback from real discharges, while taking account of the unexpected events occurring during routine operation of the reactors. The discharge limits have thus been cut by a factor of between 1 and nearly 40, depending on the current fuel management parameters. They have risen by a factor of 1.25 for liquid tritium discharges, assuming future high burnup fraction fuel management;
- with regard to non-radioactive substances, the ASN decided to improve on the previous discharge regulations.

4 | 2 | 2

Procedures carried out in 2005

Complete revision of the discharge and water intake licences

In 2005, examination of the effluent discharge and water intake licence renewal application for the Golfech plant continued. The public inquiry was held from 30 May to 13 July 2005.

A significant point is that since the application for the Cattenom NPP in 2004, EDF licence applications include an increase in liquid tritium discharge levels, linked to the future fuel management. In this respect, and for the plants concerned, EDF is submitting dossiers for France's consultation of the European Commission under the terms of article 37 of the Euratom treaty. For the Golfech plant, the European Commission's opinion dated 15 November 2005 was favourable, in particular in the light of the very slight radiological impact of the increase requested.

Examination has started on the discharge and water intake licence renewal applications for the Dampierre, Tricastin and Penly power plants.

Partial revisions

In 2005, the ASN concluded examination of the application for a liquid discharge licence as a result of monochloramine treatment to combat the growth of legionella in the secondary systems of the Chinon plant. Based on the results of a public inquiry from 25 April to 25 May 2005 and the data in the application dossier, the licence was granted on 17 August 2005.

In order to improve protection of the Belleville-sur-Loire nuclear power plant from Loire flood levels higher than the reference used in plant construction and to improve the safety of the plant's BNIs, EDF in 2004 submitted a licence application in accordance with the water law, concerning work to raise and extend the existing dyke. The licence was granted on 18 August 2005, after a public inquiry from 1 June to 2 July 2004.

Further to the formal notice delivered in 2003 by the ASN for failure to comply with certain discharge limit values in the effluent discharge and water intake licence of 2 February 1999, the licensee operating the Saint-Laurent-des-Eaux nuclear power plant submitted an application in 2004 for modification of its discharge licence. Examination of this application concluded that the modifications requested by the licensee were not significant. The modified licence should be signed in early 2006.

In 2001, the ASN issued a formal notice to the licensee operating the Belleville-sur-Loire nuclear power plant following non-compliance with a number of requirements of the effluent discharge and water intake licence of 8 November 2000. The licensee then in 2002 submitted an application for modification of its effluent discharge licence. Given the absence of any assessment of the impact on NATURA 2000 sites in the application for modification of the discharge licence, the ASN considered that in 2004 the procedure could not be taken any further. In September 2005, the operator of the Belleville-sur-Loire plant submitted another application for modification of its effluent discharge and water intake licence of 8 November 2000, but this time it included an assessment of the impact on the NATURA 2000 sites. Examination of this application has begun.

Examination of management of associated radioactive and non-radioactive effluent

In 2004, the ASN decided to consult the Advisory Committee for nuclear reactors concerning the management of radioactive effluent and of certain non-radioactive effluent discharged by the French nuclear power plants in operation and concerning the various ways of improving the situation. 2005 was devoted to identifying and preparing the documents necessary for the examination. The opinion of the Advisory Committee is expected by the end of 2007.

4 | 2 | 3

Radioactive discharge values

Discharges in 2005

Every month the licensee communicates its discharge results to the ASN. These data are regularly cross-checked against reactor operation during the period considered. Anomalies detected give rise to requests for complementary information from the licensee.

The 2005 results concerning radioactive effluent discharges are presented in the following graphs. The "Liquid radioactive discharge" graph presents the 2005 discharges of liquid tritium and liquid non-tritium (carbon 14, iodine 131, nickel 63 and other beta and gamma emitting radionuclides) per pair of reactors. The "gaseous radioactive discharge" graph presents the 2005 discharge of gases (carbon 14, tritium and rare gases) as well as halogens and aerosols (iodines and other beta and gamma emitting radionuclides) per pair of reactors.

The gas discharge activity of the Nogent-sur-Seine nuclear power plant in 2005 is higher than the average with respect to two parameters. For the "halogens and aerosols" parameter, this is due to higher iodine releases than in the first quarter of 2005, mainly as a result of high iodine activity in the primary system resulting from loss of tightness of the fuel cladding and the presence of a leak in a system carrying primary coolant. For the "gas" parameter, this is due to higher releases of rare gases, mainly as a result of loss of tightness of the fuel cladding and the leak as mentioned above.

"Halogen and aerosol" gaseous discharges from the Golfech and Gravelines nuclear power plants in 2005 were also higher than the average for their respective plant series (1300 MWe and 900 MWe). This is explained by the higher releases of iodine, mainly due to the loss of tightness of the fuel cladding in reactor No. 1 at Golfech and reactor No. 6 at Gravelines.

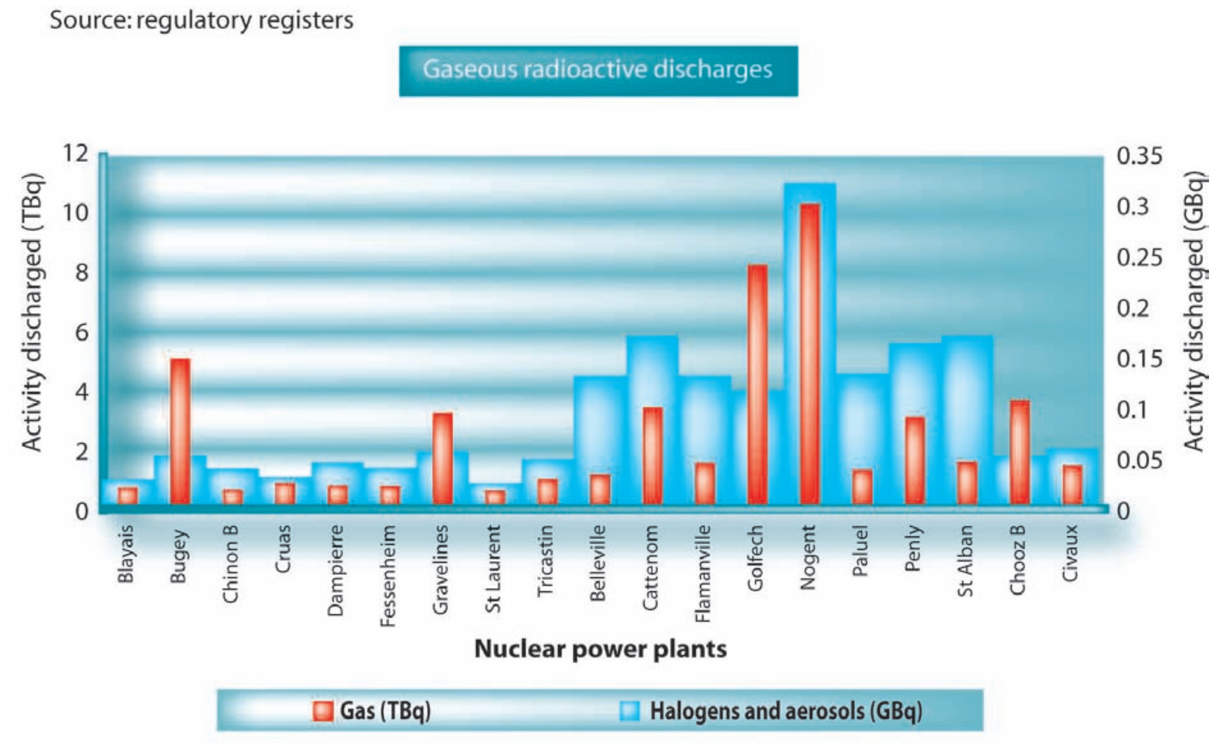
The "halogens and aerosols" gaseous releases from Bugey are higher than the average for the 900 MWe plant series, owing to the higher iodine releases. The precise origin of these releases is currently being investigated.

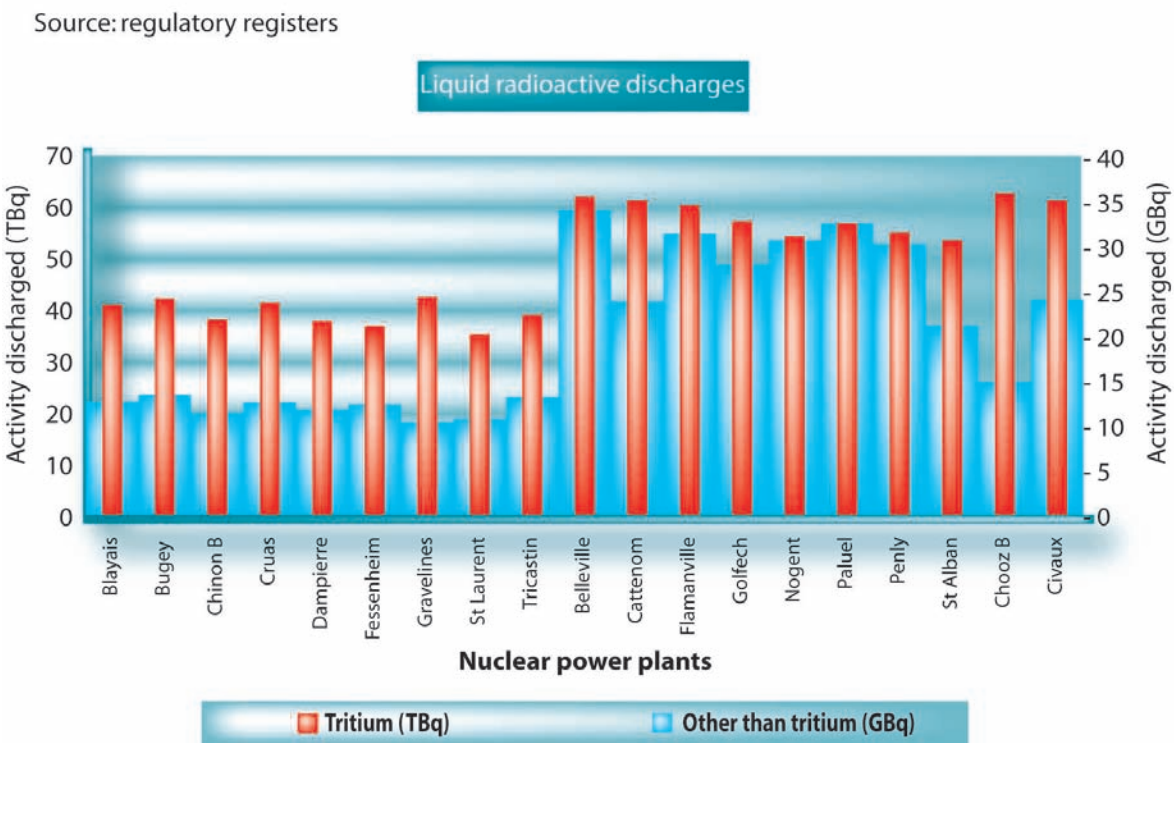
Radiological impact of discharges

The calculated radiological impact of the maximum discharges in the EDF application dossiers for the most exposed population reference group remains well below the acceptable dosimetric limits for the public.

The annual effective dose received by the population reference group given in the EDF discharge and water intake licence applications is estimated at between a few microsieverts and a few tens of microsieverts per year.

For example, the annual effective dose corresponding to the values requested by EDF for renewal of the discharge and water intake licences for the Nogent-sur-Seine nuclear power plant was evaluated at 2.3 microsieverts per year. As the actual discharges from the Nogent-sur-Seine nuclear power plant in 2005 were lower than the specified discharge limits, the actual annual effective dose in 2005 is less than this value.


Source: regulatory registers
Gaseous radioactive discharges
Activity discharged (TBq)
Activity discharged (GBq)
12
10
8
6
4
2
0
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
Blayais
Bugey
Chinon B
Cruas
Dampierre
Fessenheim
Gravelines
St Laurent
Tricastin
Belleville
Cattenom
Flamanville
Golfech
Nogent
Paluel
Penly
St Alban
Chooz B
Civaux
Nuclear power plants
Gas (TBq)
Halogens and aerosols (GBq)


Source: regulatory registers
Liquid radioactive discharges
Activity discharged (TBq)
Activity discharged (GBq)
70
60
50
40
30
20
10
0
40
35
30
25
20
15
10
5
0
Blayais
Bugey
Chinon B
Cruas
Dampierre
Fessenheim
Gravelines
St Laurent
Tricastin
Belleville
Cattenom
Flamanville
Golfech
Nogent
Paluel
Penly
St Alban
Chooz B
Civaux
Nuclear power plants
Tritium (TBq)
Other than tritium (GBq)

4 | 3

Technological waste management

Following the ASN's decision of 10 November 2000 aiming to improve the conditions for interim storage of very low level (VLL) waste in nuclear power plants, all the plants commissioned VLL waste interim storage facilities.

The nuclear auxiliary buildings (BAN), the waste auxiliary buildings (BAC) and the effluent treatment buildings (BTE) in the nuclear power plants house most of the operations associated with reactor operation and maintenance waste management operations.

Observations in recent years tended to show that the safety of waste management in the BAN, BAC and BTE buildings was unsatisfactory, in particular with regard to containment, fire protection and radiation protection. At the end of 2002, EDF was asked to correct this situation.

The ASN has begun to review the studies forwarded by EDF for eventual improvements in the design and operation of the waste interim storage and treatment buildings in the nuclear power plants. EDF also carried out work to improve these buildings in 2004. The safety analyses concerning these buildings however show inadequacies in the risk assessment owing to the lack of any precise reference system describing the operating range of the waste collection, treatment or interim storage activities in these buildings.

Finally, the series of inspections conducted by the ASN in 2005 on subjects concerning waste management in the nuclear power plants showed that the licensee was aware that improvements to waste management were really necessary and demanded close supervision of both the installations and the quantities of waste held. The actual situation brought to light by these inspections in fact showed that the operating conditions often led to sometimes serious congestion of the installations, for example owing to the problems the sites were encountering in evacuating the waste (malfunction of certain compacting presses, production of nonconforming packages, clearance of the existing stocks). The lessons learned from these inspections will be reviewd by the ASN, in particular with regard to practices in this area, and will guide subsequent monitoring actions.

4 | 4

Protection against other risks and nuisances

4 | 4 | 1

The microbiological risk

Some of the energy produced by nuclear power plants is discharged into watercourses or into the sea via a cooling system.

The energy evacuated in the form of heat is discharged either directly into the environment or, for some nuclear power plants located along a river, after cooling in air cooling towers. This latter device is a means of evacuating some of the heat into the atmosphere, thereby reducing the thermal discharges into the rivers.

Owing to its chemical and biological properties, surface water can be propitious to fouling of systems and in particular lead to the formation of deposits and the growth of biofilms. These latter are an ideal medium for the development of micro-organisms such as amoebae and legionella in the cooling systems. Particular precautions must therefore be taken to prevent these micro-organisms from being dispersed into the environment.

The issue of the development of micro-organisms in the systems of power plants with cooling towers has been studied by EDF for a number of years now. It is the subject of periodic exchanges on the basis of EDF studies particularly with the Directorate General for Health (DGS) and the ASN, and is periodically reviewed during the sessions of the French high public health council (CSHPF).

Amoebae

The condenser is a heat exchanger which cools the secondary system with water taken from the river. The older versions of this equipment are made of brass, while the more recent models are made of stainless steel or titanium. Stainless steel and titanium were chosen in place of brass because they entail fewer metal releases through wear than brass, which generates releases of copper and zinc. The Bugey, Chooz, Dampierre (reactors 1 and 3), Golfech, Nogent-sur-Seine and Civaux plants are equipped with stainless steel or titanium condensers. The condensers at the Belleville, Cattenom, Chinon, Dampierre (reactors 2 and 4) and Saint-Laurent-des-Eaux (except reactor B1) plants are still made of brass, while those in Cruas and Saint-Laurent-des-Eaux (reactor B1) are half of them brass and half titanium.

Amoebae do not grow in systems equipped with brass condensers owing to the toxicity for the micro-organisms of the copper present in this material.

Conversely, owing to the development of amoebae in their cooling systems, and in order to meet the limit value set by the health authorities of 100 Nf/l (amoebae of the Naegleria Fowleri type per litre) in the natural environment, the Bugey, Chooz, Dampierre (reactors 1 and 3), Golfech and Nogent-sur-Seine plants use monochloramine treatment, while the Civaux plant for its part uses UV treatment of the released cooling water owing to the Vienne river's greater sensitivity to chemical treatment discharges.

These measures allow effective compliance with the 100 Nf/l limit. Chemical substance discharges are for their part regulated by interministerial orders which limit the quantities of products released and require periodic forwarding of the measurement results to the ASN and to the health authorities.

EDF is also conducting a study programme to look for alternative solutions to chemical treatment.

Legionella

The legionella concentrations in the secondary systems cooling systems are variable and depend on a variety of factors (time of the year, use of anti-amoeba treatment, etc.). They can be significant, up to several hundred thousand colony forming units per litre (CFU/l), or even more than a million for those plants with no anti-amoeba treatment: Belleville, Cattenom, Civaux, Chinon, Dampierre (reactors 2 and 4) and Saint-Laurent-des-Eaux. They are less than a hundred thousand CFU/l on the other plants concerned: Bugey, Chooz, Dampierre (reactors 1 and 3), Golfech and Nogent-sur-Seine. The monochloramine treatment used against amoebae thus confirms its biocidal effect against legionella.

The ASN and the DGS considered that it was time to adopt a stance concerning the maximum concentrations for secondary system cooling systems in power plants equipped with cooling towers. In its letter of 28 January 2005, the ASN therefore asked EDF not to exceed certain legionella concentration levels in the secondary system cooling systems.

When setting these levels, account was taken of the results of EDF studies in which, for the same concentration in the systems, the large cooling towers (about 150 metres high) generate concentrations in the environment 50 times lower than the towers normally encountered in ICPEs (installations classified under environmental protection regulations). This value was reduced to 5 in the case of the Chinon nuclear power plant, where the cooling towers are of medium size (28 metres).

Thus the legionella concentration levels not to be exceeded in the secondary systems cooling systems are 5.10^6 CFU/l for nuclear power plants with large cooling towers, and 5.10^5 CFU/l for the Chinon nuclear power plant. The measurement frequencies are tailored to the measured concentrations. For systems other than the secondary system cooling system (air-conditioning for example), application of the legal current threshold for ICPEs is required.

As of the summer of 2004 and in order to avoid exceeding the level of 5.10^5 CFU/l, the licensee operating the Chinon nuclear power plant carried out chlorination of the water in the secondary systems cooling systems. Since the end of summer 2005, it has been operating a new monochloramine treatment unit, this time in order to treat legionella. On 17 August 2005, this installation was the subject of an order modifying the water intake and liquid and gaseous effluent discharge licence for operation of the Chinon nuclear site.

For the other plants without specific treatment, the value of 5.10^6 CFU/l is respected through the preventive servicing measures normally employed by EDF and designed to limit the development of biofilms.

To complement this stance, an expert appraisal of the situation appeared necessary, in particular to allow an assessment of the various studies, especially the health studies, conducted by EDF. The DGS, ASN and the Directorate for the Prevention of Pollution and Risks at the Ministry for the Environment, referred the matter to the French agency for environmental health safety.

4|4|2

Prevention of water pollution

The order of 31 December 1999 sets the general conditions to be met by BNIs concerning environmental protection and requires the performance of work to ensure conformity. A more complete description of the provisions of this order is given in chapter 5, point 5|1.

For the particular case of the KER/TER/SEK effluent tank retention areas, the measures proposed by EDF in the files submitted by the deadline of 15 February 2002 were not considered to be acceptable by the ASN, which led EDF to propose new preventive measures. On the basis of the new provisions, considered to be equivalent to the requirements of article 14 of the order, the ASN decision of 17 August 2004 set a deadline of 15 February 2006 for conformity. EDF nonetheless stated that it could not meet this deadline and asked for authorisation to complete conformity of all nuclear power plants in mid-2007. This request is currently being reviewed by the ASN.

4|4|3

Noise

The impact of installation noise is regulated: the difference between the ambient noise measured when the installation is operating and the residual noise level measured when it is stopped is subjected to a limit and, for example, must not exceed 3 dB(A) at night.

EDF has carried out noise measurements on all the plants. The study showed that ten plants were in conformity while there were nonconformities at Belleville, Bugey, Chinon, Civaux, Dampierre, Golfech, Nogent-sur-Seine, Penly and Saint-Laurent-des-Eaux. The main noise sources are the cooling towers, the turbine halls, the BAN stacks and the transformers. EDF considers that noise linked to the presence of a weir or cooling towers is comparable to natural noise such as a waterfall.

EDF defined an overall corrective approach based on technical-economic soundproofing studies. For each noise source, EDF looked for partial or total soundproofing techniques and then assessed their effectiveness and technical feasibility. It became apparent that ensuring strict conformity by the nine plants was not possible in acceptable technical and economic conditions, or would imply drawbacks, for example in terms of safety or health.

EDF consequently focused its strategy on three key areas: a reduction and if possible elimination of distinct tones, preferential treatment of noise sources of an industrial nature and, whenever possible, no aggravation in the event of development of the installations or plants. EDF agreed to ensure that the level of protection reached was maintained over time. Furthermore, for those plants with cooling towers or a river weir, EDF proposed including their contribution in the residual noise.

The justifications provided by EDF are currently being reviewed by the ASN.

5 SUMMARIES

5 | 1

Summary of incidents

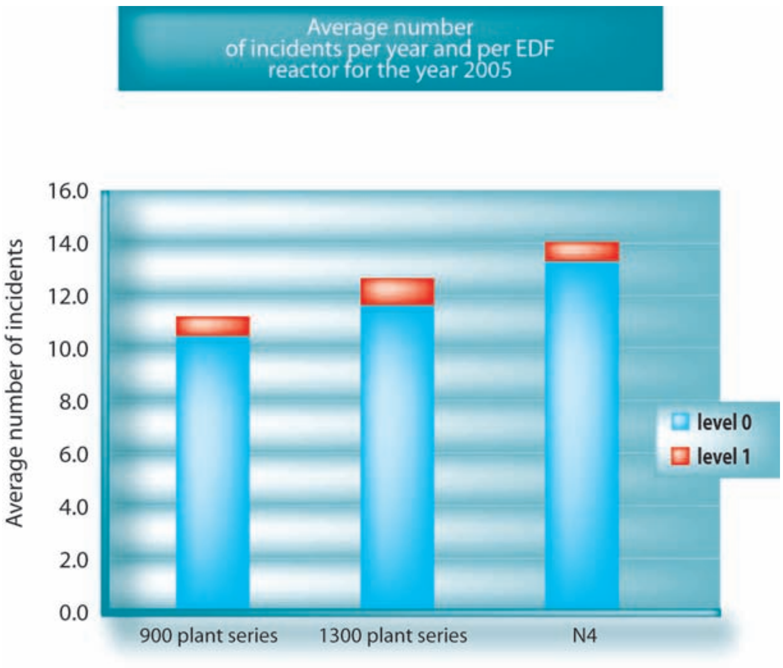
5 | 1 | 1

Summary of incidents in 2005

In application of the rules for declaration of safety, radiation protection and environmental incidents, EDF declared 759 significant incidents rated on the INES scale in 2005, 575 of which concerned safety, 170 of which concerned radiation protection and 14 of which were linked to uncontrolled releases of radioactive products into the environment.

The events declared with respect to environmental protection and which concern neither nuclear safety nor radiation protection, are not rated on the INES scale. 15 such events were declared in 2005.

The number of incidents declared in 2005 was higher than in 2004. This rise chiefly concerns the number of safety events declared and is in particular due to the rise in the number of incidents linked to application of technical operating specifications and quality assurance provisions. The proportion of incidents rated 1 on the INES scale is about 6.5%, or 47 incidents concerning safety, two



concerning radiation protection and none concerning the environment. The number of incidents classified 1 is down on 2004.

Furthermore, on 9 December 2005, the ASN rated as level 2 on the INES scale an anomaly concerning the water pumps on the low pressure safety injection system (RIS BP) and the containment spray system (EAS) for the EDF 900 MWe reactors (see point 2|2|1).

5|1|2

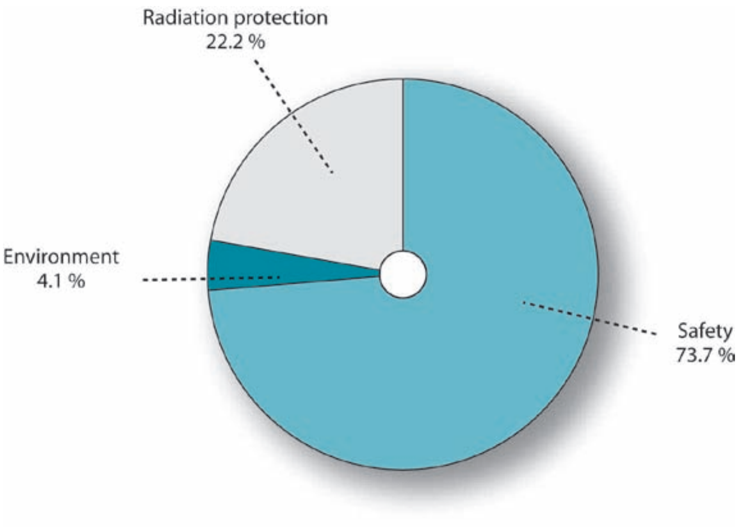
Statistical analysis of the incidents in 2005

The analysis is about the incidents declared between 1 December 2004 and 30 November 2005.

Breakdown of incidents on the EDF reactors in 2005 according to area of declaration

The areas concerned by the incidents declared by EDF are safety, radiation protection and the environment. The following graph presents the breakdown into these three areas of the incidents declared by EDF.

Breakdown of incidents per area



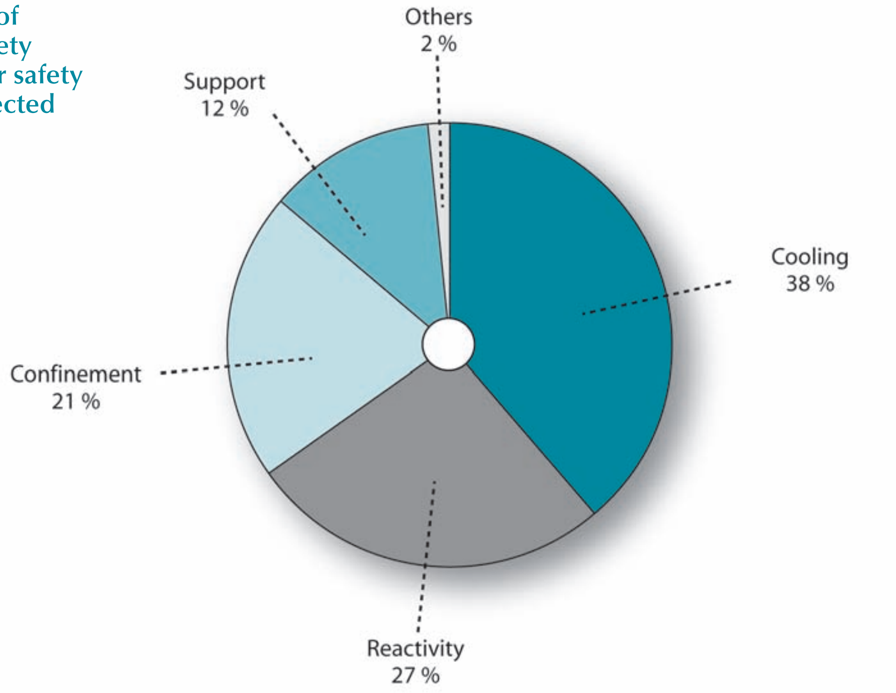
The number of radiation protection and environmental incidents declared remained stable from 2003 to 2004. In 2005, the ASN observed a drop in relation to 2004 in the number of environmental incidents declared and a rise in the number of safety-related incidents.

Breakdown of safety incidents which occurred in EDF reactors in 2005, per safety function affected and per reactor state

Safety is provided by three basic safety functions, that is reactivity control, cooling of radioactive materials and containment of radioactive materials. Certain incidents do not directly affect one of the three safety functions, but do affect auxiliary systems such as electrical power supplies. These incidents are represented under the "support" heading.

The following graph shows the breakdown of incidents per safety function affected during the event.

Breakdown of declared safety incidents per safety function affected



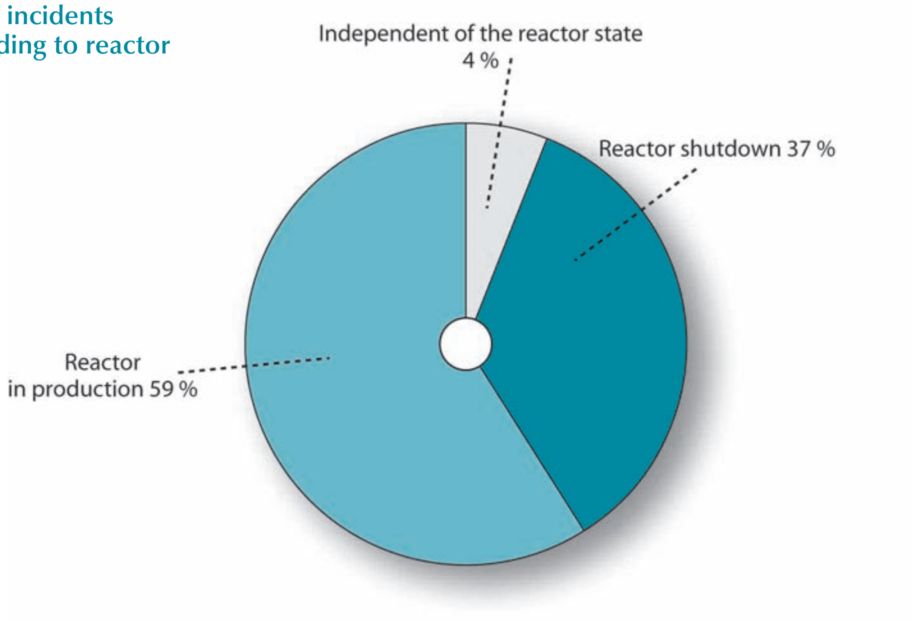
In 2005, the breakdown of incidents according to the safety function affected was appreciably the same as in previous years. The ASN did however observe a rise in the number of "support" function incidents, a trend which should be monitored and confirmed next year.

Safety incidents are also broken down according to the reactor state: some occurred while the reactor was in power operations, while others occurred during outages. The occurrence of certain incidents is independent of the reactor state and they are placed under the "Independent" heading.

The following graph shows this breakdown for EDF reactor incidents in 2005.

This graph shows that the number of safety incidents is higher when the reactor is in power operations than during an outage. The proportions remain similar to those obtained for 2004.

Breakdown of declared safety incidents according to reactor state

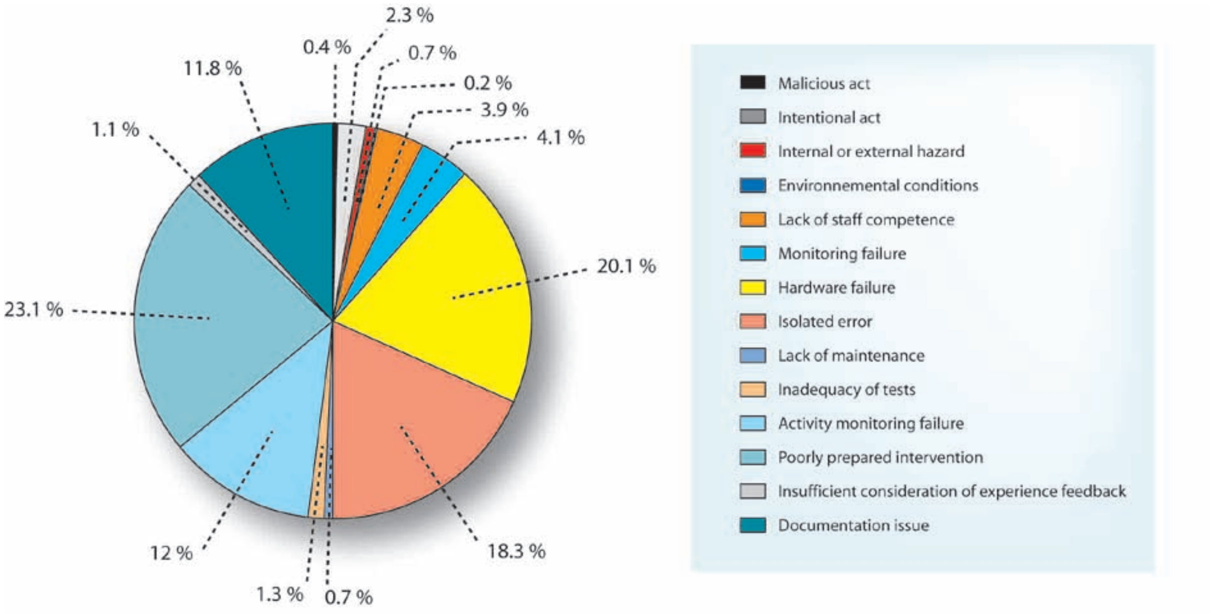


Breakdown of incidents on EDF reactors in 2005, according to the main cause

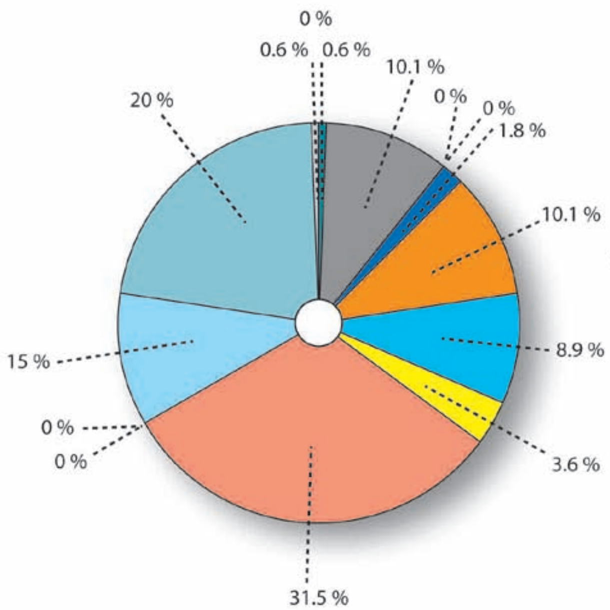
If we consider all the incidents which occurred on EDF reactors in 2005, independently of the area of declaration, the proportion of incidents linked to organisational and human causes is tending to rise, and went up from 75% in 2002 to 80% in 2005.

The graphs below show that the main causes of the incidents vary according to the area of declaration.

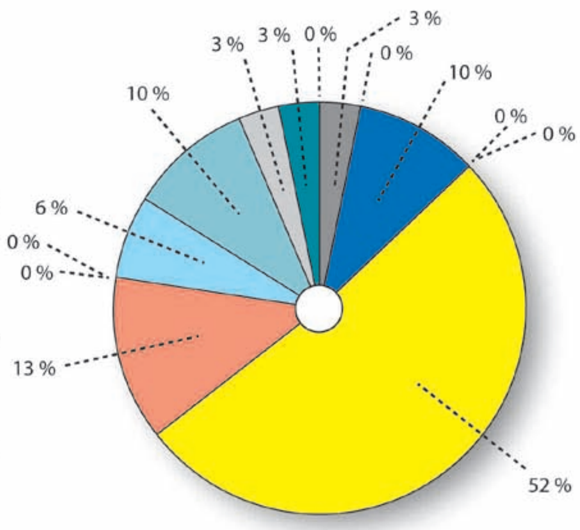
Breakdown of declared safety incidents according to main cause



Breakdown of declared radiation protection incidents according to main cause



Breakdown of declared environmental incidents according to main cause



The share of safety-related incidents declared is of the same order of magnitude as in previous years: nearly 20% of the incidents are linked to equipment faults and 80% to organisational and human causes. However, since 2003, a slight rise in the share of incidents linked to organisational and human causes is worth noting. This trend in particular concerns problems with preparation of maintenance (23%) and documentation problems (12%), which reflect a lack of stringency upstream of maintenance work that is important for safety, and problems with assuring and maintaining the quality of the documents required for preparing and carrying out these activities.

Among the organisational and human causes, it is also worth noting the following main origins: 18% are linked to isolated errors by the staff concerned and 12% to shortcomings in the supervision of operation and maintenance activities.

More than 95% of radiation protection incidents are linked to organisational and human causes. The following origins in particular should be noted:

- about 31% originate from specific errors, or 10% more than in 2004;
- 22% originate from incorrect preparation of the maintenance work, reflecting incomplete knowledge of radiological conditions at the maintenance location, failure to analyse interference between work sites or shifts in the schedule, the consequences of which were poorly identified;
- more than 20% originate in behavioural problems (“intentional act”) or shortcomings in radiation protection (“lack of skills by one or more participants”).

Environmental incidents are of three types, concerning:

- incidents linked to non-compliance with the requirements of the release orders (55%);
- release of ozone-depleting gases or greenhouse effect gases (13%);
- leaks or spillage of chemical or radioactive products (32%).

The proportion of incidents linked to releases of ozone-depleting or greenhouse gases is significantly down on 2004. EDF has made efforts to improve the situation regarding this type of release, a fact that could explain this trend if the reduction is confirmed in 2006. 70% of incidents concerning non-compliance with the requirements of the release orders have organisational and human causes, in particular specific errors on the part of the staff. With regard to the last two types of incidents, the origin is mainly due to equipment faults.

One must also underline the declaration of two incidents linked to malicious acts on two different sites. The first took place at Cattenom in December 2004 and concerned fire protection equipment, while the second occurred in April 2005 at Gravelines and concerned electrical equipment rooms. These two incidents had no safety, radiation protection or environmental consequences.

5 | 2

Significant events site by site

This table presents the most significant events over the year 2005 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. Finally, additional information is obtainable from the DRIREs concerned.

BELLEVILLE

Site:

Administrative regularisation of the mechanical metalworking shop: technical requirements notified to the licensee by the ASN.

Signature of the order of 18 August 2005 authorising the site to modify the flood protection works.

BLAYAIS

Site :

Activation of an on-site emergency plan and triggering of the national emergency response organisation following a pressure rise in the reactor cooling system during an outage, leading to threshold overshoot on 27 October 2005.

Renewal of ISO 14001 certification.

Continued dredging of the Gironde river at the water intakes to prevent clogging by mud.

Real-time monitoring of thermal discharges into the Gironde, leading to adaptation of reactor power during the summer.

OSART mission in May 2005.

Reactor 4:

Performance of the second ten-yearly outage.

BUGEY

Site :

Submission of a file concerning construction of a processing centre for pathogenic waste from the cooling towers.

Reactor 3:

Outage for maintenance and refuelling with hydrotest on main secondary system.

CHINON

Site :

In-depth inspection from 7 to 11 March 2005 on the subject of fire, mobilising 9 inspectors for one week: this inspection in particular entailed a large-scale exercise involving activation of the on-site emergency plan and mobilisation of 23 vehicles from the departmental fire and emergency services.

Signature of the prefectoral order of 9 November 2005 authorising the site to build a temporary weir on the Loire river at Avoine and la Chapelle-sur-Loire, during severe low-water periods.

Approval for addition of equipment, construction and commissioning of monochloramine treatment installations on the secondary systems cooling systems.

Signature of the 17 August 2005 order modifying the 20 May 2003 order authorising water intake and discharge of liquid and gaseous effluent from the site.

Dredging of the intake channel.

Reactor 3:

Post-maintenance testing of the main secondary systems in application of the order of 10 November 1999.

CHOOZ

Reactor 1:

Incorporation of “end of series state” modifications package during the maintenance and refuelling outage which began in January 2005.

Replacement of a pole of the step-down transformer following a problem at unit restart. This work delayed reactor restart by one month.

CIVAUX

Site:

Post-maintenance testing of the main secondary systems on reactors 1 and 2.

First removal of spent fuel in November 2005.

Final start-up of reactors 1 and 2.

Reactor 1:

Strike by the operations team and a contractor for several weeks at the beginning of the reactor 1 outage.

CRUAS

Site:

Renewal of ISO 14001 certification.

Submission of a file requesting modification of the site’s water intake and liquid and gaseous effluent discharge licence.

Repair of watertightness of radioactive liquid effluent storage tanks following detection of tritium in the site’s underground water.

Reactor 1:

Performance of the second ten-yearly outage.

Reactor 4:

Unscheduled shutdown following rise in the leak rate between primary and secondary systems.

DAMPIERRE

Site:

Submission of a file requesting modification of the site's water intake and liquid and gaseous effluent discharge licence and beginning of review.

Performance of work to shore up the flood protection dyke.

Reactor 2:

Replacement of steam generators and post-maintenance testing in application of the order of 10 November 1999.

FESSENHEIM

Site:

National emergency exercise on 19 May 2005.

FLAMANVILLE

Site:

Steps taken to reduce the large amounts of nuclear waste in interim storage.

Geological surveys conducted in the summer of 2005 as part of the technical studies conducted with a view to installing an EPR reactor on the Flamanville site. These surveys were carried out on land and at sea using a drilling platform.

GOLFECH

Site:

National emergency exercise on 3 March 2005 with civil protection measures implemented by the prefecture.

Review of the site's water intake and radioactive and non-radioactive liquid and gaseous effluent discharge licence renewal application in progress.

Peer review from 16 May to 3 June 2005.

Reactor 1:

Replacement of the reactor vessel head during the maintenance and refuelling outage in summer 2005.

GRAVELINES

Site:

Beginning of work on the cofferdams to protect the heat sink. The cofferdam is a structure separating the intake channel from the discharge channel.

Reorganisation of radiation protection supervision to comply with the requirements of the radiation protection regulations.

Reactor 3:

Inadvertent triggering of the containment spray system during the maintenance and refuelling outage.

Reactor 4:

Replacement of the RIS and EAS systems sump filters.

Installation of hydrogen recombiners.

NOGENT

Site:

Application of the order of 29 December 2004 authorising water intake and liquid and gaseous effluent discharge.

Reactor 1:

INES Level 1 incident on 30 September 2005 with activation of the on-site emergency plan and triggering of the national emergency response organisation following accidental spraying of the electrical cabinets.

PALUEL

Site:

Massive arrival of algae at the pumping station, leading to automatic reactor trips.

Loss of off-site electrical power supply to the 4 reactors on 30 December 2005, owing to weather conditions.

Reactor 2:

Performance of the second ten-yearly outage from April to August 2005. This outage was the first of this type in France for the P4 plant series reactors. It led to significant maintenance work. The primary system and containment underwent hydrostatic testing.

PENLY

Reactor 1:

Replacement of the reactor vessel head during the outage in Spring 2005.

Reactor 2

The outage began one month early in August 2005 following discovery of significant damage to the condenser.

SAINT-ALBAN

Site:

Submission of an application for modification of the order authorising water intake and liquid and gaseous effluent discharge, in order to increase the discharge limits of several components and include the water intake channel dredging operations.

Reactor 2:

Complete inspection of the main secondary system during maintenance and refuelling outage.

Unscheduled outage following a generator stator protection fault. The outage, which began on 4 December, enabled the generator to be replaced and lasted 3 months.

SAINT-LAURENT-DES-EAUX

Site:

Inspection of 30 March 2005 carried out in the presence of the Chairman and an associative member of the CLI (local information committee).

National emergency exercise on 11 October 2005.

Reactor 1:

Second ten-yearly outage.

Reactor 2:

Performance of non-destructive tests following replacement of the steam generators in 2005.

TRISCASTIN

Site:

Submission of a file applying for renewal of the water intake and effluent discharge licence.

National emergency exercise on 24 November 2005 with evacuation of a part of the population.

6 ASSESSMENT AND OUTLOOK

6 | 1

ASN assessment of the past year

Reactor operations

The documents on which operations are based, such as reactor operating and maintenance rules, are on the whole clear and of high quality, and generally well applied on the sites. However, in 2005, the ASN observed certain trends that will demand particular vigilance in 2006:

- quality problems in certain documents drafted by the EDF head office, and which the ASN had to ask EDF to correct;
- discrepancies in implementation by the sites of the national reference system, in particular with regard to documents concerning periodic tests;
- reference system interpretations which do not always benefit safety;
- existence of processes which lead to changes to the reference system without prior approval by the ASN.

On-site, the ASN observed discrepancies in application of the operating procedures, in supervision of activities and in preparation of maintenance work. A lack of stringency would seem to be the cause of these discrepancies and a factor in their persistence. However, the ASN did observe that through internal or external audits, the licensee had identified their weak points in this area and were extensively involved in steps to achieve progress, through “operational stringency” style action plans.

The ASN considers that the licensee is responsive to unexpected events, correctly manages operating incidents when they occur and learns the necessary lessons through a process of local and national experience feedback. The ASN believes that in addition to distributing incident experience feedback, distribution of good practices between the sites should be encouraged.

With regard to fire-fighting, efforts concerning organisation and equipment led to a reduction in response times, but staff backing for the organisation currently in place still needs to be improved.

The ASN notes with satisfaction the now generalised use of simulators for specific training to improve operating quality, through scenarios tailored to sensitive transients or resulting from an analysis of previous incidents. The ASN believes that joint training of the operating teams with the teams from other departments who are required to work in parallel with them is a practice to be promoted in order to improve communication and synergy between departments.

Maintenance activities and subcontractors

In line with its policy of bringing down maintenance costs, EDF is implementing methods particularly aimed at concentrating maintenance operations on equipment for which a failure entails safety, radiation protection or operational issues. The ASN notes that so far, these changes have had no impact on safety.

However, even if the maintenance reference system is clear and of good quality, the site operators still have problems with keeping up with the rate of document updates required by head office. In 2005, the ASN also observed that the quality of maintenance preparation work was sometimes inadequate. The risk analyses in particular need to be conducted with greater stringency.

Most on-site maintenance activities are entrusted to subcontractors selected on the basis of an assessment and qualification system concerning which the ASN considered no particular comments to be necessary. The ASN observed that in 2004, the supervision of the activities entrusted to the subcontractors needed to be improved. It observed in 2005 that progress had been made on this point, through implementation of a national reference system designed to ensure that supervision was better organised and better implemented by the licensee. The situation does however need to be further improved for those aspects concerning the coordination of this improvement process and its correct implementation by all departments, the quality of the supervision programmes and the effective supervision of activities in the field. The ASN will in 2006 continue its monitoring and assessment of EDF on these points. During field inspections it will check that the action initiated continues, is better coordinated and takes account of acquired experience concerning supervisory methods and human resources.

The ASN considers that the skills and resources dedicated to maintenance are on the whole appropriate. The inspections carried out on the worksites however indicate that the workload imposed on the staff is heavy and that conventional workplace safety requirements are not always complied with.

Equipment condition

The ASN believes that the equipment maintenance and replacement programmes, the safety reviews approach and the questioning attitude consisting in checking the design and conformity of the facilities in order to correct any anomalies, help maintain the plant equipment in an adequate condition.

• First barrier

The ASN is on the whole satisfied with the control of the first containment barrier, in other words the fuel cladding. However, damage or loss of fuel assembly tightness still occurs on most sites despite preventive steps being taken.

• Second barrier

The ASN considers that the second barrier, mainly consisting of the primary system, remains satisfactory: EDF pays particular attention to it and implements stringent maintenance programmes. EDF action concerning the first generation of steam generators - replacement programme underway since the 1990s and targeted maintenance since 2004 - is helping to achieve significant improvements in their integrity. The ASN considers that it is necessary to maintain particular attention on controlling the ageing phenomena affecting the main primary system.

• Third barrier

The condition of the third barrier, that is the reactor containment, is on the whole satisfactory. Feedback from operation of the single-wall containments of the 900 MWe reactors was reviewed in 2005 with the third ten-yearly outages in mind. EDF was asked for additional studies, particularly concerning containment in outage states, definition of third barrier extension and the "auxiliary buildings containment" doctrine.

The additional studies requested will be reviewed as of 2006. EDF also proceeded with its 1300 and 1450 MWe reactor containments tightness reinforcement work, scheduled to continue until 2011.

Radiation protection

The ASN observed that the active progress being made to improve radiation protection in the nuclear power plants is leading to a constant drop in individual and collective worker dosimetry. The national action plans defined and implemented by EDF to improve radiation protection are consistent with the diagnosis of the situation. The ASN in particular considers that reinforcing skills, working methods and supervision are appropriate actions.

Methodical implementation of these action plans has been initiated on the sites. Their effectiveness is being assessed and any necessary adjustments made. The ASN however observes that there are problems with having all the departments on the site follow the radiation protection approach and notes the lack of improvement in individual attitudes, which have been the cause of incidents.

Consequently, these action plans have not yet fully borne fruit and must be continued and possibly strengthened. For example, the staff "radiation protection culture" must be improved. Finally, progress is still needed in supervising application of radiation protection rules on the worksites.

The environment

The environmental protection regulations applicable to BNIs in general and to nuclear power plants in particular, have been gradually reinforced. In the field of discharges, the ASN has begun a process of systematic revision of the licences issued, for each nuclear power plant. With regard to the prevention of risks and detrimental effects, the order of 31 December 1999 introduces new requirements. The ASN notes with satisfaction that these regulatory changes have led to greater concern for environmental protection matters on the part of the nuclear power plants, be it in terms of facility design or operation.

With regard to installations design, EDF in 2005 continued its efforts to define and implement changes to improve the prevention of risks and detrimental effects. This work is satisfactorily coordinated by EDF head office.

Concerning discharges, the quality of the licence application files has improved, but changes are still needed before the files can be considered acceptable. The ASN notes that in 2005, the requirements of the discharge licence orders were on the whole followed. It should be stressed that given the fact that the new authorised discharge limits are set as close as possible to the actual discharges, in order to urge the licensee to reduce its discharges to a level as low as reasonably achievable, any underestimation in the application dossier of the quantities discharged is likely to lead to non-compliance with the licence.

In the field of waste, and at the request of the ASN, EDF conducted safety analyses of waste management activities. The main conclusion from examination of these documents is the absence of any precise operating reference system. In 2005, the ASN also found that despite increased licensee awareness of the need for improvements to their waste management procedures, a lack of equipment availability led to significant congestion of the waste disposal and packaging buildings on certain sites.

Personnel and organisation

The ASN considers that EDF's organisation is on the whole capable of dealing with safety questions. The fact that safety is the main priority is plainly apparent. The ASN recognises the competence and professionalism of the EDF staff. Managers are increasingly present in the field and the manning levels are generally speaking appropriate, although there are still some inadequacies in the maintenance area, particularly during unit outages and with sometimes problematical maintenance conditions. As a whole, EDF must improve how organisational and human factors aspects are incorporated into field activities, in particular in the maintenance sector.

Action plans have been implemented to improve maintenance and operating stringency, but the ASN considers that further progress is still needed, particularly in terms of internal supervision and thoroughness in application of the reference documents. More generally, individual and collective attitudes must give greater importance to the safety culture.

6 | 2

Outlook

For EDF's nuclear power plants, 2005 was marked by important events which will help determine supervisory actions for 2006.

First of all, the launch of the national public debate concerning the "Flamanville 3" EPR reactor project, after which EDF would be able to submit a creation decree application. Prior to any submission of such an application, the ASN will in 2006 continue to review the detailed design studies for the EPR reactor, with reference to the safety options stance adopted by the Government in 2004. It will also continue to cooperate with foreign nuclear safety authorities, in particular the Finnish one, in order to include international viewpoints in its safety assessment.

Reports on safety harmonisation drafted by WENRA, particularly for power reactors, will also be published. The heads of the nuclear safety authorities from Europe's leading nuclear countries have agreed, on this basis, to achieve a harmonised safety situation by 2010. In 2006, the ASN will continue to transcribe into France's regulatory or related texts, the "reference levels" produced by WENRA. The ASN considers this work to be a priority, as harmonisation of safety standards in Europe is one means of continuing to take safety forward in an environment marked by deregulation of the electricity markets and an increased focus on competitiveness (see chapter 7 and the significant events in 2005).

A final issue will be the partial sell-off of EDF in November 2005, after the change in status in 2005, and the opening up of the electricity market to competition, a move which started in 2000. EDF has initiated numerous cost reduction and competitiveness improvement programmes, which are submitted to the ASN supervision whenever they affect safety issues. Even if the ASN reckons that it is perfectly normal for a company to be concerned by its competitiveness, it nonetheless keeps a very close watch on the safety consequences of this search for improved competitiveness. At this stage, no negative effects have been recorded but the ASN is remaining vigilant as to how the licensee reflects its search for profitability in its long-term investment choices and as to the day to day actions of its staff.

The ASN in particular considers that the condition of the facilities is satisfactory and that EDF applies appropriate operating methods - maintenance programmes and operating rules - taking due account of the lessons to be learned from experience feedback. In the fields of radiation protection and environmental protection, the ASN notes that EDF has adapted to a context of stronger regulation and considers that in 2005, EDF's results have on the whole progressed. Supervision of activities entrusted to subcontractors, a point to which ASN had drawn EDF's attention at the end of 2004, is improving. However, the ASN expects still greater progress in the stringency of operation and maintenance, and in worksite operating conditions.

The particularity of France is that it operates standardised NPPs which meet nearly 80% of the national electricity demand. Although this situation leads to extremely efficient experience feedback between the reactors, it does demand that a particularly close watch be kept on the possible appearance of generic defects. The conformity reviews, the permanent search for anomalies by the EDF engineering departments, the tests and inspections carried out during the ten-yearly outages are all opportunities for obtaining good knowledge of the current level of safety of the facilities. The ASN observes that this positive approach continued in 2005, and led to conformity being restored within times compatible with safety significance. The work designed to prevent the risk of reactor building sump clogging was thus started and the ASN will monitor its continuation in 2006.

It is also important for EDF to continue to take steps to improve safety still further. Integration of the changes resulting from the 900 MWe reactors second periodic safety review continued in 2005 and will be completed in 2010. Furthermore, the second ten-yearly outages on the 1,300 MWe reactors began in the spring and will continue until 2014. 2005 was also marked by review of the programme associated with the periodic safety review of the 900 MWe reactors with a view to their third ten-yearly outages, scheduled to run from 2009 to 2020.

Finally, with regard to power reactor supervision procedures, the ASN carried out inspections to verify the correct working of the "internal authorisations" system set up in 2005. This system enables EDF to carry out operations which do not compromise the safety demonstration, without first having to ask the ASN for authorisation. This system, which at present only covers a very limited scope, could be extended in 2006. This would shift the burden of responsibility more squarely onto EDF, thereby correcting a natural tendency to leave it up to the ASN to check the quality of the files, a task which should be the prime responsibility of the licensee. This also enables the ASN to concentrate its supervisory actions on those subjects with more important safety issues.

In his letter of 20 September 2006, which can be found on the www.asn.gouv.fr website, the Director General of the ASN drew the attention of EDF's Chairman to these various points.

NUCLEAR FUEL CYCLE INSTALLATIONS

CHAPTER 13

1 MAIN TOPICS COMMON TO ALL INSTALLATIONS

1|1 Fuel cycle consistency

1|2 Regulatory framework for the facilities

1|2|1 Scope of operation of the La Hague reprocessing plants

1|2|2 Revision of discharge licences

1|3 Incident management and operating feedback

1|4 Licensee responsibility

2 MAIN INSTALLATIONS

2|1 Uranium conversion and processing plants

2|1|1 Comurhex uranium hexafluoride preparation plant

2|1|2 COGEMA TU5 facility and W plant

2|2 Uranium enrichment plants

2|2|1 The uranium isootopes gaseous diffusion separation plant (Eurodif)

2|2|2 The GBII ultracentrifugation enrichment plant project

2|3 Nuclear fuel fabrication plants

2|3|1 Nuclear site at Romans-sur-Isère

2|3|2 MELOX plant at Marcoule

2|4 Reprocessing plants (COGEMA establishment at La Hague)

2|4|1 Presentation of the establishment

2|4|2 Operations carried out in the plant

2|4|3 Site discharges and environment monitoring

3 END OF LIFE INSTALLATIONS

3|1 Plutonium technology facility (ATPu) and chemical purification laboratory (LPC) at Cadarache

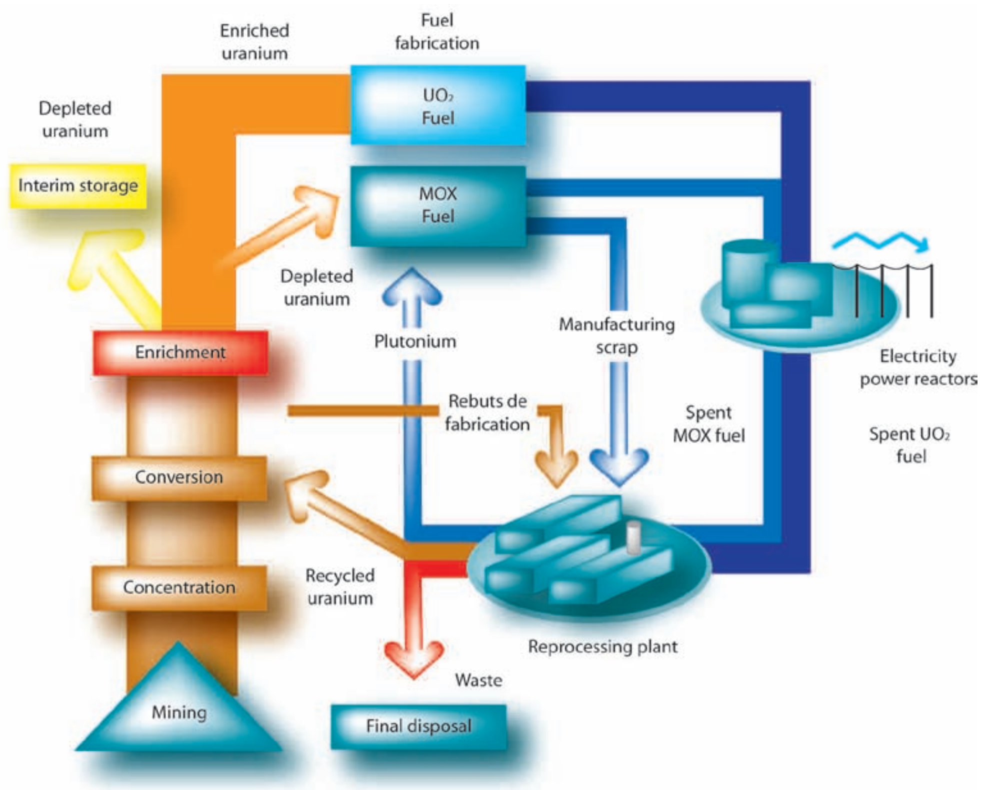
3|2 Former COGEMA La Hague installations

3|2|1 Retrieval of legacy waste

3|2|2 Final shutdown of BNIs 33, 38 and 80

4 OUTLOOK

Fuel cycle



Manufacture of the fuel and its subsequent reprocessing after it has passed through the nuclear reactors constitute the fuel cycle. The cycle begins with the extraction of uranium ore and ends with storage of a variety of radioactive waste originating from the irradiated fuel or from the industrial operations involved and utilising radioactive materials.

The uranium ore is mined, purified and concentrated into yellow-cake on the mining site. The installations involved use natural uranium, where the uranium 235 content is about 0.7%. They are not 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 5% with isotope 235. Prior to enrichment, the solid yellow-cake is converted into uranium hexafluoride gas during the conversion operation. This is done in the Comurhex facilities in Malvési (Aude *département*[1]) and Pierrelatte (Drôme *département*).

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.

1. Administrative division of the size of a county.

After about three years, the spent fuel is removed from the reactor and cooled in a pit, first of all on the plant site and then in the COGEMA reprocessing plant at La Hague.

In this plant, the uranium and plutonium from the spent fuels are separated from the fission products and the other actinides. The uranium and plutonium are packaged for interim storage before subsequent reuse. The radioactive waste is placed in a surface repository if low-level, or in interim storage pending an appropriate disposal solution.

The plutonium produced by reprocessing can be used to make fuel for fast neutron reactors (as was the case in the ATPu at Cadarache), or MOX fuel (uranium and plutonium mixed oxide), used in French 900 MWe PWRs, in the Marcoule MELOX plant.

The vast majority of the plants in the cycle belong to the AREVA group, which primarily consists of the COGEMA and Framatome-ANP groups. The uranium-based fuel manufacturing plants are operated by FBFC, a wholly-owned subsidiary of Framatome-ANP. The 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 (1)

Facility	Material processed	Tonnage	Product obtained	Tonnage
Comurhex Pierrelatte	Uranyl nitrate (based on reprocessed uranium)		UF_4 UF_6 U_3O_8	249 0 0
COGEMA Pierrelatte TU5 facility	Uranyl nitrate (based on reprocessed uranium)	5 803	U_3O_8	1,744
COGEMA Pierrelatte W plant	UF_6 (based on depleted uranium)	16 767	U_3O_8 produced U_3O_8 stored	11,335 10,353
Eurodif Pierrelatte	UF_6 (based on natural uranium) UF_6 (based on enriched uranium)	21 509 868	UF_6 (depleted uranium) UF_6 (enriched uranium)	19,627 2,804
FBFC Romans	UF_6 (based on enriched natural uranium) UF_6 (based on enriched reprocessed uranium)	882 38	UO_2 (powder) UO_2 (fuel elements) UO_2 URE-fuel elements	423 443 37
MELOX Marcoule	UO_2 (based on depleted uranium) PuO_2	164 12	MOX (fuel elements	145
COGEMA La Hague	Reprocessed spent fuel elements UP3 UP2 800 UP2 400 Spent fuel elements unloaded into pit	 683 429 0 1 233	Vitrified waste packages produced UP3 (number of containers) UP2 800 (number of containers) NU produced PuO_2 produced	 453 450 944 11

(1) The table only deals with throughput in fuel cycle BNIs and excludes the COGEMA W plant.

1 MAIN TOPICS COMMON TO ALL INSTALLATIONS

1 | 1

Fuel cycle consistency

The ASN supervises the overall technical, safety-related and regulatory consistency of the industrial choices made with regard to fuel management. The question of the long-term management of spent fuels, mining residues and depleted uranium is a very real one and it is important to take account of all contingencies and uncertainties.

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.

The data presented by EDF and reviewed to date, provide 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.

In order to maintain an overview of the fuel cycle, these data will have to be periodically updated. For any new fuel management system, EDF will be required to present a feasibility study, accompanied by a revision of the "nuclear fuel cycle" dossier, specifying and justifying any differences.

Through this forward-looking approach, the ASN aims to avoid saturation of the nuclear power plant interim storage capacity that has happened in other countries, and prevent the licensees from using older installations as an palliative interim solution, owing to their less stringent regulatory and technical authorisations.

1 | 2

Regulatory framework for the facilities

As time passes, so the fuel cycle installations change. The ASN ensures that the technical solutions adopted by industry have and continue to have no safety and radiation protection consequences for the workers, the population and the environment. However, and aside from technical considerations, the regulatory framework of the installations may turn out to be no longer appropriate to the activities actually carried out in them.

For a number of years now, the ASN has therefore been implementing various procedures to offer a better legal framework for the workings of the main installations: revision of the authorisation decrees and discharge licences for the COGEMA La Hague site and revision of the discharge licences for the Tricastin site.

This should continue in the coming years, in particularly through drafting of an authorisation decree for the CERCA installation on the Romans site, which had previously simply been covered by the notification system (see point 2|3|1).

1 | 2 | 1

Scope of operation of the La Hague reprocessing plants

The revision of the La Hague site nuclear installations authorisation decrees, which was completed on 10 January 2003, is a technical decision designed to allow changes to the activities in the installations in satisfactory conditions of safety and environmental protection, and in conformity with the regulations. The reference fuel elements for which reprocessing was envisaged at the time of publication of the old decrees were relatively unrepresentative of the fuel elements actually loaded into the reactors. This difference will be accentuated in the future. This revision was therefore needed to manage current fuel throughput. The authorised modifications will combine improved nuclear safety with greater environmental protection through the use of the best techniques available.

COGEMA La Hague – general view

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 legacy waste from.

The decrees published on 11 January 2003 in the Official Gazette define a new operating framework for the facilities and article 5 requires that any extension of the current operating framework within this new framework, receive specific authorisation issued by interministerial order. The actual operations to process the fuels, substances and materials authorised by interministerial orders must, as presently, be the subject of an operational agreement for each particular processing campaign outside the previously authorised domain. This enables account to be taken of the time elapsed between the authorisation to extend the domain and the actual processing operation performance and checks to be made on the compatibility of the performance conditions envisaged by the licensee with installation safety and protection of persons and the environment. The interministerial orders specify that the operational agreement will be issued by the Director General for Nuclear Safety and Radiation Protection.

In 2003, environmental defence associations took legal action to obtain cancellation of the decrees authorising the requested modifications and the water intake and effluent discharge licences for the La Hague installations. So far, only one of the cases has been judged and the Conseil d'Etat (supreme administrative court) rejected the request for revocation of the 10 January 2003 decree authorising COGEMA to modify STE3.

In 2001, environmental defence associations also took action to obtain recognition of the illegality of operations to import, dispose of and reprocess spent nuclear fuel from the Australian ANSTO nuclear research reactor. Claiming that reprocessing took too long, the plaintiffs asked that the assemblies be returned to the country of origin, on the grounds that they should be regarded as waste. In a decision of 12 April 2005, the Caen court of appeal partially overturned a judgement of the Cherbourg court dated 3 February 2003 and considered that the nuclear fuel in question did constitute radioactive waste under the terms of the Environment Code, and ordered COGEMA La Hague to produce and to communicate to the plaintiff organisations the operational authorisation for reprocessing the stock of fuel, failing which COGEMA should terminate the presence of all of these materials on French soil. Reprocessing of the assemblies concerned began on 9 June 2005. The above-mentioned order by the Caen court of appeal was confirmed by the Cour de Cassation (supreme court of appeal) on 7 December 2005.

1 | 2 | 2

Discharge licence revision

The ASN initiated revision of certain water intake and effluent discharge licences, with a view to correcting three types of unsatisfactory situation:

- old plants, where the licence application for regularisation purposes has not been entirely reviewed by the authorities and where discharge levels are controlled in the context of a contractual system;
- installations where effluents are discharged via purification plants belonging to other nuclear licensees. Such installations do not have their own specific discharge licences;
- installations where the discharge licences are to a varying extent disproportionate with respect to technical possibilities and actual discharge rates involved or are incompatible with foreseeable plant modifications.

The orders of 12 August 2005, concerning discharges from the Comurhex, Eurodif and Socatri installations, are the end-result of a process that was started in 1997. The dossiers presented by the licensees were the subject of a public inquiry, which began on 15 February and ended on 23 March 2001. The procedure and in particular the public inquiry showed no reason to oppose the various applications.

At the beginning of 2003, the operators of the COGEMA Pierrelatte and Comurhex facilities realised that handling of certain products could lead to release of tritium, or even carbon 14, which was not provided for in the above-mentioned applications. These operators submitted a new discharge licence application, which will be the subject of a public inquiry in 2006.

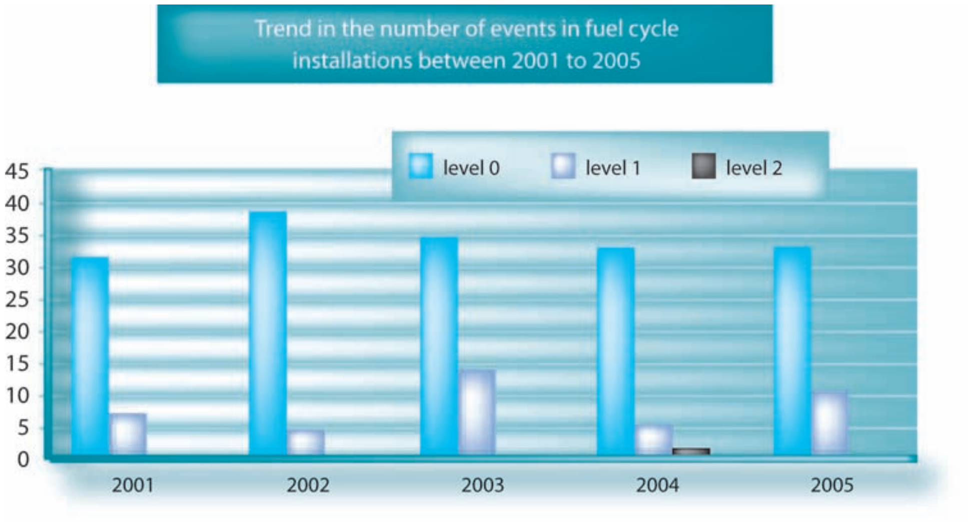
Tricastin site – general view

1 | 3

Incident management and operating feedback

The detection and processing of significant events that have occurred in operation of the installations play a fundamental safety role. The lessons learned from correcting these unusual occurrences lead to new requirements applicable to safety-related items and to new operating rules. Licensees 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 events reported by fuel cycle installations.



ASN monitoring of these events and how they are managed by the licensees in particular enables it to identify:

- events recurring on the same installation;
- events 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 licensees.

With respect to experience feedback, the ASN sent out a letter on 22 August 2005 to inform all licensees of an event which occurred during filling of the “Padirac” waste transport casks, which, if incorrectly supervised, could lead to damage of the inner container at closure. This letter also asked for notification of the steps taken to remedy this type of problem in the BNIs that use these casks.

In 2005, the 26 July 2004 contamination event in MELOX (see point 2|3|2) was also re-rated at level 2 on the INES scale.

1 | 4

Licensee responsibility

Nuclear installation safety is primarily based on the supervision carried out by the licensee itself. In this respect, for each installation, the ASN checks that the organisation and resources deployed by the licensee enable it to assume this responsibility.

The restructuring of the AREVA group led to increased vigilance in this area, in particular with respect to the small installations. It is important that the fact of centralising resources, particularly financial resources, enables each nuclear licensee to can continue to assume its responsibility as licensee.

In addition, to increase licensee accountability and to rationalise its supervisory actions, the ASN asked COGEMA to propose an internal authorisation system allowing changes to the installation or the safety reference system which do not compromise the overall safety demonstration. Only operations which do not fall outside the scope of the authorisation decree or the technical specifications of the installation could be dealt with using this process. Significant modifications will still be submitted to the ASN for approval. 2005 was an opportunity to implement this process on the La Hague units in the final shutdown phase.

2 MAIN INSTALLATIONS

2 | 1

Uranium conversion and processing plants

To allow production of fuels usable in the French reactors, the uranium ore first has to be converted into UF_6 and then enriched.

2 | 1 | 1

Comurhex uranium hexafluoride preparation plant

The ICPE (installation classified according to the environmental protection regulation rather than the nuclear installation regulation) part of the Comurhex plant in Pierrelatte is designed to manufacture uranium hexafluoride. This manufacturing uses natural uranium in the ICPE part of the installation and reprocessed uranium in the BNI part. This latter mainly consists of two facilities:
- the 2000 facility, which converts uranyl nitrate from the reprocessing plants into UF_4 or into U_3O_8;
- the 2450 facility, which converts the UF_4 (whose uranium 235 content is between 1 and 2.5%) from the 2000 facility into UF_6. This UF_6 will be used to enrich the reprocessed uranium for recycling in the reactor.

Comurhex – general view

Structure 2450 was shut down by the licensee in 2002.

Since then, ^{235}U levels have been limited to strictly lower than 1% for all activities in the COMURHEX BNI, which could enable the licensee to benefit from downgrading to an ICPE rather than a basic nuclear installation.

In a letter dated 8 December 2004, the licensee also confirmed its intention to close the 2000 structure and move to final shutdown of the entire BNI no later than 31 December 2008.

2 | 1 | 2

COGEMA TU5 facility and W plant

COGEMA operates on the Pierrelatte site BNI 155,which comprises:
- the W plant (ICPE within the BNI boundary) 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 facility 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.

TU5 – general view

Planned developments

The P0 interim storage project is being studied by COGEMA and could give rise to a licence application in the near future. The P0 would be intended for the interim storage of civil materials currently stored in classified BNI facilities also operated by COGEMA on the site, together with the uranium produced by reprocessing in the TU5 facility.

2 | 2

Uranium enrichment plants

2 | 2 | 1

The uranium isotopes gaseous diffusion separation plant (Eurodif)

The isotope separation process used in the plant is based on gaseous diffusion. The plant comprises 1,400 cascaded enrichment modules, split into 70 sets of 20 modules grouped in leak-tight rooms.

The gaseous enrichment principle consists in repeatedly diffusing UF6 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 U^{235} 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 licensee in 2002 forwarded the dossiers concerning the seismic resistance of the plants. Additional investigations were necessary to determine the seismic behaviour of the U annex building, where the enrichment cascade feed and draw-off operations are carried out, taking account of the seismic movement determined according to the new RFS 2001-01. The investigations show that the seismic resistance of the U annex building needs to be improved and the licensee proposed measures designed on the one hand to reinforce the civil engineering structures and on the other to limit the quantities of radioactive materials present in these buildings. The licensee intends to limit the quantities of liquids present and to apply for the corresponding authorisation in 2006.

2 | 2 | 2

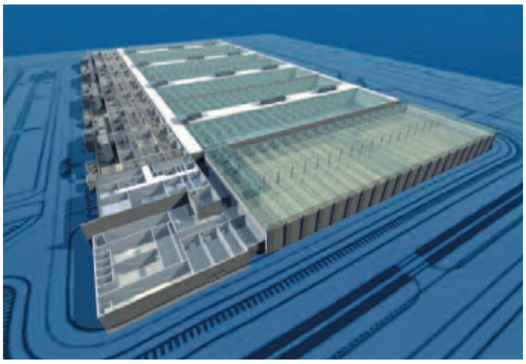
The GBII ultracentrifugation enrichment plant project

The ultracentrifugation process should eventually replace gaseous diffusion. COGEMA has transmitted the safety options dossier for the future ultracentrifugation enrichment units. This dossier was analysed by the ASN and its technical support organisation. The licensee also forwarded the preliminary safety analysis report for the installation which, from 2007, is scheduled to gradually replace the Eurodif plant. Commissioning of the three planned production units will take place from 2007 to 2016.

This planned new plant was the subject of a public debate which ended on 20 October 2004 and led to no opposition to the project. This installation will be covered by a public inquiry in 2005 as part of the authorisation application process.

Review of this project involved the nuclear safety authority visiting nuclear facilities throughout Europe that use the same technology and initiating exchanges with its foreign counterparts concerning the corresponding safety considerations.

The Almelo ultracentrifuge plant



The GBII project

2 | 3

Nuclear fuel fabrication plants

After the uranium enrichment process, the nuclear fuel is made in different installations, depending on its final destination. The UF_6 is converted into uranium oxide powder so that after processing it can be made up into fuel rods, themselves subsequently assembled to form fuel assemblies.

Depending on whether the fuel is intended for PWRs, fast reactors or experimental reactors, and depending on the fissile material it contains, it is manufactured in one of the following establishments: FBFC at Romans-sur-Isère or MELOX at Marcoule, this latter plant being designed to produce fuel containing plutonium.

2 | 3 | 1

Nuclear site at Romans-sur-Isère

The two basic nuclear installations, BNI 63 and BNI 98, installed on this site, on which they share a certain number of common resources, belong respectively to the CERCA and FBFC companies, which form part of the Framatome-ANP group fuel division. Under the terms of decree 63-1228 of 11 December 1963, as amended, concerning nuclear installations, the FBFC company is the site's sole nuclear licensee.

BNI 63 comprises a series of facilities 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 light water reactors.

Fuel element fabrication plant (BNI 98)

In 2002, the licensee submitted an application to increase production capacity, leading to modification of the prior authorisations dating from 1978. The modifying decree will be sent for signature in early 2006 and is the end-result of the procedure implemented under the above-mentioned decree of 11 December 1963, in particular including a public inquiry, which began on 2 June and ended on 11 July 2003.

FBFC – pellet incorporation into fuel rods

At the same time and in order to meet the objectives of the safety review carried out in 2003, the licensee proposed renewing and modernising its industrial tool. After review by the Advisory Committee, this project was accepted by the ASN. The resulting site modernisation process should run until 2008.

CERCA company plant (BNI 63)

The CERCA company plant, one of the oldest French nuclear sites, predates publication of the above-mentioned 1963 decree on nuclear installations. This installation was simply declared for regularisation after publication of this decree.

The ASN wishes to see the requirements applicable to operation of this plant covered by a decree, as is the case with the FBFC company's fuel fabrication plant. The procedure could be started when the application is submitted for modification of the installations and could be based on the safety review for this plant currently in progress.

In March 2005, the licensee also submitted an application for commissioning of an HTR (High Temperature Reactor) pilot fuel unit. This activity is part of the generation IV reactor R&D programme in which the Framatome-ANP company is a participant.

2 | 3 | 2

MELOX plant at Marcoule

With the cessation of industrial production in the Cadarache facility (ATPu), MELOX is now the only French nuclear installation producing MOX fuel, consisting of a mixture of uranium and plutonium oxides.

After releasing a decree authorising the plant annual production capacity to be raised from 101 tons of heavy metal (or 115 tons of oxide) to 145 tons of heavy metal, to absorb the ATPu's order book, the licensee in August 2004 presented a further application to increase the production capacity to 195 tons. This application from the licensee will undergo a public inquiry in spring 2006.

Using the rods manufactured in the Cadarache ATPu facility, the MELOX plant also fabricated the four assemblies for the EUROFAB project. As the plutonium isotopes used in this context do not comply with the requirements of the plant's authorisation decree, this campaign was authorised by a decree of 4 October 2004. The campaign ended with the March 2005 shipment of four assemblies and the manufacturing scrap.

MELOX – preparation for package loading

Radiation protection

Since 2000, the external collective and individual doses received by the workers have been rising. This is due both to the change in the actual radiological content of the materials used (plutonium resulting from reprocessing of higher burnup fraction fuels) and the rise in the plutonium oxide content of the MOX fuel.

In the context of the above-mentioned capacity increase, the ASN is particularly attentive to ensuring that the licensee continues with and reinforces actions to optimise radiation protection to keep the rise in doses received under control.

In 2005, the 26 July 2004 event was re-rated at level 2. This was the first such occasion in the fuel cycle installations since 1999. This event is described in detail below.

Level 2 event ont the MELOX site

On 26 July 2004, a technician was contaminated by radioactive substances during an operation carried out using a glovebox. While he was trying to free a mechanical device, it suddenly fell onto his hand. The resulting wound was decontaminated and required minor surgery. The X-rays taken revealed no fracture.

This event was provisionally rated at level 0 on the INES scale on 27 July 2004.

Subsequent to this event, the measurements taken and the 50-year committed dose rate assessment showed that the annual dose limit on the technician's hand had been exceeded.

These findings led the ASN to re-rate this event at level 2 on the INES scale.

This event had no consequences either on or outside the site and the surface and atmospheric contamination checks carried out on the installation proved to be negative.

2 | 4

Reprocessing plants (COGEMA establishment at La Hague)

2 | 4 | 1

Presentation of the establishment

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 licensee 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 discharge 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 French fuel), the UP3 plant (for reprocessing foreign fuel) and a new liquid effluent treatment plant, STE3.

The various facilities in the UP3, UP2 800 and STE3 were commissioned from 1986 (reception and interim storage of spent fuel) to 1994 (vitrification facility), with most of the process facilities becoming active in 1989/1990.

Under the terms of the decrees of 10 January 2003, the individual capacity of each of the two plants is 1,000 t per year of initial metal (U or Pu), with the total capacity of the two plants being limited to 1,700 t.

COGEMA La Hague – general view

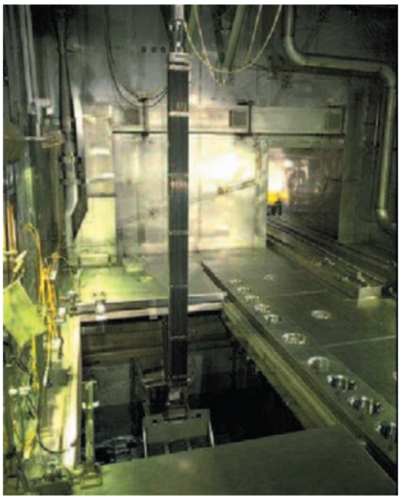
The COGEMA La Hague site thus houses the following installations:
- BNI 33 covering plant UP2 400, the first reprocessing unit, and AT1, a prototype installation currently being dismantled;
- BNI 38 covering effluent treatment station n° 2 (STE 2);
- BNI 47 covering the Élan II B facility, a CEA research facility currently being dismantled;
- BNI 80 covering the HAO facility, the first PWR fuel reprocessing unit;
- BNI 116 comprising the UP3 plant, initially intended for reprocessing foreign fuels;
- BNI 117 comprising the UP2 800 plant, initially intended for reprocessing French fuels;
- BNI 118 comprising effluent treatment station n° 3 (STE3).

Spent fuel reprocessing in the UP2-400 plant has now stopped. The production facilities in the UP2 400 plant have all been shut down.

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.



La Hague – fuel assembly being lowered into the cooling pit, TO dry unloading shop cell

First operations at the plant consist in delivery of transport packages and interim storage of spent fuel. Upon arrival at the reprocessing plant, the packages are unloaded, either underwater, in a pit, or dry, in a leak-tight shielded cell. The fuel is then stored in pools.

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 (U_30_8) in the Pierrelatte TU5 installation.

La Hague – T1 shearing and dissolution shop supply cell

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 licensees 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 discharges are processed by washing in a gas treatment unit. Certain residual radioactive gases, in particular krypton, are checked before being discharged into the atmosphere. The liquid effluents are processed and generally recycled. Certain radionuclides, such as iodine and less active products are, after checking, sent to the marine discharge pipe. The others are sent to facilities for encapsulation (glass or bitumen).

Solid waste is packaged on the site. Two methods are used: compacting and encapsulation in cement.

In accordance with article L.542-2 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.

The main authorisations issued

The ASN has issued COGEMA La Hague with various authorisations, some of which are recalled below.

The La Hague plant facilities

• 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, uranium purification and storage 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:	facility for secondary packaging and interim storage of plutonium oxide;
R7:	fission products vitrification facility.

• UP3 plant

T0 facility:	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 facility and process control laboratories;
ACC:	hull and end piece compacting facilities.

• STE3 facility: effluent recovery and treatment and interim storage of bituminised packages.

La Hague – loading of TN 28 packaging

• UP3 and UP2 80 plants

By delegation of the Ministers for Industry and for the Environment, the Director General of Nuclear Safety and Radiation Protection signed the following interministerial orders:

- of 8 February 2005 authorising COGEMA La Hague to receive, unload, store and reprocess fuels assemblies based on enriched reprocessed uranium, called "URE", in the UP2-800 and UP3 plants;
- of 29 March 2005 authorising COGEMA La Hague to receive and store fuel assemblies for test and research reactors in the UP2-800 plant;
- of 29 March 2005 authorising COGEMA La Hague to receive and process fuel assemblies for test and research reactors in the UP3-A plant;
- of 29 March 2005 authorising COGEMA La Hague to receive, store and reprocess nuclear materials and radioactive substances in the UP2-800 and UP3 plants;
- of 8 July 2005 authorising COGEMA La Hague to receive, store and reprocess unused MOX fuel assemblies from fuel fabrication plants, in the UP2-800 plant;
- of 8 July 2005 authorising COGEMA La Hague to package and store unused MOX fuel assemblies from fuel fabrication plants, in the UP3-A plant.

The Director General of the ASN also issued the following operational approvals:

- of 30 May 2005, for reprocessing of "aluminide" RTR fuel assemblies based on a mixture of uranium and aluminium (UAlx), in the UP3-A facility;
- of 27 June 2005, for performance in STE3 of a series of bituminisation tests on sludges taken from silo 550-14 (production of about fifty bituminised drums);
- of 31 August 2005, for receipt and unloading, in the NPH facility, of TN 9/4 type packagings designed for dry transport of spent fuel assemblies from boiling water reactors;
- of 29 July 2005, for startup of a new process for preparation of basic effluent concentrates in order to facilitate vitrification.

2 | 4 | 3

Site discharges and environment monitoring

Discharges from La Hague, notably liquid discharges, have on the whole, been decreasing over the last ten years, whereas production has increased. This decrease was obtained thanks to technical enhancements within the plants.

The effluents discharged in this case differ from those from a nuclear reactor and the quantities are larger, as it must be remembered that:

- the La Hague plant reprocesses fuel from about a hundred nuclear reactors;
- this reprocessing involves spent fuel shearing, followed by nitric acid immersion, whereas maximum fuel containment is assured in a reactor. The processing of the radioactive materials contained in these fuels consequently produces different effluents.

The 10 January 2003 order authorising COGEMA to continue with water intake and liquid and gaseous effluent discharges for operation of the La Hague nuclear site, 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 10 January 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. However, the licensee will be required to submit a dossier at the beginning of 2006 to justify the means to be employed to further reduce discharges and optimise the impact of its activities. The discharge limits and conditions will then be revised within a period of one year.

In addition, the COGEMA La Hague complex publishes a quarterly record of results of measurements carried out in the context of environmental surveillance. This document is sent to the French and British authorities and to the special standing information committee for the COGEMA La Hague complex.

The quantity of fuel reprocessed has risen from about 400 t in 1987 to about 1112 t in 2005, with a maximum of about 1670 t in 1996 and 1997.

La Hague – environmental monitoring: sampling of algae and grasses

The 2005 discharges and a reminder of those in 1999 are presented below

Gaseous discharges (TBq per year)	Limits in order of 1984	Limits in order of 2003	1999[1] discharges	2005[2] discharges	Forecast for 2006[3]
Tritium	2,200	150	80	72.1	84.3
Iodines	0.11 (halogens)	0.02	0.008 (halogens)	0.0066	0.0059
Rare gases including krypton 85	480,000 (gases other than tritium)	470,000	295,000	301,000	279,513
Carbone 14		28	18,8	17	18
Others β and γ emitters	0.074 (α and β emitter aerosols)	0.001[4]	0.000 12 (α and β emitter aerosols)	0.00012	0.000 2
α emitters		0.000 01		0.000 0019	0.000 0018

1 For 1,562 tons of fuel reprocessed
2 For 1,115 tons of fuel reprocessed
3 For 10,300 tons of fuel reprocessed
4 This limit is applicable from 12 January 2005, until which time the annual limit remains set at 0.074 TBq

Liquid discharges (TBq per year)	Limits in order of 1984	Limits in order of 2003	1999 discharges	2005 discharges	Forecast for 2006
Tritium	37,000	18,500	12,900	13,500	14,344
Iodines	/	2.6	1.83	1.42	1.607
Carbon 14	/	42[1]	9.93	8.27	9.50
Strontium 90	220	12[2]	2.16	0.5	0.4
Caesium 137		8[3]		0.71	0.85
Ruthenium 106	/	15	7	5.84	5.5
Cobalt 60	/	1.5[4]	0.32	0.23	0.4
Caesium 134	/	2	0.058	0.06	0.06
Others β and γ emitters	1,700	60[5]	29.6	6.6	10.5
α emitter	1.7	0.17[6]	0.040	0.022	0.026

1 This limit value takes account of total carbon 14 discharges in the liquid effluent, assuming elimination of all gaseous discharges.
2 The limit is 2 for normal discharges and 10 for discharges linked to shutdown and dismantling (MAD) and recovery of legacy waste (RCD).
3 The limit is 2 for normal discharges and 6 for MAD and RCD discharges.
4 The limit is 1 for normal discharges and 0.5 for MAD and RCD discharges.
5 The limit is 30 for normal discharges and 30 for MAD and RCD discharges.
6 The limit is 0.1 for normal discharges and 0.07 for MAD and RCD discharges.

The following table evaluates the impact of the annual discharges, in terms of effective dose, on the "reference groups", in other words the groups of persons among the population for whom exposure from a given source is relatively uniform and who are representative of the persons who receive the highest doses from this source.

Evaluation of annual impact of releases on the reference groups				
Limits in order of 1984	Limits in order of 2003	Actual 1999 discharges	Actual 2005 discharges	Forecast for 2006
0.120 mSv	0.020 mSv	0.011 mSv	0.010 mSv	0.010 mSv

Finally in 2005, an inspection was conducted from 10 to 14 October, to check the conformity of the environmental monitoring carried out around the La Hague site with article 35 of the EURATOM treaty. On this occasion, the quality and the stringency of the supervision by the licensee and the Authorities was highlighted by the European Commission..

3 END OF LIFE INSTALLATIONS

3 | 1

Plutonium technology facility (ATPu) and chemical purification laboratory (LPC) at Cadarache

Owing to the fact that the resistance of these facilities to the seismic risk specific to the Cadarache site cannot be demonstrated and their incompatibility with current seismic design rules, COGEMA halted industrial activities in the ATPu in mid-July 2003. The effectiveness of this shutdown was confirmed by the ASN's inspectors during the course of an unannounced inspection on 1 August 2003.

This shutdown commits the ATPu and the LPC to a common decommissioning and dismantling process to be covered by a decree. In 2006, for each of these two installations, the licensee will therefore be required to submit the dossier specified in article 6 ter of the above-mentioned decree of 11 December 1963 and the impact assessment required by the Environment Code.

Since industrial production ceased in the installation, the licensee has been making the necessary modifications to be able to start packaging the scrap from previous fabrication work as well as other discarded materials containing plutonium and present in other installations on the Cadarache site, for shipment to COGEMA La Hague. These operations should last until the end of 2006.

In July 2004, the ATPu was also authorised to produce rods for four test assemblies based on American military plutonium, as part of the EUROFAB project. The purpose of this project was to demonstrate the feasibility of eliminating surplus American military plutonium stocks in the form of MOX fuel. In March 2005, all the assemblies produced, and the waste arising from their fabrication, were returned to the United State. The relatively small operation, which has a limited safety impact, does not call into question the cessation of industrial production in the ATPu.

Radiation protection

The operations to package old materials containing plutonium, owing to the rise in their americium level, mean that the licensee is required to reinforce its radiation protection measures.

3 | 2

Former COGEMA La Hague installations

3 | 2 | 1

Retrieval of legacy waste

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. The operations involved in recovering this waste are technically difficult and require the use of considerable resources. The problems linked to the age of the waste, in particular its characterisation prior to any recovery and reprocessing, confirms the ASN's approach to the licensees which is to require that for all projects, they assess the corresponding production of waste and plan for processing and packaging as and when the waste is produced.

Further to review of the former waste recovery programme by the Advisory Committees for laboratories and plants and for waste at the end of 1998, the ASN asked COGEMA in 1999, to undertake 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 start-up 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. In November 2005, the Advisory Committees for waste and for plants reviewed the La Hague establishments waste management policy, and in particular the solutions envisaged by the licensee for recovery and packaging of the legacy waste stored on the site.

STE2 sludge

In recent years, processing of STE2 sludge has been the subject of research and development work, in particular with a view to determining the methods for retrieval and transfer required prior to any packaging.

• Sludge recovery from silos

The recovery and transfer trials carried out in recent years, between one of the silos of the STE 2 facility and the STE 3 facility, demonstrated the efficiency of the equipment developed by the licensee. Improvements were however made in order to optimise the excavation operations. At the end of 2005, a similar device was installed and started up on another silo, for joint recovery of sludge from both of them.

• Sludge packaging

The packaging system today adopted by COGEMA consists in bituminisation using a process employed in the STE3 facility. In 2002, COGEMA was authorised to carry out sampling in one of the silos with a view to conducting bituminisation tests on about twenty drums in the STE3 facility in order to validate the adequacy of this process. The result of the analysis conducted in 2003 by the ASN and its technical support organisation showed that major developments were still needed before industrial retrieval of the sludge could take place.

In 2004, the licensee therefore forwarded additional justifications to enable packaging to start as of 2005. It also agreed to produce 3000 drums in the first three years of operation, while continuing to investigate alternative solutions. Before authorising industrial recovery of sludge from the silos, the ASN asked the licensee to validate the scenarios given in the safety analysis file transmitted in 2004, by carrying out experimental trials. These trials are based on the production of about fifty instrumented drums. Experience feedback from these trials, consisting chiefly of temperature recordings, should shortly be transmitted to the ASN. If the scenarios of the 2004 dossier are validated by these experimental results, operational approval could be given for industrial scale recovery.

• Alternative processes

In August 2005, the licensee presented the ASN with its latest research into alternative processes. The areas studied were vitrification, ceramic encapsulation, cement encapsulation and the drying process (DRYPAC). The first two were ruled out owing to technical feasibility problems, while the last two require additional research into prior drying of the sludges.

La Hague – STE3: automatic transfer of bitumen containers

HAO silo

The nuclear installation safety is primarily based on the supervision carried out by the licensee itself. COGEMA is considering dealing with the hulls and end-pieces in this silo by compaction. 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.

The programme to characterise the fines and resins, which began in 2002, is still in progress. The report on washing and characterisation of hulls and end-pieces should be sent to the ASN soon.

Recovery requires prior dismantling of the equipment installed on the silo slab, construction of the recovery cell and qualification of the equipment to be used. Initial dismantling work should begin in 2006. In 2005, through inactive testing, the licensee also qualified the gripper and the “approach” rake.

Recovery work should be complete en 2018.

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.

Old fission product solutions stored in the SPF2 unit in the UP2 400 plant

To package fission products from reprocessing of gas-cooled reactor fuel, in particular that containing molybdenum, COGEMA opted for vitrification with a specific glass formulation. Initial hot pot vitrification tests showed significant corrosion of the melting pot (lifetime of about 30 to 40 packages). Research therefore turned towards cold pot production of this glass. The particular advantage of this technique is that higher temperatures can be reached, enabling new glass formulations to be used. Sensitivity studies concerning the reference formulation are still continuing today. ASN representatives also visited the CEA’s “cold pot” R&D installations at Marcoule. Commissioning of the first cold pot on the La Hague site is scheduled for 2010, with packaging operations scheduled to start in 2011.

Other waste

In September 2002, COGEMA sent the ASN a safety case about the characterisation and stowage of the waste drums present in the ATTILA pit. In August 2003, COGEMA was authorised to carry out these operations, which were completed in 2005. The results will shortly be sent to the ASN. On the basis of the characterisation results, the licensee draws up the dossiers for a new installation for sorting waste drums. Once sorted, the waste can be sent to the appropriate disposal channels.

3 | 2 | 2

Final shutdown of BNIs 33, 38 and 80

Most of the old facilitites on the site will need to be decommissioned prior to dismantling. After equipment rinsing, the units on the main process lines in the UP2 400 facilities are no longer in operation. The licensee has taken the necessary organisational steps for transition of these installations to the surveillance phase, pending the decommissioning procedures.

Within this framework, on 30 December 2003, the licensee notified its decision for 1 January 2004 cessation of processing of spent fuel in the UP2 400 facility. This notification was accompanied by a dossier presenting the operations planned for the final decommissioning phase (CDE) in the various facilities concerned in this plant.

The CDE phase enables the licensee to carry out certain operations to prepare the installation for the dismantling phase. These operations must be either covered by the operational reference system, or be authorised by the ASN. In the case of the HAO/Sud and MAPu facilities, the licensee submitted the safety analysis files for removal of certain equipment (in particular gloveboxes and shears) which is no longer needed. Some of these operations began in 2005 and will continue in 2006.

The ASN also urged COGEMA, on several occasions, to speed up submission of the decommissioning and dismantling (MAD/DEM) dossier for BNIs 33, 38, and 80. The licensee acted accordingly and set up the ORCADE project. The licensee's current approach will involve the production of the MAD/DEM file in several stages.

4 OUTLOOK

In 2005, the fuel cycle front-end installations experienced no significant safety problems.

The effluent discharge licences for the Tricastin site installations were published in the Official Gazette in September 2005, marking the end of a procedure initiated in 1997.

Finally, the periodic safety review of the Romans-sur-Isère nuclear site should be continuing with the safety review of the CERCA company facilitites (BNI 63), scheduled for 2006.

The ASN still has a positive opinion of the rigorous and responsible attitude of COGEMA's operation of the La Hague installations. It continues to attach considerable importance to supervision of safety and radiation protection of this establishment by devoting nearly 10% of all its inspections to it. This is in particular justified by the nature and quantity of radioactive materials stored on the site. Finally, among the priority subjects, the ASN is keeping and will continue to keep a close watch on the recovery of legacy waste and the decommissioning and dismantling of a certain number of old facilities in the UP2 400 plant.

Chapter 13

NUCLEAR FUEL CYCLE INSTALLATIONS

NUCLEAR RESEARCH FACILITIES AND VARIOUS NUCLEAR INSTALLATIONS

CHAPTER 14

1 ATOMIC ENERGY COMMISSION INSTALLATIONS

1|1 Generic subjects
1|1|1 Increased CEA responsibility as a nuclear licensee
1|1|2 Management of nuclear materials and monitoring of sub-criticality at the CEA
1|1|3 Management of radioactive sources at the CEA
1|1|4 Revision of water intake and discharge licences
1|1|5 Safety reviews of former installations
1|1|6 Assessment of seismic hazards
1|1|7 Experimental reactor cores and devices
1|1|8 Research reactor maintenance outages

1|2 Topical events in CEA research facilities
1|2|1 Cadarache Centre
1|2|2 Fontenay-aux-Roses Centre
1|2|3 Grenoble Centre
1|2|4 Saclay Centre
1|2|5 Rhone Valley Centre
1|2|6 Phénix reactor
1|2|7 Effluent and waste treatment installations

2 NON-CEA NUCLEAR RESEARCH INSTALLATIONS

2|1 Electromagnetic radiation laboratory (LURE)
2|2 Large National Heavy Ion Accelerator (GANIL)
2|3 Laue-Langevin Institute high flux reactor
2|4 European Organization for Nuclear Research (CERN) installations
2|5 The ITER (International Thermonuclear Experimental Reactor) project

3 IONISERS, MAINTENANCE FACILITIES AND OTHER NUCLEAR INSTALLATIONS

3|1 Industrial ionisation installations
3|2 Maintenance facilities
3|3 Chinon irradiated material facility (AMI)
3|4 Inter-regional fuel warehouses (MIR)
3|5 CENTRACO waste incineration and melting facility

4 OUTLOOK

"Nuclear research facilities and various basic nuclear installations (BNIs)" are all the BNIs covered by the civilian part of the French atomic energy commission, the BNIs of other research organisations, and a few other BNIs 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 BNIs (experimental reactors, laboratories). Research is focused notably on the lifetime of operating plants, future reactors, fuel performance and nuclear waste.

The constant changes made to these installations, due to their research functions, require particularly attentive supervision and frequent updating of the relevant safety files. The action of the Nuclear Safety Authority (ASN) may be considered at two levels:

- at national level, it implements an overall approach to "generic" subjects concerning several installations. The person contacted in this context is generally the Head of Nuclear Protection and Safety, assisting the General Administrator of the CEA;
- as required, it reviews the specific safety files of each CEA BNI. In this case, it will mainly contact the manager of the Centre and the head of the installation concerned. Paragraph 1|1 below lists the generic subjects dealt with in 2005. Section 2 describes topical events in the various CEA installations currently operating. The installations undergoing clean-up or dismantling are discussed in chapter 15.

1 | 1

Generic subjects

By means of series of inspections and analysis of lessons learned from the daily life of the installations, the ASN identifies topics on which it questions the CEA: assessment of seismic and fire hazards and the criticality risk, management of nuclear materials or radioactive waste (see Chapter 16), dismantling of facilities (see Chapter 15), radiological cleanness, definition of accident management reflex stages, electricity supplies, external hazards, discharges from installations, environmental protection, etc.

Generic subjects are regularly discussed by the ASN and the CEA's head office. They can lead to requests on the part of the ASN and possibly to a stance being adopted following review of a dossier. The subjects which particularly attracted ASN attention in 2005 were containment inside BNIs and how the criticality risk is dealt with. A draft guide was produced for the safety reviews conducted on the CEA's BNIs, specifying the investigation procedures and the calendar.

1 | 1 | 1

Increased CEA responsibility as a nuclear licensee

In 2003, the ASN informed the CEA that its new organisation was improving the clarity of the responsibilities and duties of the units, in particular with respect to continuity of action, independence of the supervision function and identification of installations assistance function. Furthermore, reorganisation of the head office departments brought safety and radiation protection closer together.

However, the ASN informed the CEA that it was waiting for self-assessment of the effectiveness of the organisational measures taken, in particular through indicators monitoring safety and the correct working of the organisation.

In this context, the ASN considered in 2002 that the Centre managers, with the assistance of the Centre's safety unit and the safety commissions as applicable, should be allowed to authorise certain minor operations which do not compromise the installation safety demonstrations, without requiring formal authorisation from the ASN.

About fifteen installations are currently concerned and the system could be extended to the other installations.

Finally, this approach demands that the CEA keep the safety reference systems of its installations up to date.

These updates should be an opportunity to think about defining broader operating domains than those currently described, in order to allow the necessary changes to these installations, which imply no overall increase in the hazards involved.

In 2005, after close monitoring of initial implementation of this new system in 2003 and 2004, the ASN submitted the first results highlighting the good practices and the areas for progress expected by the CEA. The ASN in this respect considers that the organisation set up by the CEA is such as to guarantee independent analysis of the dossiers submitted by the licensees. However, the ASN does consider the need for greater second level checks on compliance with the requests sent to the installation heads at notification of authorisation by the centre's director. In 2006, the ASN will be particularly vigilant on this point as well as on CEA training of the installation heads in the requirements of this new process.

1 | 1 | 2

Management of nuclear materials and monitoring of sub-criticality at the CEA

Following the Saclay incident on 15 September 2004, the many inadequacies observed during the "criticality" inspections carried out in 2005 and the shortcomings brought to light in the dossiers with a "criticality" aspect transmitted by the various centres, the ASN asked the CEA to conduct a stringent assessment, across the entire CEA, of the organisation put in place to supervise the criticality risk, the action taken as part of the first and second level inspections, the criticality risk training or information given to the licensees and experimentation staff, all the resources, particularly human resources, deployed to deal with the criticality risk and the material resources linked to the criticality detection and alarm network.

The ASN asked the CEA to exercise permanent vigilance to ensure that a high level of competence is maintained with regard to the criticality risk.

1 | 1 | 3

Management of radioactive sources at the CEA

Since 2002, the CEA no longer enjoys its historical special status with regard to source possession licences. Many discussions have been held to determine the conditions for transition to the common system, in particular with respect to the radioactive sources which today should be considered as waste (see chapters 10 and 16). During the course of 2003, the CEA submitted proposals to the ASN concerning its source management organisation in the various establishments, as well as the future of expired or unused sources, and the ASN accepted the general principles.

During the course of 2004 and 2005, the CEA gradually implemented its organisational arrangements in its various centres. The guidelines proposed by the CEA were accepted by the ASN and the source possession and use authorisation applications are currently being finalised. These arrangements were reviewed particularly closely by the ASN in 2005, in particular with regard to regularisation of sealed sources more than 10 years old and verification of application of the new regulatory provisions of the Public Health Code.

1|1|4

Revision of water intake and discharge licences

The CEA's effluent discharge and water intake licence revision process is continuing, under application of decree 95-540 of 4 May 1995 concerning gaseous and liquid effluent discharge and water intake by BNIs. One of the goals in this revision is to reduce the discharge limits to levels consistent with the actual releases from the installations.

Water intake and effluent discharges from the CEA's Grenoble site are regulated by the order of 25 May 2004.

Regulations concerning water intake and liquid and gaseous discharges from the Cadarache site should be signed in early 2006 concerning its BNIs, its installations under the supervision of the Defence nuclear safety and radiation protection delegate, and its ICPEs respectively.

The effluent discharge and water intake licensing order for the CEA Saclay site should be revised soon.

1|1|5

Safety reviews of former installations

Many current CEA installations began operating at the beginning of the 1960s. These installations, designed to meet former requirements, contain timeworn equipment. They have also undergone modifications on various occasions, sometimes without overall review from the safety standpoint. At the present time, compensatory provisions are necessary to ensure medium or even long term satisfactory safety conditions at these installations. In certain cases, replacement by new installations even proves necessary; the MAGENTA and CEDRA interim storage projects and the STELLA and AGATE effluent treatment station projects are the result of discussions along these lines (see chapter 16).

The ASN informed the licensees that it considers a safety review of old installations to be necessary about every ten years. The periodic safety reviews for the LEFCA (advanced fuel design and fabrication laboratory) and the experimental CABRI reactor on the Cadarache site were presented to the Advisory Committee (CABRI = advisory committee for reactors, see point 1|2|1) and were monitored in 2004 and 2005. The periodic safety reviews are also in progress at the CEA for the solid waste management zone, the effluent and waste treatment station at the CIS-Bio International facility on the Saclay site, and the MASURCA reactor on the Cadarache site.

The CEA plans to conduct periodic safety reviews on its other installations within the next six years, following a schedule approved by the ASN in 2005. The ASN in 2005 specified its responsibility, content and scheduling requirements for the periodic safety reviews on the CEA installations.

1 | 1 | 6

Assessment of seismic hazards

On the occasion of the LEFCA installation periodic safety review in 2004, the ASN submitted a number of requests concerning the seismic risk, particularly to take account of the particular effects on the Cadarache site. In 2005, the CEA presented a study programme designed to supplement knowledge of seismic hazards on the site. These studies will be the subject of annual reports under the aegis of a steering committee comprising experts in this field. The CEA's aim is to provide substantial data in 2008.

1 | 1 | 7

Experimental reactor cores and devices

One particularity of the many experimental reactors is the frequent modification of the reactor core configuration and the sometimes only very temporary introduction of experimental irradiation devices into the reactor core.

The ASN focuses particular attention on these operations, owing to the related risks, in particular concerning reactivity control (chain reaction) and the hazard constituted by the fuel elements.

Significant work was done in 2003 on experimental devices. A note stipulating the conditions for the design, production and licensing of these devices was issued by the ASN at the beginning of 2004. This note, which entered into force in July 2004, specifies that safety reviews are required on all experimental devices every 10 years.

With regard to management of the reactor core configuration, the ASN conducted a series of inspections in 2001 and work to improve supervision of the configuration modification operations was carried out by the ASN in 2004.

1 | 1 | 8

Research reactor maintenance outages

In 2004, the ASN undertook an initiative to improve monitoring of installations undergoing a prolonged outage for maintenance or renovation work. This initiative led to the preparation of a draft guide submitted to the licensees and should reach a conclusion in 2006.

1 | 2

Topical events in CEA research facilities

This section deals only with research facilities currently operating. The installations in the clean-up and dismantling stages are dealt with in chapter 15.

1 | 2 | 1

Cadarache Centre

The Cadarache Centre is located at Saint-Paul-lez-Durance, in the Bouches-du-Rhône *département*[1]. It covers an area of 1,600 hectares. The main purpose of the units installed there is the industrial appli-

1. Administrative division of the size of a county.

cation 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 BNI.

• Jules Horowitz reactor

The construction of a new reactor is deemed necessary by the CEA in view of the ageing 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 prime objective of the reactor is the irradiation of materials and fuel, in support of the French nuclear energy programme. Provisions were 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. The ASN informed the CEA in August 2003 that it had no objection to continuation of the RJH project, based on the safety options presented and provided that additional requests were taken into account. The CEA is currently continuing with the detailed design of this reactor, for which commissioning is scheduled in 2014. The preliminary safety analysis report for the installation should be transmitted in support of the authorisation decree application, in mid-2006.

• CABRI reactor

The Cabri pool-type reactor is mainly used for experimental programmes aimed at better understanding nuclear fuel behaviour in the event of reactivity accidents.

The IRSN has defined a new research programme, the "CABRI water loop" programme, designed to determine the behaviour of high burnup fraction fuel in an accident situation representative of the conditions encountered in a pressurised water reactor.

For this new programme, in which the sodium loop of the CABRI reactor is to be replaced by a water loop, the CEA filed an installation modification application with the Nuclear Safety Authority at the end of 2002. In parallel with this application, the CEA conducted a safety review of its entire installation in order to define the work needed to bring it into conformity with current requirements, with a view to continuing reactor operations for about a further twenty years. During the inspections conducted for the installation safety review, the CEA in January 2004 brought to light local deterioration of a fuel rod, but which was still leaktight. This event was subject to extensive investigation in order to determine the causes of this damage.

After obtaining the opinion of the Advisory Committee for nuclear reactors, the ASN informed the CEA in July 2004 that it had no objection to continuation of the CABRI water loop programme. Initial work on dismantling the former sodium loop began in mid-2003 and continued in 2004 and 2005. The new water loop is currently being manufactured.

• 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. Four experiments were carried out between 1993 and 2004.

Phébus reactor overview

In August 2005, the CEA announced its intention to continue operating the installation at reduced levels, pending the results of the investigations by the International Expert Group set up to look at future programmes in the installation and their funding. These results are expected by the end of 2006. This type of operation will require a separate authorisation.

• MASURCA reactor

The Masurca reactor was built for FBR core neutronic studies. It now takes part in minor actinide transmutation research, having been coupled with a particle accelerator, GÉNÉPI.

As early as February 2000, the ASN informed the CEA that it was necessary to conduct a safety review of the reactor, the previous such review dating back to 1988 and several reactor items now being obsolescent. As the CEA had accumulated a considerable delay in the installation's periodic safety review, the ASN informed it that it was no longer in favour of any further experimental programme authorisations. Consequently, priority in 2005 was given to continuing the periodic safety review of the installation and carrying out a certain amount of renovation work. The Advisory Committee for reactors should therefore in March 2006 be reviewing the steps taken to enable MASURCA to operate on a long-term basis.

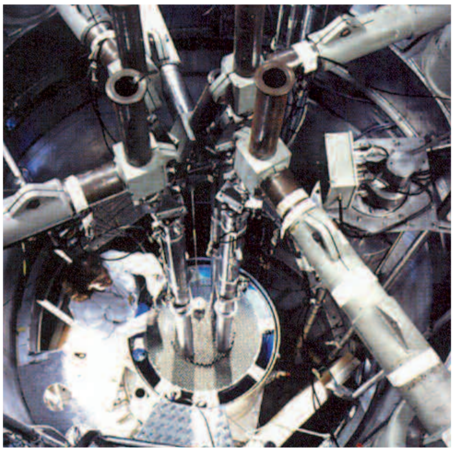
• ÉOLE et MINERVE reactors

The Eole reactor is a host structure for LWR experimental cores. It consists of a reactor block with biological shielding compatible with high neutron flux operation, in which is installed a cylindrical vessel designed to contain different types of core and associated structures.

In 2002, the CEA made technical improvements to Eole's SIREX neutron control cabinets by replacing the conditioning frames to improve their resistance to electromagnetic interference. The CEA plans to initiate the safety review of this facility by the end of 2005.

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.



View of the ÉOLE reactor vessel, empty of water

• CHICADE

CHICADE (chemistry, waste characterization) is a facility for research and development on medium- and low-level waste.

• Enriched uranium warehouse (MCMF)

In 2005, the licensee continued with removal from storage of the fissile materials held in the installation, a process that should be completed in 2009. The ASN in particular observed that the licensee met a significant commitment in achieving an 88% reduction in the total mass of plutonium-bearing material initially stored there.

• Active fuel review laboratory (LECA)

LECA is a laboratory for the destructive and non-destructive review of fuel from FBR, GCR and PWR reactors (notably MOX fuel) and from Cadarache experimental facilities. This installation was commissioned in 1964. In early 2005, the licensee asked for more time to finalise the installation renovation work. In August 2005, the licensee also indicated technical difficulties which would mean postponing transfer of the activities from the units of the "lead" line to the renovated LECA cells, and thus a delay in the beginning of construction of this line.

Given the progress of the renovation work initiated, the ASN authorised continued operation of the installation beyond 21 August 2005, which was the initial date scheduled for the end of the renovation programme. The ASN also required the licensee to transfer the activities from the units of the "lead" line before 1 March 2006.

• Treatment, cleanup and reconditioning station (STAR)

STAR comprises 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 designed for performing basic engineering studies on plutonium, uranium, actinides and their compounds in all forms (alloys, ceramics or composites) with a view to application to nuclear reactors, the performance of ex-pile studies necessary for the interpretation and understanding of fuel behaviour in the reactor and at the various stages in the cycle, and the manufacture of irradiation test capsules or experimental assemblies.

In July 2005, the licensee sent replies to the ASN's requests of February 2004, following the installation's periodic safety review. Technical review of these documents, in particular those concerning building reinforcement work, is still in progress. The CEA is continuing to investigate the possibility of bonding strips of carbon fibre material to the elements to be strengthened. Given the currently available data, the ASN does not consider that it is in possession of sufficient information to be able to rule in favour of this process and asked the CEA to opt for other proven, validated processes.

At the end of 2005, the ministers notified the new technical specifications applicable to the installation. The LEFCA was thus added to the list of CEA installations benefiting from the regime of internal authorisations.

1 | 2 | 2

Fontenay-aux-Roses Centre

This centre is currently undergoing dismantling and clean-up (see chapter 15).

1 | 2 | 3

Grenoble Centre

The CEA has decided to stop all research activities in the BNIs on this site. This site is dealt with in chapter 15.

1 | 2 | 4

Saclay Centre

The Saclay Centre is located about 20 km from Paris in the Essonne département. It occupies an area of 200 hectares, including the Orme des Merisiers annex.

The Centre's activities range from fundamental research to applied research in a wide variety of fields and disciplines, such as physics, metallurgy, electronics, biology, climatology, simulation, chemistry and ecology.

The purpose of nuclear applied research is to optimise the operation and safety of the French nuclear power plants and to develop future reactors.

This research work is supplemented by research into radioactive waste management.

The Centre also houses a unit of the INSTN (national teaching institute for nuclear science and techniques) and two industrial companies: Technicatome, which designs nuclear reactors for ship propulsion, and Cis Bio International, which develops and markets diagnostic and radiotherapy products. En 2005, the CEA reorganised its Saclay site: responsibility as nuclear licensee now lies with a director delegate for nuclear safety activities at Saclay. However, nuclear safety and security, particularly in the event of an emergency, remain the responsibility of the Director of the centre.

• CIS Bio International Installation

CIS Bio International is a key player on the French market for radiopharmaceutical products used for both diagnosis and therapy. Since December 2001, CIS Bio International has been wholly-owned by Schering S.A..

In 2004, as a result of the many incidents which had occurred in the previous two years, the ASN kept a particularly close watch on the installation and asked Schering S.A. to draft a plan of action to rectify the situation.

In 2005, the ASN maintained specific vigilance concerning improvements to safety culture and radiation protection, while ensuring compliance with good drug manufacturing practices and pharmaceutical legislation. In mid-2005, the licensee also forwarded a dossier describing the safety options for the installation renovation project. The ASN submitted comments on this dossier, which CIS Bio International will have to consider in the safety analysis report on the renovated installation, to be transmitted during the first half of 2006.

The ASN considers that although the licensee has already made a considerable effort, the future efforts required will be just as demanding. The installation periodic safety review is only just starting and the incident which occurred in laboratory 1423 in July 2005 shows that CIS Bio International still has some way to go in terms of operational stringency and safety culture. In 2005, the ASN also continued with its investigation of the administrative procedure to transfer nuclear licensee responsibility from the CEA to CIS Bio International.

At the end of 2005, Schering S.A. announced its intention to relinquish ownership of Cis Bio International. The ASN will in 2006 be particularly vigilant regarding continuation of the efforts initiated to improve the safety of the installation, with regard to operation and safety culture, as well as to the pursuit of the current renovation process by the future owners.

• Spent fuel test laboratory (LECI)

The spent fuel test laboratory is an installation designed to analyse the various components of fuels used in nuclear reactors (components of the radioactive material, components of the fuel assembly cladding, etc.), in order to determine their behaviour when irradiated.

The Advisory Committee for laboratories and plants met on 28 April 2004 to review the safety of LECI extension, based on the safety files forwarded by the CEA. Review of these files revealed shortcomings in control of the civil engineering design of the installation, although it does however comply with the requirements of its authorisation decree. Given the small quantity of dispersible radioactive materials that is to be present in the installation, the ASN authorised commissioning of the extension provided that a certain number of requests were taken into account. In 2005, the ASN authorised partial startup of the LECI extension (limited to certain types of samples). In addition, the new technical requirements for the installation will be notified after review of a set of files concerning the safety of the LECI main building.

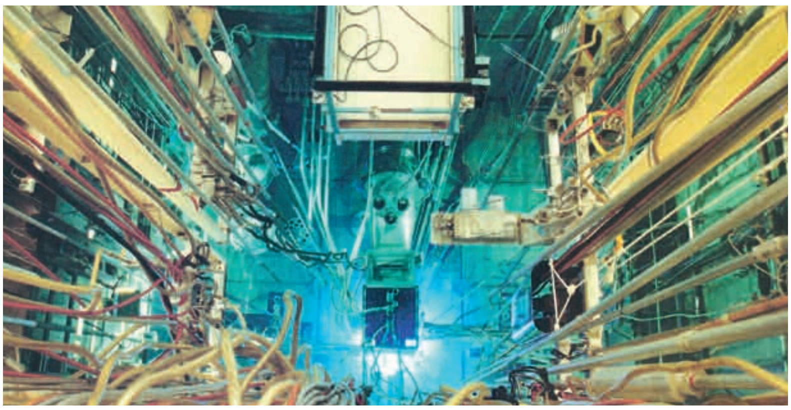
• Osiris and Isis reactors

The 70 MWth pool-type reactor Osiris is mainly used for technological irradiation tests on structural materials and fuels for various types of power reactor (notably PWRs), for the production of radioelements and doped silicon and for the irradiation of specimens for activation analysis. Since the end of 1996, the reactor core has consisted entirely of a new U3Si2Al type fuel.

The Isis reactor is a mock-up of the Osiris core. Its power is limited to 700 kWh and it is designed for neutronic measurements and dose metering. Modification of the reactor I&C system began in 2004 so that it could also be used for training purposes as of autumn 2005.

In 2004 and 2005, the CEA continued with OSIRIS reactor renovation work.

In 2005, the ASN assessed the progress of the steps the CEA was asked to take following the 1999 safety review. The ASN also asked the CEA about the future of the installation, because despite the scale of the renovation work undertaken in recent years and without calling into question the quali-



View of the OSIRIS reactor pool

ty of operation, the ASN nonetheless considers that given the age of the design, operation of the installation cannot be considered beyond the end of the decade.

• ORPHÉE reactor

The 14 MWth Orphée reactor is a pool-type research reactor, equipped with nine horizontal fuel channels, tangential to the core, enabling the use of 20 neutron beams. These beams are used by the Léon Brillouin Laboratory (CEA and CNRS) to perform experiments in widely different fields, such as physics, biology or physico-chemistry.

This reactor is jointly funded by the CEA and the CNRS. Owing to new CNRS budget restrictions in 2003, the facility submitted files to the ASN describing restricted operations up until the end of 2005.

The authorisations allowing this new operating mode were issued at the end of 2003.

In December 2004, the CEA announced that the reactor would return to normal operation in 2006. With the aim of long-term operation by the reactor, the ASN asked for studies to be started in preparation of the forthcoming installation periodic safety review.

Overview of the ORPHÉE reactor installations

• 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 to cease reactor operations at the end of 2006. 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-classified installations represent only a fraction of the installations on these sites.

• ATALANTE

The Atalante installation (Alpha facility and laboratory for analysis of transuranians and reprocessing studies) chiefly comprises CEA research and development resources concerning high level radioactive waste and reprocessing. These activities were previously distributed over three sites: Fontenay-aux-Roses, Grenoble and the Rhone Valley.

In the light of the numerous modifications made to the installation since it was created, the ASN asked the licensee to carry out a safety review.

The inspections conducted in 2005 and the various dossiers transmitted by the licensee highlighted inadequacies in the organisational and human resources deployed by the CEA to ensure that work to strengthen the buildings' seismic resistance was progressing satisfactorily. In particular owing to an incident on the process shielded line, 2005 also confirmed the operational problem already observed in previous years at the interfaces between the department in charge of operating the installation and those in charge of running R&D programmes.

At the request of the ASN, the CEA initiated a plan of action and enhanced the installation safety manning levels. In 2006, the ASN will therefore be particularly vigilant as to the installation's operating conditions and supervision of this manning level enhancement project.

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 département). 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 are subject to articles L. 542-1 to L. 542-14 of the Environment Code concerning radioactive waste research.

In 2002, following major reactor renovation work, the ASN informed the CEA that it considered the answers provided on subjects concerning the installation periodic safety review to be satisfactory and that it had no objection to reactor operations resuming at partial power of 350 MWth, for the 6 burnup cycles still to be carried out.

In September 2004, during checks required by pressure vessel regulations, the licensee brought to light malfunctions affecting two of the 12 modules of steam generator no. 3. In the light of the safety

PHÉNIX reactor platform

analyses presented and the reinforced inspection programme proposed by the licensee, the ASN considered that the modules concerned could be kept in service until the next maintenance outage scheduled for April-May 2005. Following a request and additional safety analyses by the CEA, the ASN in March 2005 authorised the CEA to keep the modules provided that supervision was enhanced.

In May 2005, the CEA also submitted its programme for final shutdown and dismantling of the reactor. Decommissioning should begin in 2009 after the six authorised burnup cycles. This programme will include the use of installations for reprocessing Phénix sodium and will in particular rely on experience feedback from Superphénix dismantling.

1 | 2 | 7

Effluent and waste treatment installations

The CEA's effluent and waste treatment installations are spread over the Fontenay-aux-Roses, Grenoble, Cadarache and Saclay sites. They are generally equipped with characterisation facilities to enable checks on the declarations made by the waste producers and verification of the conformity of the waste packaged with respect to the specifications for acceptance prior to routing to the appropriate channel. The processing and packaging installations primarily handle the liquid and solid waste generated by the CEA centre on which they are located. They occasionally process waste from outside nuclear sites (CEA or others) depending on their specific nature.

The installations devoted specifically to interim storage of waste and spent fuels are dealt with in chapter 16.

• CEA Fontenay-aux-Roses site

The main function of the radioactive effluent and solid waste treatment station (STED – BNI 34 and 73) is interim storage of solid and liquid waste prior to removal to the appropriate channels. As part of the site clean-up process (see chapter D 15), and in addition to removal of the waste from storage, the STED will act as the support installation for management of the waste generated by dismantling and BNIs 34 and 73 will therefore be incorporated into a new BNI known as the support BNI, for which the authorisation decree should be granted in 2006.

• Grenoble site

The effluent and waste treatment station (STED - BNIs 36 and 79) is continuing with removal of waste from storage and recovery of former waste, for complete dismantling by 2010. This installation will from now on also be the support installation constituting the interim storage facility for the waste generated by dismantling of the Grenoble site installations (see chapter 15) prior to removal to the appropriate disposal channels. The installation also stores containers of Na and NaK, pending reprocessing.

• Cadarache site

The function of the effluent and waste treatment station (STED-Cadarache) is to treat and package liquid and solid radioactive waste. Following the STED-Cadarache periodic safety review in 1998, continued operation was authorised for a limited period, initially compatible with the time needed to create replacement installations, particularly AGATE for management of liquid effluent and CEDRA and the ROTONDE ICPE for solid waste management. The delay in progress of the new installation construction work meant that the CEA had to look at interim solutions for managing the solid and liquid waste on the Cadarache site.

With regard to solid waste processing, the 250-ton waste compacting press was shut down in 2004 and the waste, which had previously been treated using this technology, is now taken directly to ANDRA's Aube repository, where the packages are compacted. The CEA's deliberations concerning its overall solid waste management strategy will include a decision on whether or not to continue to use the 500-ton press. If yes, work would probably be needed to increase its earthquake resistance. The ROTONDE ICPE, scheduled for mid-2007, will primarily constitute the interface between the waste producers and the treatment, storage and disposal installations.

With regard to liquid effluent management, treatment of intermediate level "special" alpha effluent was stopped on 1 July 2005. The CEA envisages transferring this effluent to the liquid effluent treatment station on the Marcoule site (STEL). However, under the terms of the agreement between the Delegate for Nuclear Safety and Radiation Protection for National Defence Installations and Activities (DSND) and the ASN, concerning transfers of radioactive materials and waste between BNIs and classified BNIs, these transfers may only take place after authorisation by the DSND which is the competent authority for the Marcoule STEL. This authorisation will in particular depend on whether the CEA can demonstrate compatibility between the scope of operation of the STEL and the nature of this effluent.

The CEA also asked the ASN to postpone the shutdown of bg liquid effluent treatment until the AGATE facility is commissioned. The ASN will make a decision on this request in 2006, after reviewing the STED's updated safety reference system. The ASN decision will also take account of the CEA's actions in 2004 and 2005 to make a significant reduction in the source term present in the installation's storage tanks.

With regard to the AGATE project, the CEA presented a new strategy in 2005, which casts doubt on the initial project. Given the redefined needs of the Cadarache centre in terms of future production of liquid effluent, which would have led to initial over-sizing of the project, the CEA decided to restrict the configuration of the AGATE project. According to the CEA's current strategy, AGATE would, for a period of several years, pre-concentrate the bg effluent produced in the Cadarache centre, with the pre-concentrates then being transferred to the Marcoule STEL, which would handle final treatment before packaging. This strategy presupposes that the Marcoule STEL, for which the periodic safety review is scheduled for about 2007, would pose no safety problems in the coming years. The CEA then envisages renovating the STEL or creating a new installation at Marcoule to receive the pre-concentrates from Cadarache and the liquid effluent from Marcoule and for which a cement encapsulation process would replace the current bituminisation process.

According to the ASN, technical and regulatory review of the AGATE project should only be started if the CEA can provide certain guarantees that there is a long-term disposal channel for the pre-concentrates to be produced by AGATE. The decision will be taken jointly with the DSND's services.

Finally, evacuation and final treatment of the radioactive organic liquids from the ZELORA building in BNI 37, remains an ASN priority.

• Saclay site

The solid waste management zone (BNI 72) handles treatment and interim storage of solid radioactive residues produced in the Centre by the reactors, laboratories and workshops.

This installation provides the interface between the waste producers on the Saclay site and the treatment, interim storage and disposal installations for this waste. BNI 72 also recovers waste from the small producers (scintillation liquid sources, ion exchanger resins) and provides interim storage of radioactive sources. In 2005, the CEA continued the programme for recovery of spent fuel elements stored in fuel assembly block (PRECIS). This programme consists in characterising old containers, stored in the fuel assembly block, so that they can be taken to the STAR installation for reconditioning before interim storage in CASCAD, pending a final solution (reprocessing or disposal).

The CEA's current strategy is to reduce the source term present in the installation and primarily maintain the functions to provide the interface between the producers of solid waste and the appropriate disposal channels. A periodic safety review will shortly be carried out on BNI 72.

The radioactive liquid effluent management zone (STE - BNI 35) collects, stores and treats the low-level aqueous effluent and stores aqueous and organic effluent. The radioactive aqueous effluent is evaporated and stored in RESERVOIR tanks pending treatment. Decree 2004-25 of 8 January 2004, authorised the CEA to modify the STE-Saclay by adding the STELLA extension to it.

In 2006, The Advisory Committee for Plants will rule on the safety of the "former plant" part of BNI 35 and on commissioning of the new STELLA extension facility.

In parallel with commissioning of STELLA, the CEA must set itself priorities including, first of all, recovery of former effluent stored pending treatment, and secondly, clean-up of the older buildings in the installation.

STELLA extension building – BNI 35

2 NON-CEA NUCLEAR RESEARCH INSTALLATIONS

2 | 1

Electromagnetic radiation laboratory (LURE)

The Electromagnetic radiation laboratory (LURE), in Orsay (Essonne), is an installation producing synchroton radiation (high-power X-rays) for a wide variety of research applications.

In June 2002, the licensee announced its intention to cease operation of the facility at the end of 2003, apart from the autonomous use of the CLIO laser. The decommissioning phase began in early 2004. The facility's first ring (ACO ring), built in the 1960s, is now included on the "supplementary" list of industrial historical monuments.

2 | 2

Large National Heavy Ion Accelerator (GANIL)

The GANIL, located in Caen (Calvados *département*) is designed to accelerate all heavy ions (from carbon to uranium) with a maximum energy of 100 MeV per nucleon.

The CIRIL6 radiobiology laboratory was started up in autumn 2003. In May 2004, the GANIL submitted the safety options file for the SPIRAL 2 project (creation of new experimentation rooms with a more powerful beam). The ASN approved the safety options proposed by the GANIL, provided that account was taken of the comments made concerning the dossier in July 2005. At the same time, the ASN asked the GANIL to proceed with the periodic safety review of the installation.

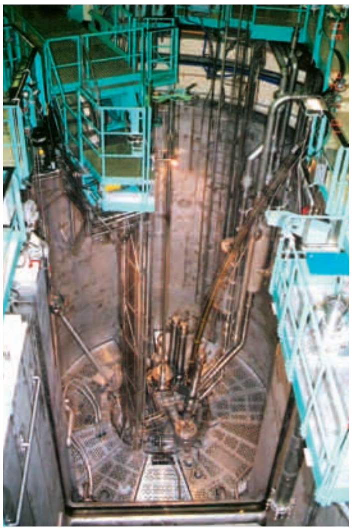
2 | 3

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.

In 2002, the ASN asked for seismic reinforcement work on the installation. This work is still in progress and should continue until 2007.

The installation's liquid and gaseous effluent discharge authorisations are also being revised.



View of the RHF vessel, empty of water

2 | 4

European Organization for Nuclear Research (CERN) installations

The European Organization for Nuclear Research (CERN) is an intergovernmental organization established on the basis of a treaty between States for the purpose of carrying out purely scientific and fundamental research concerning high energy particles.

The CERN site is located near Geneva, on the Franco-Swiss border.

The safety of these installations is regulated by a convention binding the French Government and the CERN. The convention currently in force, which dates from July 2000, states that French legislation applicable to BNIs applies to the LHC and to the SPS, two rings which make up part of the CERN's installations. It also designates the DSIN (now the DGSNR) as the French Government representative to deal with technical matters concerning the convention. The ASN also has a seat on the CERN's radiation protection committee, in charge of all radiation protection problems on the site.

The CERN is currently working on setting up a hadron collider (Large Hadron Collider, LHC) which should enable progress to be made in particle physics research, notably by implementing proton-proton collisions at a beam energy of 7 TeV. The LHC is installed in the tunnel of the Large Electron-Positon (LEP) which has been dismantled. The work on the LHC site is continuing and LHC commissioning is scheduled for 2007.

2 | 5

The ITER *(International Thermonuclear Experimental Reactor)* project

The ITER project is an experimental installation the purpose of which is scientific and technical demonstration of controlled thermonuclear energy with a deuterium-tritium plasma magnetic confinement, during long-duration experiments with a significant power level (500 MW for 400 s). This project is an international one and enjoys financial support from China, South Korea, Japan, Russia, the European Union and the United States. After lengthy negotiations, Cadarache was finally chosen at the end of June 2005 to host the facility.

The ITER Legal Entity (ILE), which is to be the licensee, is currently being set up. On this subject, the ASN pointed out that although it had no particular concerns regarding nuclear safety, it would nonetheless keep a close watch on the ILE's ability to assume fully its responsibilities as nuclear licensee, without enjoying excessive protection through its diplomatic immunity status.

In February 2002, the CEA, which should play a major role in the French side of the ILE, began technical dialogue with the ASN by presenting the safety options file for the future BNI. The ASN considered that the safety options for the installation were acceptable. However additional requests were made, primarily concerning management of the beryllium risk (chemical toxicity), the radioactive waste and the tritium inventory. This technical dialogue continued in 2004 and 2005. The CEA's aim is to draft the preliminary safety analysis report for this installation in 2006.

The regulatory procedure authorising such an installation should begin in 2007.

3 IONISERS, MAINTENANCE FACILITIES AND OTHER NUCLEAR INSTALLATIONS

3 | 1

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 a licensee has to intervene. There is thus no risk of irradiation inside the bunker.

Such facilities have been installed at Pouzauges, Marseille, Sablé-sur-Sarthe and Dagneux.

3 | 2

Maintenance facilities

Three BNIs specifically handle nuclear maintenance activities in France. They are:
- the SOMANU (nuclear maintenance company) facility in Maubeuge (Nord *département*), 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 *département*) which handles maintenance, interim storage and cleanup of equipment from the nuclear industry and storage of waste on behalf of ANDRA;
– the Tricastin operational hot unit (BCOT), also in Bollène, which carries out maintenance and interim storage of contaminated PWR equipment, except for fuel elements.

In 2004, the SOMANU was authorised to extend the active parts interim storage building in its Maubeuge facility. In an order dated 16 February 2005, it was authorised to call in an outside laboratory for the measurements specified in its radioactive effluent discharge licence.

The surface treatment facility, 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.

The discharges and water intake by the SOCATRI company were regulated by an order of 16 August 2005. The file presented by the operators was the subject of a public inquiry, which started on 15 February and ended on 23 March 2001. The procedure and in particular the public inquiry showed no reason to oppose the various applications.

3 | 3

Chinon irradiated material facility (AMI)

This installation, located on the Chinon nuclear site (Indre-et-Loire *département*), is operated by EDF. It is mainly used for review and appraisal of PWR fuel elements and activated or contaminated materials.

During the course of 2004, EDF specified the options of the installation's safety reference system with regard to its operation following renovation. EDF in particular made a commitment to significantly reducing the inventory of radioactive materials present in the installation, to cease all reactor fuel element appraisal work and to confine the remaining inventory in a new building meeting current safety standards. The work on this renovation project, including construction of the new building and renovation of the old one, should begin in 2006 and be completed towards the end of 2007.

While approving the planned work to improve short-term safety, the ASN considers that the renovation project presented by EDF only allows continued operation to be considered for a short period and asked EDF for its position concerning the long-term future of the installation before starting the work.

Removal of the unused fuel being stored also continued at a satisfactory rate in 2005, leading to a significant reduction in the radiological inventory. This process should be completed during the first quarter of 2006. The former waste for which there is no disposal solution, is for its part repackaged and safely stored in the installation.

3 | 4

Inter-regional fuel warehouses (MIR)

EDF has two inter-regional fuel warehouses, on the Bugey site in the Ain département and at Chinon in Indre-et-Loire. EDF uses them to store nuclear fuel assemblies (only those made of uranium oxide) pending loading into the reactor. Accessibility considerations and a just-in-time fuel management policy have led EDF to indicate that it intends to close down the Chinon warehouse in the near future.

3 | 5

CENTRACO waste incineration and melting facility

The CENTRACO low-level waste processing and packaging centre (BNI 160), located in Codolet near the Marcoule site (Gard), is operated by the SOCODEI company.

SOCODEI has begun to look at ways of expanding its scope of operations, given the need to reposition itself in the low-level waste management sector, particularly since ANDRA's VLL waste repository opened. This strategy requires modification of the creation authorisation (DAC), revision of the SOCODEI water intake and effluent discharge licence (ARPE) and ASN approval of the new CENTRACO safety reference system. So that the necessary additional studies can be carried out to enable it to expand the scope of operations of its installation, SOCODEI initially asked for a five-year postponement in startup of the installation. This extra time will be used for technical and regulatory review of the simultaneous modification of the DAC and the ARPE. Given the nature of the modifications envisaged by SOCODEI, the dossiers will be subject to a public inquiry.

4 OUTLOOK

The operators of nuclear research installations find themselves in a particular 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, and at the request of the ASN, the CEA has in recent years set up a system of internal authorisations which enables it to assume more fully its responsibility as nuclear operator for minor operations which do not compromise the installations' safety demonstrations. This system of internal authorisations was approved by the ASN in 2002 and gradually extended. The aim is eventually for it to cover most CEA installations. More generally, and along the same lines, the ASN in 2005 looked at issues linked to organisational and human factors in nuclear research installations, and defined future procedures for this field, particularly by ensuring that the licensees learn the lessons from installation operating experience.

The ASN has a mixed opinion of how the CEA operates its installations. It considers that the CEA needs to take better account of nuclear safety and radiation protection priorities upstream of its investment budget decisions, and develop its internal capacity for assessing the safety of its installations. The ASN also believes that the CEA needs to progress further in reviewing the safety of its installations, with respect both to review preparation - by providing the ASN with a more reliable forecast of the future of the installations - and to compliance with the ten-yearly frequency of these reviews. Finally, the CEA must exercise greater stringency in meetings its commitments to the ASN, particularly with regard to improving the safety of the older installations.

The ASN also continued its work to provide a regulatory framework, especially in the form of guides. It finalised the periodic safety review guide for the CEA's BNIs, prepared a draft guide for monitoring research reactor core maintenance outages, which should be finalised in 2006, and prepared a draft guide for research reactor core management.

Finally, 2005 was marked by decisions to create new public research installations, primarily ITER. The ASN, with its technical support organisation the IRSN, will be in charge of reviewing the nuclear safety and radiation protection aspects of the authorisation procedures for these installations.

SAFE FINAL SHUTDOWN AND DECOMMISSIONING OF BASIC NUCLEAR INSTALLATIONS

1 TECHNICAL AND ADMINISTRATIVE PROVISIONS

2 FINANCING OF DECOMMISSIONING AND RADIOACTIVE WASTE MANAGEMENT

3 THE SITUATION OF NUCLEAR INSTALLATIONS BEING DECOMMISSIONED IN 2005

3|1 EDF nuclear power plants

3|1|1 Increasing EDF accountability as nuclear licensee for installations being decommissioned

3|1|2 Monts d'Arrée plant

3|1|3 Gas cooled reactors (GCR)

3|1|4 Chooz AD reactor (Ardennes nuclear power plant)

3|1|5 Superphénix reactor

3|2 CEA installations

3|2|1 Fontenay-aux-Roses site

3|2|2 Grenoble site

3|2|3 The Cadarache site installations being decommissioned

3|2|4 The Saclay site installations being decommissioned

3|2|5 The La Hague installations being decommissioned

3|3 Other installations

3|3|1 The Société Normande de Conserve et Stérilisation (SNCS) irradiator

3|3|2 The Strasbourg University reactor

3|3|3 SICN plant in Veurey-Voroize

3|3|4 The Miramas interim storage facility

4 OUTLOOK

5 LIST OF BASIC NUCLEAR INSTALLATIONS DELICENSED AS AT 31.12.2005

6 LIST OF BASIC NUCLEAR INSTALLATIONS FINALLY SHUTDOWN AS AT 31.12.2005

CHAPTER 15

SAFE FINAL SHUTDOWN AND DECOMMISSIONING OF BASIC NUCLEAR INSTALLATIONS

Upon completion of their operating period, basic nuclear installations (BNIs) undergo a series of clean-up and transformation operations allowing final shutdown prior to 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 delicensing of the BNI concerned into an installation classified on environmental protection grounds (ICPE) which has to be licensed or registered, or simply in a return to the public sector (for uses which may or may not be restricted), subject to possible adjusted encumbrances.

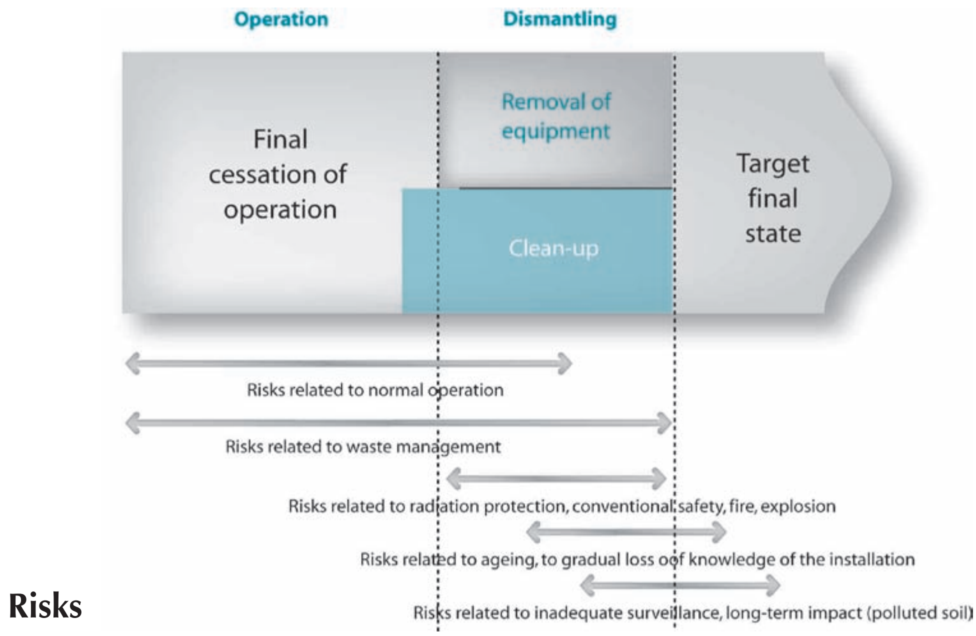
The first steps lead to removal of the fuel or nuclear materials present in the facility, which already helps reduce the risk from the nuclear safety viewpoint. This is then replaced by human radiation protection and conventional safety-related risks owing to work being done close to residual nuclear material and the numerous handling operations for removal of the waste generated by decommissioning.

The Nuclear Safety Authority (ASN) now strives to integrate relevant experience feedback from past decommissioning projects in France and abroad. The ASN encourages complete decommissioning either immediately or after slight postponement, provided that upstream of the regulatory processes, the licensee is able to present and justify the chosen decommissioning scenario, from the final cessation of production up to the final decommissioning of the installation. Regulatory practices concerning BNI decommissioning operations were updated along these lines in early 2003.

The ASN considers the current decommissioning operations as test cases, providing an opportunity for the licensees, on the one hand, to define and implement a decommissioning strategy (decommissioning level to be reached, detailed operating schedule), and, on the other hand, a management policy for the large amounts of radioactive waste that will be generated (notably the very low level waste). If carried through to their conclusion, they would also constitute examples demonstrating the technical and financial feasibilities of an entire decommissioning operation.

1 TECHNICAL AND ADMINISTRATIVE PROVISIONS

The technical provisions applicable to installations to be decommissioned must obviously be in compliance with general safety and radiation protection rules, notably regarding worker external and internal exposure to ionising radiation, criticality, the production of radioactive waste, release to the environment of radioactive effluents or measures designed to limit accident hazards and mitigate their consequences.



Safety issues, in other words protection of persons and the environment, can be significant, during clean-up or decommissioning operations, as well as during passive surveillance phases. The rapidly changing nature of the installation is a non-negligible risk factor in that it is harder than for an operating installation to guarantee that all potential risks have been consistently and exhaustively taken into account.

The above figure attempts to summarise the main risks encountered when decommissioning an installation and the periods during which these risks are highest.

The risks linked to waste management (radioactive waste disposed of inappropriately in a conventional channel, etc.) are present throughout all phases producing large quantities or a wide variety of waste.

As decommissioning 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 (decommissioning requires that the workers go into areas they were not used to visiting during operation) or risks linked to the technologies used for decommissioning 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 decommissioned 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, decommissioning 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 licensees leave the installation, and it is vital to be able to collect and record the recollections of the persons involved in these phases, all the more so as the traceability of the design and operation of old installations is frequently less than rigorous.

With each subsequent phase in decommissioning, 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 surveillance systems with other (radiological, fire) more appropriate means, either temporarily or more permanently. As it is hard to constantly check that surveillance is appropriate to the constantly changing state of the installation, there is a risk of failure to detect an incipient hazardous situation.

Once the final installation state is reached, there is still the risk of pollution being inadequately or not at all identified or poorly characterised, having a significant long-term impact on the site or its environment.

The decommissioning scenario (immediate or deferred) is selected by the licensee on a case by case basis, generally in the light of comparative studies. The strategies today adopted by the licensees, CEA or EDF, are presented in points 3|1 and 3|2.

Similarly, the various technical provisions chosen for each stage in decommissioning of a nuclear installation are chosen by the licensee on a case by case basis. However, to avoid splitting up the decommissioning 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 until the target final state is reached, 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 decommissioned, it seems necessary in most cases that there should be a means of preserving the memory of the past existence of a BNI on a site, along with any utilisation restrictions corresponding to the condition of the site. The procedures for delicensing after clean-up are mentioned in chapter 16.

The ASN specified the regulatory framework for BNI decommissioning 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 above-mentioned amended decree of 11 December 1963 are now in place in order to:
- clarify the definition of the leading technical and administrative stages in decommissioning to ensure that it is better tailored to the diversity of nuclear installations;
- to encourage complete decommissioning either immediately or after slight postponement;
- encourage presentation and justification by the licensee of the decommissioning scenario chosen before initiating the regulation process, from the decision to cease operations up to complete decommissioning;
- to clarify the administrative notion of delicensing 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 decommissioning decree for the decommissioning phase. This creates a more balanced picture, both technically and administratively, between the importance given to the decommissioning phase and that given to the operating phase.

All these requirements are detailed in the ASN note of 17 February 2003, entitled: “regulatory procedures concerning decommissioning of basic nuclear installations”. This note is available on the ASN website, www.asn.gouv.fr

2 FINANCING OF DECOMMISSIONING AND MANAGEMENT OF RADIOACTIVE WASTE

In its previous annual reports, the ASN stressed the importance of financing the management of radioactive waste and of decommissioning. Furthermore, the ASN stated that the prospect of a change in the status and partial privatisation of EDF and AREVA requires that a system be implemented to guarantee that sufficient funds will be available, when the time comes, to finance decommissioning of the installations and management of the waste. The ASN confirmed that it will consequently exercise particular vigilance on this point.

In 2005, the ASN observed that this subject had been widely examined both in France and within the European Union.

A number of reports on this subject were published in France in 2005.

In January 2005, the Government Audit Office published a report on the “decommissioning of nuclear installations and management of radioactive waste”. This report depicts the situation at the main nuclear licensees (EDF, AREVA, CEA) and proposes a certain number of recommendations. In this respect, the ASN noted the Government Audit Office’s approach concerning the cost estimates made by the licensees and the areas of uncertainty (decisions concerning a future deep geological repository, the cost of such a repository, the future of spent fuel in particular MOX) as well as the situation regarding the dedicated assets set up by the licensees. The ASN in particular noted the following recommendations:
- taking inspiration from the best practices in the OECD countries, it would be worth reviewing the means of securing the funds intended for decommissioning and waste management;
- financial information from the companies needs to be improved, and in particular should comprise more details concerning the structure of the future costs and the cost assessments for each category

of operations, describing the scenarios on the basis of which they were calculated and giving both the gross value and discounted value of the costs in question.

The Parliamentary Office for the Assessment of Scientific and Technological Options published a report in March 2005 entitled "Research progress and prospects concerning radioactive waste management", which contains a chapter devoted to financing of radioactive waste management. The ASN is particularly attentive to the goals highlighted by this chapter, that is the need for clear, long-term financing and the creation or reinforcement of institutional and financial tools. With regard to resources, and on the basis of experience acquired abroad, the authors of the report recommend the creation of a dedicated fund by the State for waste management, with an initial contribution to it from the producers, followed by annual contributions paid in by them. The report adds that this dedicated fund should finance ANDRA's industrial and research activities, as well as research carried out into separation/transmutation. Finally, given the current context, the report rules out any notion of transfer of responsibility for and ownership of radioactive waste from the producers to a third party, even if accompanied by any fixed, compensatory sum.

In its document entitled "Update of the basic document deposited with the Financial Markets Authority on 23 September 2005", EDF stated that its Board had validated the proposition consisting in:
- when calculating the dedicated assets to be set up (in other words the financial resources that need to be set aside and identified as such) include those plants already shut down and for which dismantling has started, as well as the cost of processing the fuel present in the plant cores at the time of final shutdown;
- speeding up the rate of collection of the dedicated assets, in order to advance from the situation qualified as "embryonic" by the Government Audit Office to one in 2010 corresponding to the forecast sums felt to be necessary by EDF.

The EDF document states that this view is consistent with the conclusions of the report published in the summer of 2005, concerning the role entrusted by the State to the General Inspectorate of Finance and the General Council for Mining Engineering, with respect to the problem of dedicated assets.

The report on the mission given to the General Inspectorate of Finance and the General Council for Mining Engineering underlines the need to organise a new type of supervision implying intervention by a third-party from outside the companies (Administration, Commission, Supervisory Authority, etc.). In this respect, the report points out that the American experience could constitute a starting point for future consideration required on this subject (every two years, the US NRC reviews documents supplied by the companies assessing decommissioning costs and the adequacy of the corresponding dedicated funds).

At European Union level, a number of actions are being carried out by the Commission, the Parliament and the Council, to ensure fair competition and for safety reasons. These actions consist of:
- periodic reports from the European Commission on the situation in the various countries of the Union and preparation of a recommendation concerning the steps to be taken within the Union for financing radioactive waste management and decommissioning operations;
- a report from the European Parliament on the use of financial resources intended for nuclear power plant decommissioning, currently being adopted;
- work initiated by the Council, following the failure of the directive proposals in 2003 drafted by the Commission concerning nuclear safety, radioactive waste and fuel. It entails wide-ranging discussion by the European countries on these subjects, including the financial resources to be collected, before any implementation of the appropriate instruments on a European scale. This work should reach its conclusion by the end of 2006.

Through its bilateral relations, the ASN has gained greater knowledge of the steps taken by the United States, Great Britain, Sweden, Finland and Switzerland. The ASN observes that in these countries, there is a legislative and regulatory framework regulating the financing of radioactive waste management and decommissioning. The funds are generally externalised and managed by legal entities other than the operators. Finally, in some cases (United States and Sweden in particular), the nuclear regulator plays a key role in the overall supervision of the system.

To conclude, the ASN observes that the question of financing radioactive waste management and decommissioning is assuming increasing importance in France and across the European Union.

For its part, the ASN wishes to underline the importance of the following principles:
- The financial resources must be adequate.
This presupposes identifying the future costs (perimeter) and estimating these costs as accurately as possible on the basis of duly clarified scenarios and assumptions.

- The sums gathered in the form of funds must be effectively available when the time comes. This implies that the rate at which each fund is built up is commensurate with the estimated future expenditure and deadlines and that the fund is managed in accordance with the performance targets, but nonetheless with a reasonable degree of prudence. This also presupposes protection of each fund against uses other than those for which it is created, with respect both to the managers of the company and to any creditors.
To achieve this, the system needs to be supervised. The following in particular are required:
- construct a legal and regulatory framework for the various aspects of the question;
- define and implement supervision procedures. This supervision will in particular be based on reports produced by each company and periodically revised, including the scope of the expenditure to be covered by each fund (contributions, fund performance, withdrawals, etc.) and the proposals for replenishment as applicable;
- define procures for clear and complete information with a view to public transparency.

As in certain other countries, the Nuclear Safety Authority must help implement the measures needed to comply with these principles. More particularly, the ASN will naturally be called on concerning the scenarios and assumptions and more generally on the various aspects of the estimation methodology. However, the ASN will need to have wide-ranging powers of access, particularly within the supervision mechanism, in order to ensure that adequate funds are available for radioactive waste management and decommissioning to take place in satisfactory conditions of safety.

3 THE SITUATION OF NUCLEAR INSTALLATIONS BEING DECOMMISSIONED IN 2005

3 | 1

EDF nuclear power plants

Until recently, the generic strategy adopted by EDF for decommissioning of its nuclear power plants, was that of deferred complete decommissioning. 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 decommissioning 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 operator departed, which could be prejudicial to the decommissioning operations. The ASN asked EDF to review this strategy and to evaluate the feasibility of reducing the time needed to undertake complete decommissioning work.

After an initial evaluation submitted in November 1999, EDF decided to revise its strategy for the EL4 reactor, undertaking to carry out complete decommissioning of the reactor soon after completion of the partial decommissioning operations currently in progress.

Then in April 2001, EDF decided to adopt this new decommissioning strategy for all its decommissioned nuclear installations (Brennilis, Bugey 1, Saint-Laurent A, Chinon A, Chooz A and Superphénix), based on complete decommissioning of the reactors, with no standby period. It thus provides for complete decommissioning of these reactors by 2025.

To ensure the success of the new complete decommissioning 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 addition to the data to be transmitted in the documents specific to the various sites, the ASN feels that EDF had sent all the expected answers to the Advisory Committee on 24 March 2004, concerning the decommissioning strategy to be applied to the first generation of EDF reactors.

In its letter of 30 September 2005 sent to the Chairman of EDF, ASN in particular stressed the need for EDF to ensure that reactor decommissioning takes place in good technical and economic conditions. More particularly, in the case of the first generation reactors, priority must be given to decommissioning Bugey 1 and Saint-Laurent A1 et A2, in compliance with the schedule proposed by EDF. With regard to the pressurised water reactors currently in operation, EDF must start looking at decommissioning conditions, taking account of NPP standardisation, the number of installations and the dates envisaged for their shutdown.

3 | 1 | 1

EDF responsibility as nuclear operator of installations being decommissioned

In a letter dated 9 February 2004, the Nuclear Safety Authority authorised EDF to set up a system of internal authorisations for the installations concerned by the decommissioning programme. This approach is primarily designed to meet a strong demand for constant updating of the safety reference system of an installation. Setting up such a system therefore enables the licensee to make changes to the reference system which do not compromise the safety demonstration.

In September 2005, EDF sent the initial results after 18 months of use of the internal authorisation system for the decommissioning programme. EDF incorporated experience feedback from the event which had led the ASN to suspend a decommissioning worksite at Chooz A, which was the first occasion the internal authorisations system was used. The ASN considers that the organisation put in place by EDF now works satisfactorily.

3 | 1 | 2

Monts d'Arrée plant

The EL4 nuclear reactor, which entered service on 23 December 1966, finally ceased all production of electricity on 13 July 1985. This reactor was an industrial prototype, built and operated jointly by the CEA and EDF. As part of the partial decommissioning process for this installation, the 31 October 1996 decree authorised modification of the existing installation, converting it into a facility for interim storage of its own equipment left on the site and thus created a new basic nuclear installation called EL4-D. On the basis of a study defining the various possible options for final decommissioning earlier than planned, EDF on 22 July 2003 submitted an application for final shutdown and decommissioning of the EL4-D installation.

In 2005, EDF carried out preparatory work on the site in advance of future decommissioning work inside the reactor containment, modification of the reactor containment and reactor block ventilation system and cutting work to isolate the CO_2 system from the reactor bloc. In the light of the inconclusive results of the clean-up operation on the effluent treatment station sub-soil already carried out and the corresponding safety risks, the work had to be suspended in order to define a new operating methodology.

Brennilis – renovation of the ventilation system

3 | 1 | 3

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 decommissioning.

• Chinon A1D, A2D and A3D reactors

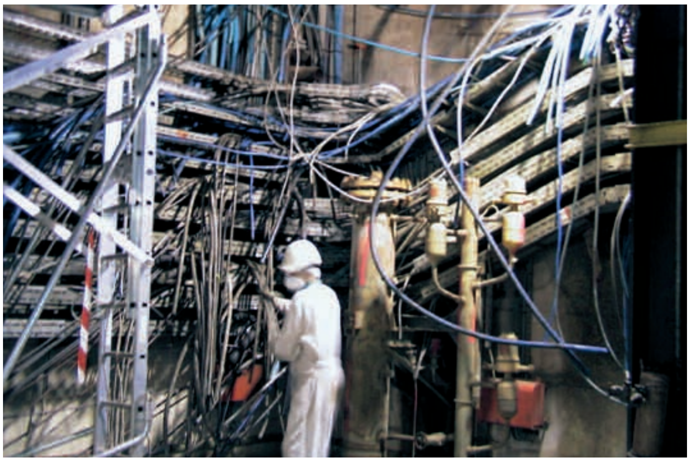
The old Chinon A1, Chinon A2 and Chinon A3 reactors were partially decommissioned and transformed into storage facilities for their own equipment. These operations were authorised by the decrees of 11 October 1982, 7 February 1991 and 27 August 1996, respectively. These installations are currently in the care and maintenance phase.

Chinon – blasting of the CHA 3 water tower

The new water intake and liquid and gaseous effluent discharge authorisation was signed on 17 August 2005. The Chinon A installations should be brought into conformity so that gaseous discharges can be measured during the forthcoming worksites. The licensee has also started the administrative formalities prior to demolition of the Chinon A pumping stations, which should take place during the course of 2006. In 2005, EDF began demolition of the conventional buildings and evacuation of nuclear waste continued in the conditions initially planned.

• **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 2005, EDF began core drilling of the graphite and the concrete of the caisson in order to consolidate the radiological inventory.

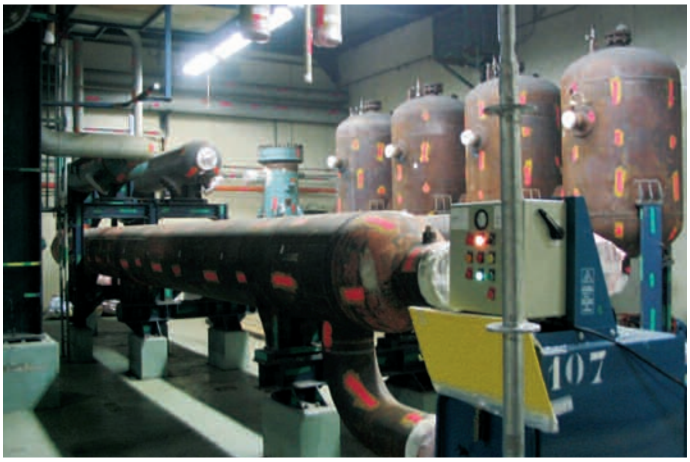


Saint-Laurent – cable removal worksite

• **Bugey 1 reactor**

The decree authorising final shutdown operations was signed on 30 August 1996. In 2005, the licensee completed packaging of the graphite sleeves and removal of all the containers to the Aube centre. Decommissioning work on the CO_2 treatment areas began in May 2005.

In October 2005, EDF submitted an application for the complete decommissioning authorisation. Review of these documents is currently in progress.



Bugey 1 – CO_2 area

3 | 1 | 4

Chooz A D reactor (Ardennes nuclear power plant)

The Ardennes nuclear power plant, which was coupled to the grid on 4 April 1967, finally ceased all electricity production on 30 October 1991. This reactor was the first PWR built in France. As part of the reactor partial decommissioning process, the 19 March 1999 decree authorised modification of the existing installation so that it could be converted into an interim storage facility for its own equipment left on the site, thereby creating a new basic nuclear installation called CNA-D. Owing to the change in the decommissioning strategy for this reactor, EDF submitted an application on 30 November 2004 for final shutdown and complete decommissioning of the CNA-D installation.

In 2005, EDF completed decommissioning in the main galleries and the electrical vault which in particular consisted in significantly reducing the fire load by removing decommissioned cabling. The licensee also started decommissioning work on the ventilation flue and the preparatory work for civil engineering demolition.

Chooz A – dismantling of ventilation flue

3 | 1 | 5

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 on-site 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 authorised by decree 98-1305 of 30 December 1998.

In early 2003, all the fuel assemblies had been removed from the reactor and stored in the APEC. At present, the reactor vessel only contains special assemblies and the lateral neutron protections which present no criticality risk. The final decommissioning operations continued and the turbine hall is now almost completely empty. To allow treatment of the sodium contained in the reactor's systems, interim storage of the existing new core in the APEC and decommissioning of the reactor installations, EDF in 2003 submitted an application for authorisation for complete decommissioning of the reactor. It also submitted an application for a water intake and effluent discharge licence for the site. In 2004, these various applications were the subject of an administrative procedure, a technical investigation and a public inquiry. They should end in the publication of a decommissioning decree covering the entire period necessary for reactor decommissioning, while specifying hold points for the technical subjects felt to be the most sensitive, and a water intake and discharge license. The draft decree was approved by the CIINB on 11 May 2005.

Spent fuel removal facility (APEC)

This facility was commissioned on 25 July 2000 by the Ministers for Industry and the Environment. Spent fuel removed from the Superphénix reactor and washed is placed in the APEC pool.

In 2003, EDF submitted an application for modification of the installation's authorisation decree for storage of unused Superphénix fuel and for storage within the boundary of this BNI of the blocks of sodium-impregnated concrete resulting from the destruction of the sodium in this same reactor. This application should lead to publication of a decree modifying the installation's authorisation decree. The draft decree was approved by the CIINB on 11 May 2005.

3 | 2

CEA installations

Following a request from the ASN, the CEA in June 2004 forwarded several documents enabling the ASN to assess the overall decommissioning strategy for the CEA's civil installations, particularly with respect to consistency and management of the corresponding waste. The ASN envisages referring the matter to the Advisory Committee for laboratories and plants in 2006.

3 | 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 *département*[1]. 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 cleaned-up. Only the radioactive liquid effluent and solid waste treatment station and the interim storage facility for radioactive solid waste are still operating.

The Fontenay-aux-Roses research centre will be decommissioned in around 2010. In view of this decision and the accompanying clean-up operations, the CEA is preparing to group its nuclear activities in the Fort part of the installation, which presupposes modification of the existing BNI perimeters , a process which has already been started. The final shutdown, decommissioning and perimeter modification application dossier for the basic nuclear installations at the Fontenay-aux-Roses centre was sent to the ASN in December 2003. A public inquiry from May to June 2004 was carried out accordingly. The approval process of the draft decrees which should lead to the creation of two BNIs in place of the four original BNIs mentioned above are still following their course.

• Radioactive effluent and solid waste treatment station and solid waste interim storage station (also see chapter 13)

Despite the closure of some workshops (incineration, evaporation), the Radioactive effluent and solid waste treatment station (BNI 34) continues to evacuate radioactive effluent from the site and to treat solid waste, in particular as part of the site decommissioning 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

1. Administrative division of the size of a county.

interim storage of low and very low level waste drums waiting for shipment to a repository. BNI 73 is carrying on the removal of the irradiating drums of solid waste from the decay pits. Shutdown of these BNIs is included in the decommissioning dossier for the CEA's Fontenay-aux-Roses site.

• 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.

Final shutdown of this installation began in July 1995 and is continuing pending the publication of the final shutdown and decommissioning order for the entire Fontenay-aux-Roses site. This will involve recovering, processing and removing the radioactive materials present in the installation.

The Petrus high-level tanks were characterised in June 2004, confirming that their content was indeed liquid. The operations to empty these tanks were approved by an internal authorisation in 2005. This work will be carried out in 2006.

• Laboratory for plutonium-based fuel studies

This radio-metallurgical laboratory, located on the CEA site at Fontenay-aux-Roses, comprised two units, RM1 and RM2, located in two separate buildings. The activities of the spent fuel analysis laboratory ended in 1984.

Cleanup operations took place from 1991 to 1995.

In 1999, the CEA provided an end-of-cleanup report for the RM1 part and a more detailed decontamination plan for the RM2 part. The CEA sent the ASN a clean-up report concerning the floor in the filters room as experience feedback. Decommissioning will be regulated by a common decommissioning order covering the CEA site at Fontenay-aux-Roses (see previous point).

3 | 2 | 2

Grenoble site

The Grenoble research centre (Isère) is located in an industrial zone north-west of the town, at the confluence of the Drac and the Isère rivers. It covers an area of 128 hectares.

The main activities of this Centre are fundamental and applied research in non-nuclear fields (condensed state physics, biology, electronics and materials) and applied research into development of nuclear reactor technologies, mainly focused on safety (thermal hydraulic aspects). The Centre also houses a unit of the INSTN (National Teaching Institute for Nuclear Science and Techniques).

• Effluent and solid waste treatment station and decay storage

The effluent and solid waste treatment station (STEDS - BNI 36) is phasing its activities out until the end of 2010. The solid waste and liquid effluent treatment and packaging functions have ceased. The STEDS is still taking in and providing interim storage for waste, primarily that resulting from clean-up of the BNIs in the centre, before taking them away to alternative disposal routes. One of the major activities in 2005 was removal of the high-level waste bins from the installation's decay pits (BNI 79). The high-level packages stored in these pits were recovered for sorting and optimisation of their contents prior to repackaging. This will enable some of the packages to be sent to ANDRA's Aube repository or to the CEDRA BNI for waste with sufficiently decayed radioactivity levels. For packages for which the level is still too high for removal through the above-mentioned channels, the CEA envisages storing them in ventilated pits in BNI 72 (STED at CEA Saclay).

The CEA will present its final shutdown and decommissioning dossier for this installation at the end of 2006.

· 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 case 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 reviewed.

The CEA will present the final shutdown and decommissioning dossier for this installation at the end of 2006.

· Siloette reactor

Siloette is a pool-type 100 kWth reactor, primarily used to train operational personnel for the nuclear power generating plants. This reactor has been in the decommissioning phase since mid-2002. All the fuel and the beryllium still present in the installation were removed and the two pools in the installation were drained. All the moving equipment still in the pools has been removed. The decree authorising final shutdown and decommissioning of the reactor was signed on 26 January 2005.

· Mélusine and Siloé reactors

Mélusine is a pool reactor operated by the CEA at its Grenoble Centre. It was finally shut down in 1994.

The decree authorising the CEA to modify the Mélusine reactor prior to its decommissioning and delicensing was published in the Official Gazette in January 2004. The installation's pool is now empty and the its ceramic tiles and the ends of the neutron channels were removed as well. The building and ventilation decommissioning work continued in 2005.

The Siloé reactor, located on the CEA site in Grenoble, has been shut down since 23 December 1997. In 2004, the CEA forwarded a summary of the decommissioning operations which had begun in 1999. Pool drainage was completed in February 2005. The decree authorising final shutdown and decommissioning of the reactor was signed on 26 January 2005. Decommissioning, particularly electromechanical decommissioning, began in 2005.

3 | 2 | 3

The Cadarache site installations being decommissioned

· Rapsode reactor and Fuel assembly shearing laboratory (LDAC)

Rapsodie, a fast neutron experimental reactor, was shut down on 15 April 1983. Final shutdown was declared on 28 May 1985. As from 1987, this installation has been undergoing work, which led to its partial decommissioning.

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 decommissioning operations, necessitated rehabilitation and partial cleanup processes, which were completed by the end of 1997. Since then, the clean-up, limited decommissioning and waste removal work has resumed and the installation has now reached the servicing and surveillance phase. Renovation and refurbishment work has also been carried out.

Installed at Cadarache, the LDAC, which is part of the BNI comprising the Rapsodie reactor, carried out tests and reviews on spent fuel irradiated in Rapsodie or in other fast neutron reactors. This laboratory has been shut down since 1997. It is cleaned-up, under surveillance and awaiting decommissioning.

In 2002 and 2003, the CEA sent the ASN the updated General Operating Rules (RGEs) and an updated safety reference system which covered the Rapsodie reactor, the LDAC and the neutron radiography reactor in a single document. The 2005 review of these documents found that the justifications were insufficient, in particular with respect to the forthcoming clean-up operations. A revised version of the installation's safety reference system should be forwarded to the ASN at the end of 2005.

• Harmonie reactor

The Harmonie reactor, a source of graded neutrons, mainly used for detector calibration and investigation of the properties of certain materials, installed on the CEA Cadarache site, has been shut down since 1996. After removal of the depleted uranium, the experimental rigs, the fuel and the sources it contained, it was decommissioned on 18 December 1997.

The decree authorising the CEA to proceed with final shutdown and decommissioning was published on 8 January 2004. The operations covered by this decree are in progress. Reactor block cutting, reactor hall clean-up and waste removal were carried out in 2005.

Reactor hall with reactor block cutting hatch – Harmonie

• Enriched uranium processing facilities (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 scraps to recover the enriched uranium they contain. The facility was also equipped with a low level organic liquid incinerator. Production in the facilities 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 decommissioning of this BNI, which was updated in 2003. The decree authorising these operations should be published in 2006.

• 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 licensee 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 proceed with final shutdown and decommissioning was published on 8 January 2004. The operations covered by this decree were carried out during 2004, after which, the CEA sent the ASN a BNI delicensing application based on a residual environmental impact assessment. A draft conventional encumbrance on behalf of the State was transmitted to the ASN in 2005.

3 | 2 | 4

The Saclay site installations being decommissioned

• High activity laboratory (LHA)

The high activity laboratory (LHA) comprises several units equipped for research and production assignments on various radionuclides.

The ASN was informed of clean-up work end on cells 12 and 16. In 2005, cells 11 and 15 were being cleaned-up. Cells 0 and 2 were however still in operation. The ASN asked the licensee to send it a final shutdown and decommissioning dossier by early 2006.

• CELIMENE cell

The CELIMENE cell, adjoining the EL3 reactor, was commissioned in 1965 for review 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. Decommissioning of the installation, currently under surveillance, is not planned before about 2010.

• Saturne accelerator

Saturne was a particle accelerator, located at the CEA Saclay Centre, dedicated to fundamental and applied research, circulating proton, deuteron, helium, or even heavier ion beams.

The decree authorising final shutdown and decommissioning of this installation was published in October 2002. The operations covered by this decree ended in February 2004. A request for BNI delicensing was sent to the ASN, along with a draft conventional encumbrance on behalf of the State. All the radioactive waste resulting from decommissioning was sent to the authorised channels. The encumbrance and the delicensing decision were signed in October 2005. The installation was therefore removed from the list of BNIs on 18 October 2005.

• Saclay linear accelerator (ALS)

The Saclay linear accelerator is located on the Orme des Merisiers site on the Saclay plateau. It is operated by the CEA. It has been shut down since 1996 and is currently in a "closure of operation" stage.

The decree authorising the CEA to carry out the shutdown and decommissioning operations on the ALS installation was published in January 2004. The operations covered by this decree ended in February 2004. The results of final shutdown and decommissioning were sent to the ASN. The final waste resulting from these operations was being taken away in 2005.

ALS before dismantling

ALS after dismantling

3 | 2 | 5

The La Hague installations being decommissioned

• AT1 pilot reprocessing facility

The AT1 pilot reprocessing facility, 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).

Decommissioning 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 facility (Élan IIB)

The ELAN II B installation, a CEA installation operated by COGEMA on the La Hague site, manufactured caesium 137 and strontium 90 sources until 1973.

The initial decommissioning operations undertaken by the Technicatome firm ended in November 1991.

A large number of renovation and maintenance operations took place during 2002 and 2003 (upgrading of the ventilation system, radiological mapping, etc.) with a view to decommissioning operation resumption. All the installation upgrade work and the work preparatory to decommissioning of the installation was carried out during 2004 and 2005. Radiological reconnaissance work was carried out in 2005 and the licensee sent the ASN the final shutdown dossier at the end of 2005. The CEA's provisional target is to complete decommissioning in 2013.

• **UP2 400**

COGEMA announced its decision to no longer reprocess spent fuel in the UP2 400 as of 1 January 2004 and to effect final shutdown (see chapter 13).

3 | 3

Other installations

3 | 3 | 1

The Société Normande de Conserve et Stérilisation (SNCS) irradiator

The SNCS ionisation plant, located at Osmanville (Calvados), authorised by decree on 17 October 1990, was used for the sterilization of foodstuffs and medico-surgical equipment.

In 1995, the cobalt 60 sources contained in the installation were transferred to ionisers operated by the Ionisos company.

The licensee presented an application for final shutdown and decommissioning 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.

The decision to delicense the installation was signed at the end of 2002 and should be followed by conventional encumbrances on behalf of the State, which have yet to be signed.

3 | 3 | 2

The Strasbourg University reactor

Very similar in design and characteristics to the Ulysse reactor at Saclay, the Strasbourg University reactor (RUS-Université Louis Pasteur) was mainly used for experimental irradiations and the production of short-lived radioisotopes.

The ASN asked the Université Louis Pasteur to provide it with considerable data by June 2003, to supplement the files transmitted for the formal notice of November 2001 and concerning the provision of a final shutdown and decommissioning 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 decommissioning in the very near future. In 2004, he informed the ASN that he agreed to immediate decommissioning.

The final shutdown and decommissioning dossier was reviewed in 2005, and a draft authorising decree has been prepared.

3 | 3 | 3

SICN plant in Veurey-Voroize

Two nuclear installations, BNIs 65 and 90, grouped together on the site of the SICN site in Veurey-Voroize, make up this establishment. Work involving the fuel elements used in experimental reactors and fabrication of fuel pellets with all enrichment levels has now finally ceased. The decommissioning operations continued in 2005 (mainly removal of nuclear materials to the appropriate channels) and a pilot worksite, the purpose of which is to define the techniques to be used to clean up the site, began in 2005. A dossier presenting the strategy for managing the outdoor areas outside the BNI buildings (soil) is currently being reviewed.

Adjustment of a bush hammering robot (pilot worksite)

3 | 3 | 4

COGEMA interim storage facility at Miramas

The COGEMA Miramas establishment (BNI 134) was created in 1983. It is a warehouse for solid and stable compounds of natural enriched or depleted uranium, and uranium hexafluoride (UF_6). Store clearance operations took place from the end of 2002 to the end of 2003 and the warehouse was completely empty of nuclear materials by 1 January 2004. A final shutdown and decommissioning dossier was sent to the ASN in 2004. A draft decree authorising final shutdown and decommissioning of the installation has been prepared. In 2005, clean-up and radiological mapping were carried out.

4 OUTLOOK

In 2003, the ASN redefined how BNI decommissioning operations were managed, with the aim of encouraging the licensees to proceed with early decommissioning of those installations already shut down. The ASN also asked EDF and the CEA to produce dossiers giving an overall description of the their strategy and schedule for decommissioning of the many shut down installations, giving safety and radiation protection justifications. In 2004, the ASN concluded its review of EDF's overall decommissioning strategy for the first generation reactors and in 2006 will adopt a stance on the overall decommissioning strategy for the CEA's civil installations.

In this context, the ASN is satisfied with the 2005 supplementary budget act provision for a 50% reduction in the BNI tax for installations being decommissioned. This measure, which has no impact on the State budget, will primarily benefit the Research sector in the coming years.

Finally, in 2005, much thought and discussion was given over to the question of financing radioactive waste management and decommissioning, both in France and across the European Union. This subject has assumed increasing importance in the context of the changing status and partial privatisation of EDF.

For its part, the ASN underlines the importance of the following principles:
- the financial resources must be sufficient;
- the sums collected in the form of funds must be effectively available when the time comes.

To achieve this, the system must be supervised and the following in particular are necessary:
- construct a legal and regulatory framework for the various aspects of the question;
- define and implement supervision procedures;
- establish the procedures for clear and complete information with a view to public transparency.

The ASN will contribute to implementation of the measures needed to comply with these principles.

5 LIST OF BASIC NUCLEAR INSTALLATIONS DELICENSED AS AT 31.12.2005

Installation LOCATION	BNI	Type of installation	Commissioned	Final shutdown	Final regulatory procedures	Current status
NÉRÉIDE FAR*	(former BNI 10)	REACTOR (500 kWth)	1960	1981	1987: removed from BNI list	Decommissioned
TRITON FAR*	(former BNI 10)	REACTOR (6,5 MWth)	1959	1982	1987: removed from BNI list and classified as ICPE	Decommissioned
ZOÉ FAR*	(former BNI 10)	REACTOR (250 kWth)	1948	1975	1987: removed from BNI list and classified as ICPE	Confined (museum)
MINERVE FAR*	(former BNI 12)	REACTOR (0,1 kWth)	1959	1976	1977: removed from BNI list	Dismantled at FAR reassembled at Cadarache
EL 2 SACLAY	(former BNI 13)	REACTOR (2,8 MWth)	1952	1965	Removed from BNI list	Sealed source
EL 3 SACLAY	(former BNI 14)	REACTOR (18 MWth)	1957	1979	1988: removed from BNI list and classified as ICPE	Partially decommissioned, remaining parts confined
PEGGY CADARACHE	(former BNI 23)	REACTOR (1 kWth)	1961	1975	1976: removed from BNI list	Decommissioned
CÉSAR CADARACHE	(former BNI 26)	REACTOR (10 kWth)	1964	1974	1978: removed from BNI list	Decommissioned
MARIUS CADARACHE	(former BNI 27)	REACTOR (0,4 kWth)	1960 IN MARCOULE, 1964 IN CADARACHE	1983	1987: removed from BNI list	Decommissioned
LE BOUCHET	(former BNI 30)	Ore processing	1953	1970	Removed from BNI list	Decommissioned
GUEUGNON	(former BNI 31)	Ore processing		1980	Removed from BNI list	Decommissioned
SATURNE	(former BNI 48)	Accelerator	1958	1997	2005: removed from BNI list	Cleaned up – encumbrances (***)
ATTILA** FAR*	57	Reprocessing pilot	1966	1975		Decommissioned
BAT 19 FAR*	(former BNI 58)	Plutonium metallurgy	1968	1984	1984: removed from BNI list	Decommissioned
LCAC GRENOBLE	(former BNI 60)	Fuels analysis	1968	1984	1997: removed from BNI list	Decommissioned
ARAC SACLAY	(former BNI 81)	Fabrication of fuel assemblies	1975	1995	1999: removed from BNI list	Cleaned up
FBFC PIERRELATTE	(former BNI 131)	Fuel fabrication	1983	1998	2003: removed from BNI list	Cleaned up – encumbrances (***)
SNCS OSMANVILLE	(former BNI 152)	Ioniser	1990	1995	2002: removed from BNI list	Cleaned up

(*) Fontenay-aux-Roses - (**) Attila: reprocessing pilots located in the BNI 57 cell - (***) Encumbrances: conventional encumbrances on behalf of the State were taken out on the plots concerned.

6 LIST OF BASIC NUCLEAR INSTALLATIONS FINALLY SHUTDOWN AS AT 31.12.2005

Installation LOCATION	BNI	Type of installation	Commissioned	Final shutdown	Final regulatory procedures	Current status
CHOOZ AD (FORMER CHOOZ A)	163 (former BNI nos 1, 2, 3)	REACTOR (1040 MWth)	1967	1991	1999: partial decommissioning decree for Chooz A and creation of the Chooz AD interim storage BNI	Partially decommissioned, modified to BNI for interim storage of waste left on-site
CHINON A1D (FORMER CHINON A1)	133 (former BNI n° 5)	REACTOR (300 MWth)	1963	1973	1982: Chinon A1 confinement decree and creation of the Chinon A1D interim storage BNI	Partially decommissioned, modified to BNI for interim storage of waste left on-site (museum)
CHINON A2D (FORMER CHINON A2)	153 (former BNI n° 6)	REACTOR (865 MWth)	1965	1985	1991: partial decommissioning decree for Chinon A2 and creation of the Chinon A2D interim storage BNI	Partially decommissioned, modified to BNI for interim storage of waste left on-site
CHINON A3D (FORMER CHINON A3)	161 (former BNI n° 7)	REACTOR (1360 MWth)	1966	1990	1996: partial decommissioning decree for Chinon A3 and creation of the Chinon A3D interim storage BNI	Partially decommissioned, modified to BNI for interim storage of waste left on-site
MÉLUSINE GRENOBLE	19	REACTOR (8 MWth)	1958	1988	2004: decommissioning authorisation decree	Decommissioning in progress
SILOÉ GRENOBLE	20	REACTOR (35 MWth)	1963	1997	2005: decommissioning authorisation decree	Final shutdown in progress
SILOETTE GRENOBLE	21	REACTOR (100 kWth)	1964	2002	2004: decommissioning authorisation decree	Final shutdown in progress
RAPSODIE CADARACHE	25	REACTOR (40 MWth)	1967	1983		Decommissioning in progress
EL 4D (FORMER EL4 BRENNILIS)	162 (former BNI n° 28)	REACTOR (250 MWth)	1966	1985	1996: decree ordering decommissioning and creation of the EL-4D interim storage BNI	Decommissioning in progress
AT1 LA HAGUE	33	Fast fuel reprocessing	1969	1979		Cleaned up
HARMONIE CADARACHE	41	REACTOR (1 kWth)	1965	1996	2004: final shutdown and decommissioning decree	Decommissioning in progress
ALS SACLAY	43	Accelerator	1965	1996	2004: final shutdown and decommissioning decree	Decommissioning in progress
STRASBOURG UNIVERSITY REACTOR STRASBOURG	44	REACTOR (100 kWth)	1967	1997		Final shutdown in progress
BUGEY 1	45	REACTOR (1920 MWth)	1972	1994	1996: final shutdown decree	Final shutdown in progress

6 LIST OF BASIC NUCLEAR INSTALLATIONS FINALLY SHUTDOWN AS AT 31.12.2005 (CONTINUATION)

Installation LOCATION	BNI	Type of installation	Commission-ed	Final shutdown	Final regulatory procedures	Current status
ST-LAURENT A1	46	REACTOR (1662 MWth)	1969	1990	1994: final shutdown decree	Final shutdown in progress
ST-LAURENT A2	46	REACTOR (1801 MWth)	1971	1992	1994: final shutdown decree	Final shutdown in progress
ÉLAN II B LA HAGUE	47	Fabrication of Cs 137 sources	1970	1973		Decommissioning in progress
HIGH LEVEL LABORATORY (LHA) SACLAY	49	Laboratory	1960	1996		Final shutdown in progress – some cells still active
ATUE CADARACHE	52	Uranium processing	1963	1997		Clean-up in progress
LCPU FAR*	57	Plutonium chemistry laboratory	1966	1995		Final shutdown in progress
RM2 FAR*	59	Radiometallurgy	1968	1982		Decommissioning in progress
SUPERPHÉNIX CREYS-MALVILLE	91	Reactor (3000 MWth)	1985	1997	1998: final shutdown decree	Final shutdown in progress

(*) Fontenay-aux-Roses

Chapter 15

SAFE FINAL SHUTDOWN AND DECOMMISSIONING OF BASIC NUCLEAR INSTALLATIONS

RADIOACTIVE WASTE, CLEAN UP AND POLLUTED SITES

CHAPTER 16

1 RADIOACTIVE WASTE MANAGEMENT PRINCIPLES
1|1 Radioactive waste management channels
1|2 The regulatory framework for radioactive waste management
1|3 European regulations harmonisation work within WENRA
1|4 Organisation and responsibilities
1|5 ANDRA national inventory of radioactive waste and reusable materials
1|6 The national radioactive waste and reusable materials management plan (PNGDR-MV)

2 MANAGEMENT OF VERY LOW LEVEL WASTE
2|1 VLL waste management principles
2|2 The particular case of clean-up when dismantling installations
2|2|1 Basic nuclear installations
2|2|2 Medical, industrial and research installations
2|3 Morvilliers VLL waste repository

3 MANAGEMENT OF RADIOACTIVE WASTE BY THE PRODUCERS
3|1 Waste management in basic nuclear installations
3|1|1 CEA waste management
3|1|2 Management of COGEMA waste
3|1|3 EDF waste management
3|1|4 Other licensees
3|2 Radioactive waste management in medical, industrial and research activities
3|2|1 Origin of waste and radioactive effluent
3|2|2 Management and disposal of radioactive waste and effluent produced by biomedical research and nuclear medicine
3|3 Management of technologically enhanced naturally occurring radiation (TENORM) waste
3|3|1 Uranium mining waste
3|3|2 Waste resulting from other activities

4 INTERIM STORAGE OF RADIOACTIVE WASTE AND SPENT FUEL
4|1 Basic nuclear installations intended for interim storage of radioactive waste and spent fuel
4|1|1 Solid waste treatment stations
4|1|2 CEDRA
4|1|3 PEGASE/CASCAD
4|2 Legacy waste
4|2|1 Recovery of waste from trenches in the CEA BNI 56
4|2|2 The EDF Saint-Laurent silos (BNI74)
4|3 Management of radioactive waste for which the producer is unknown or insolvent: a public service duty
4|3|1 Organisation of the public authorities and their various responsibilities
4|3|2 The types of waste concerned and special actions in progress
4|3|3 Public service storage facilities

5 **SITES POLLUTED BY RADIOACTIVE SUBSTANCES**
5 | 1 The legal framework of action by the public authorities
5 | 1 | 1 Interministerial circular of 16 May 1997
5 | 1 | 2 The law of 30 July 2003
5 | 2 The inventories of polluted sites in France
5 | 2 | 1 The ANDRA national inventory
5 | 2 | 2 Databases of the Ministry for Ecology and Sustainable Development
5 | 3 Actions performed and dossiers in progress
5 | 3 | 1 General
5 | 3 | 2 Action taken
5 | 3 | 3 Some of the dossiers in progress
5 | 3 | 4 Management of incidental contamination

6 **LONG-TERM MANAGEMENT OF RADIOACTIVE WASTE BY DISPOSAL**
6 | 1 Long-term management by surface or subsurface disposal of radioactive waste
6 | 1 | 1 Manche waste repository
6 | 1 | 2 Aube waste repository
6 | 1 | 3 Package acceptance rules
6 | 1 | 4 Surface or subsurface disposal projects
6 | 2 High level long-lived waste disposal: application of the provisions of chapter II of part IV of the Environment Code as a result of law 91-1381 of 30 December 1991 concerning research into radioactive waste management
6 | 2 | 1 Separation/transmutation
6 | 2 | 2 Underground laboratories
6 | 2 | 3 Long-term storage
6 | 2 | 4 Specifications and approval certificates for waste packages unsuitable for surface disposal

7 **OUTLOOK**

Chapitre 8
LES RÉACTEURS À EAU SOUS PRESSION

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, depending on whether or not it can be considered liable to have been contaminated by radionuclides. Waste containing high levels of natural radioactivity, sometimes resulting from use of a process leading to concentration of this radiation, can be produced by non-nuclear activities, in which the radioactive substances are not used for their radioactive or fissile properties.

Certain industrial waste, considered to be hazardous, must be managed in specific channels.

Radioactive waste management begins with the design of installations using radioactive substances, and proceeds during the operating life of these installations through concern for limitation of the volume of waste produced, of its harmfulness and of the quantity of residual radioactive materials contained. It continues through identification, sorting, treatment, packaging, transport and interim storage and final disposal. All operations associated with management of a category of waste, from production to disposal, constitute a waste management channel, each of which must be appropriate to the type of waste concerned.

The operations within each channel are interlinked and all the channels are interdependent. These operations and channels form a system which has to be optimised in the context of an overall approach to radioactive waste management addressing safety, radiation protection, traceability and volume reduction issues. This management must also be completely transparent to the public.

1 | 1

Radioactive waste management channels

Radioactive wastes vary considerably by their activity level, their half-lives, their volume or even their nature (scrap metal, rubble, oils, etc.). The treatment and long-term management solution must be appropriate to the type of waste 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, intermediate or high level waste and, on the other hand, waste known as very short-lived, resulting mainly from medical activities (activity level halved in less than 100 days), short-lived (activity level halved in less than 30 years) and long-lived, containing a large quantity of long-lived radioelements (activity level halved in more than 30 years).

The table below shows the stage reached in implementation of the different waste management channels, notably the final disposal channel adopted. It shows that for certain waste, there is at present no final disposal solution.

Table 1: Existing or future disposal channels for the main radioactive solid wastes

<table>
<tr><th>Period / Activity</th><th>Very short-lived</th><th>Shot-lived</th><th>Long-lived</th></tr>
<tr><td>Very low level</td><td rowspan="4">Management by radioactive decay</td><td colspan="2">Dedicated surface disposal
Recycling channels</td></tr>
<tr><td>Low level</td><td rowspan="2">Surface disposal (Aube repository)
except tritiated waste, sealed sources (under study)</td><td>Dedicated sub-surface disposal under study</td></tr>
<tr><td>Moyenne activité</td><td>Channels under study under article L. 542.3 of the Environment Code (law of 30.12.1991)</td></tr>
<tr><td>High level</td><td colspan="2">Channels under study under article L. 542.3 of the Environment Code (law of 30.12.1991)</td></tr>
</table>

- 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 originating from former operation of uranium mines in France, most very low-level waste today comes from nuclear installation dismantling, from conventional industrial or research sites which use low-level radioactive substances, or from clean-up of sites polluted by radioactive substances. The quantity produced will grow considerably when the time comes for the large-scale complete dismantling of the power reactors and plants currently in operation. Radioactivity of this waste is about a few Becquerels per gram.

- Short-lived intermediate and low level waste

The activity of short-lived intermediate 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 point 6|1). This disposal channel has been operational since 1969, when France decided to cease its participation in the VLL waste immersion operations organized by the OECD. At that time, 14,300 m³ of radioactive waste of French origin had already been immersed in the Atlantic Ocean.

– Special case of short-lived intermediate and low-level waste for which no disposal channel is currently available

Short-lived intermediate and low-level waste includes certain categories which have characteristics making them currently unsuitable for acceptance at the Aube repository in Soulaines, without additional authorisation from the ASN.

Some sealed sources fall into this category: in industrial or medical activities, the radioactive elements used are frequently contained in perfectly leaktight containers. The tightness of the container is guaranteed by periodic leak tests and by a strictly limited source operational life. After use, the sources must be returned to their manufacturer.

A specific feature of these sources is that they contain often highly concentrated radioactivity. Consequently, even when the radioactive elements concerned have a relatively short life, they cannot always be accepted as such by a surface waste repository, because even after 300 years, they would still have significant radioactivity. In addition, their envelope is often made of stainless metals, making them tempting for people digging into the repository. The future of used sources is being reviewed by a special working group headed by the ASN with the aim of drafting the national radioactive waste and reusable materials management plan.

In addition, some waste contains significant quantities of tritium, a short-lived radionuclide but one that is hard to confine owing to its mobility, unlike the other radionuclides.

– Long-lived low-level waste

This waste usually comes from industrial activities leading to concentration of naturally occurring radioactive materials (NORM) (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).

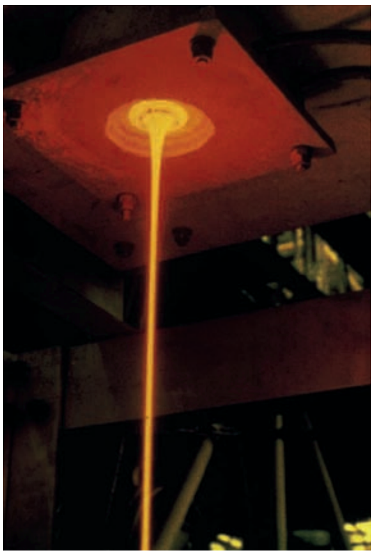
Owing to its long life, this waste cannot be disposed of in a surface repository as it is impossible to take advantage of its radioactive decay within a time-frame compatible with permanent institutional surveillance. However, its low intrinsic hazard could enable it to be disposed of in a subsurface repository about fifteen metres deep.

– High-level waste and long-lived intermediate 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 intermediate level and high-level waste.

The intermediate level waste is mainly process waste (spent fuel hulls and end-pieces, effluent treatment sludge) and in-service maintenance waste from spent fuel reprocessing facilities and research centres, or certain activated waste from the dismantling of nuclear installations. In this waste, the alpha emitters can often reach significant quantities.

The high level waste generally originates from fission and activation products deriving from spent fuel processing. Vitrified waste is characterised by significant release of heat (up to 4 kW per 150-litre container), making the use of cooling systems necessary. This high level waste also includes fuel irradiated in CEA research reactors, together with EDF spent fuel which is not to be reprocessed.



Vitrification of a solution of fission and activation products

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. 542-3 of the Environment code (see point 6|2).

1 | 2

The regulatory framework for radioactive waste management

Radioactive waste management falls within the general scope of law 75-633 of 15 July 1975 and its implementation decrees, concerning waste disposal and the recovery of materials. The basic principles of this law are the prevention of waste production, the responsibility of the waste producers, the traceability of this waste and the need to inform the general public.

– Production of radioactive waste in basic nuclear installations

Management of radioactive waste from basic nuclear installations is structured within a strict regulatory framework, defined by a ministerial order of 31 December 1999 stipulating the general technical regulations intended to prevent and limit the detrimental effects and external hazards resulting from the operation of basic nuclear installations. This order requires drafting of a study specifying how the waste produced in basic nuclear installations is to be managed. One part of this study is submitted for approval to the Director General for Nuclear Safety and Radiation Protection.

– Production of radioactive waste in other activities using radioactive substances

The provisions mentioned in the decree of 4 April 2002 concerning the general protection of persons against ionising radiation have been incorporated into the public health code. Article R.1333-12 of this code states that management of waste contaminated by radioactive substances originating in any activity comprising a risk of exposure to ionising radiation must be reviewed and approved by the public authorities, in conditions and according to technical rules which have yet to be defined.

Circular 2001/323 of 9 July 2001 sets the technical aspects to be taken into account when ensuring good management of radioactive waste, mainly in health institutions, but also in biomedical research laboratories. This circular requires that each institution draw up an individual on-site management plan for radioactive waste, based on the following main principles: sorting of the waste as early as possible in the process, separate storage areas according to the type of waste, disposal of the waste through identified channels.

Since July 2003, presentation of the institution's waste management plan has been a pre-requisite to renewal of the radioelement possession licences.

– Radioactive waste generated by clean-up of polluted sites

When clean-up of a polluted site is justified in terms of protection against ionising radiation, the waste resulting from the work must be correctly characterised in order to determine which disposal channels are necessary. The ANDRA in general takes part in these rehabilitation operations and conducts these investigations directly.

– Waste management channel supervision

Supervision of the waste management channels requires on the one hand traceability of radioactive waste treatment and disposal operations, and on the other detection of the presence of radioactive waste upstream of any treatment in installations not authorised to receive them.

As regards waste traceability, whether the waste is radioactive or not, decree 2005-635 of 30 May 2005 concerning the monitoring of waste treatment channels aims to ensure improved supervision and monitoring of the waste throughout the processing and disposal channel. It requires the creation of traceability systems (registers, periodic declaration to the Administration and waste trace sheets).

With regard to waste treatment or disposal installations not authorised to receive radioactive waste, the action taken by the authorities led to radioactivity detection systems being installed at the entrances to the sites (landfills, foundries, incineration plants, etc.). These systems constitute an extra line of defence in the supervision of radioactive waste management channels.

1 | 3

European regulation harmonisation work by WENRA

The Western European Nuclear Regulators' Association (WENRA) was created in 1999. It originally consisted of the heads of the nuclear safety authorities of the member countries of the European Union, plus Switzerland.

It initially provided the expertise for reviewing the safety of the reactors in the eastern European countries applying for membership of the European Union. The authorities of the eastern European countries have since then joined WENRA.

One of the key WENRA missions is to develop a joint approach to nuclear safety and regulation. WENRA therefore implemented a procedure designed to draft reference safety levels for harmonising nuclear safety practices.

Working groups were set up in 2002 in order to draft these reference levels. One of them, the WGWD (Working Group on Waste and Decommissioning) was more specifically tasked with defining reference levels concerning the safe interim storage of radioactive waste and spent fuel and nuclear installation dismantling operations.

Interim storage of low-level waste packaged in metal drums pending reprocessing (CEA/Saclay)

The WGWD working group submitted the final version of the reference levels in December 2005. They had been approved by the members and were published on the websites of the WENRA member safety authorities in early 2006, so that the stakeholders could submit their comments prior to incorporation into national regulations by 2010.

With regard to the reference levels for interim storage of radioactive waste and spent fuel, the main recommendations concern the need to identify the owner of the waste or fuel, to ensure that storage is reversible and to monitor the waste or fuel, so that it can be recovered if damage is confirmed, and to prefer passive safety protection devices, in other words, requiring no human intervention.

The reference levels concerning the safety of dismantling operations require that the nuclear licensees prepare dismantling strategies for all of their sites, draft dismantling plans, that the most important dismantling phases be submitted to the safety authority and that dismantling be taken into account as of the design of the nuclear installation, so that all the operations involved can be made easier when the time comes.

If the WENRA members are to adopt the reference levels, French regulations concerning interim storage of radioactive waste and spent fuel and dismantling of nuclear installations will have to be updated.

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 licensees (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 licensees 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 point 4|4).

Research organisations (CEA, ANDRA) contribute to the technical optimisation of radioactive waste management, with regard to both production and development of treatment, packaging and characterisation processes. Efficient coordination of the research programme is necessary to ensure overall safety optimisation in this area.

In this context, the Nuclear Safety Authority (ASN) drafts regulations governing radioactive waste management, supervises the safety of the basic nuclear installations which give rise to this waste or play a part in its disposal and conducts inspections in the facilities of the various waste producers

(EDF, COGEMA, CEA, hospitals, research centres, etc.) and of the ANDRA. It supervises the ANDRA's overall organisational provisions for acceptance of waste from the producers. It 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 on-site interim storage facilities, and the inherent risks.

1 | 5

ANDRA national inventory of radioactive waste and reusable materials

In November 2004, ANDRA published the national inventory of radioactive waste and reusable materials. This inventory is an exhaustive list of the waste identified as radioactive throughout France. It also includes a forward-looking part which proposes estimates for the quantities of waste that will be produced by 2010 and by 2020. The ASN is a member of the steering committee for the national inventory of radioactive waste and reusable materials, a new version of which is expected for early 2006.

The following tables present some data extracted from the national inventory published in 2004. The largest volumes concern very low level or short-lived low and intermediate level waste, representing only a few teraBecquerels, which is a minute fraction of the total activity. On the other hand, long-lived, high-level waste will in 2020 represent more than a billion teraBecquerels, for a total volume of a few thousand cubic metres.

Tables 2 et 3: stocks of waste and spent fuels, both existing and anticipated by 2010 to 2020 as a result of operation of the installations

Waste categories	Existing volumes in 2002 disposed of or stored (m^3)	Anticipated volumes in 2010 disposed of or stored (m^3)	Anticipated volumes in 2020 disposed of or stored (m^3)
Very low level	108,219	247,981	515,991
Low and intermediate level short-lived	778,322	913,900	1,196,880
Low lelvel – long-lived	44,559	46,581	87,431
Intermediate level – long-lived	45,359	50,207	54,509
High level	1,639	2,521	3,621

	Existing quantity in 2002 (t)	Existing quantity in 2010 (t)	Existing quantity in 2020 (t)
EDF uranium oxide spent fuel waiting for processing	10,350	11,250	10,850
PWR reactor MOX fuels	520	1,300	2,350

(source: national inventory of radioactive waste and reusable materials – ANDRA 2004)

The national radioactive waste and reusable materials management plan (PNGDR-MV)

The preceding paragraphs show the various technical and regulatory aspects of radioactive waste management: categories (according to the disposal method), inventory, regulations at source, and role of the various players. These elements were gradually implemented over the years, as and when inadequacies in various areas were highlighted.

It is clearly obvious that a general framework is needed which, for all radioactive waste and whatever the producers, would guarantee safe and consistent management with the corresponding financing, in particular by defining priorities.

In response to a request from the Parliamentary Office for the assessment of scientific and technological options in 2000, the Nuclear Safety Authority has since 2003 been overseeing the preparation of a national radioactive waste and reusable materials management plan within a wide-ranging working group.

At the meeting of the French cabinet on 4 June 2003, the Minister for Ecology and Sustainable Development officially confirmed his intention to draw up such a plan.

The waste producers (all sectors), the waste disposal facilities, ANDRA, the departments of the ministries concerned, environmental protection associations and representatives of elected officials are invited to take part in these meetings. An initial draft of the national radioactive waste and reusable materials management plan was published on the ASN website for consultation purposes on 13 July 2005, and will be available until the end of 2005.

The plan is based on work designed to identify the waste that exists throughout the country. This mainly concerns the ANDRA national inventory. Interfaces with existing work to designate management channels for long-lived high-level waste, in accordance with the provisions of article L. 542-3 of the Environment Code, are also specified.

The PNGDR-MV project therefore proposed a certain number of actions and the corresponding deadlines

1) Revive the search for a disposal site for low-level long-lived waste, so that such a repository would be available in 2012.

2) Those in possession of reusable materials will be required to carry out precautionary studies by 2010 into possible management channels, if these materials were subsequently to be reclassified as waste. A review will be carried out by 2008 by those in possession of reusable materials for which the reuse procedures are still being studied and have never been implemented. These studies will be the subject of a joint analysis by the DGEMP and the ASN.

3) Continue studies into disposal of used sealed sources and their possible reprocessing, so that a management scheme is available by 2008.
The impact of the disposal of used sealed sources with a half-life longer than that of Cs137 in a LL-LL type repository will need to be reviewed by ANDRA by 2007.
Interim storage solutions could be necessary to manage the long-lived sealed sources, in particular for the programme to phase out ion detector use.
The conditions for extension of the sealed source possession period beyond the 10 years set in the Public Health Code will be clarified in 2006, in order to limit the number of scrapped sealed sources.

4) A study will be carried out onto the long-term management of tritiated waste. Together with ANDRA, the CEA will look for the best solutions for the necessary interim decay storage prior to disposal, with proposal of a management strategy by 2008.

5) ANDRA will propose criteria in 2006 for providing aid to a defaulting owner of waste so that it can be recovered and sent either for interim storage, or for disposal.
The conditions for allocation of public funding for these public service duties will be clarified in 2006, in accordance with the requirements of the service level and resources contract between the State and ANDRA for the period 2005-2008. The Government's commissioner (DGEMP) will coordinate the work to be done on this subject between the various administrations concerned and the establishment.
ANDRA will review the conditions in which recovery of radioactive lightning conductors could be accelerated by mid-2006. An estimate of the available storage capacity and qualified personnel requirements for speedier recovery of these radioactive items will be made by ANDRA. This recovery could require regulations which will be specified by the authorities.
By 2007, an estimate will be made of the number of used sealed sources which, for historical reasons, cannot be returned to their supplier. Sources for which possession has been authorised and for which the owners are experiencing temporary difficulties concerning their recovery are not concerned by this measure.
An information campaign targetting the potential holders of these sources could be organised in conditions yet to be defined.

6) By 2008, review the status of the short and long-term management solutions for TENORM (Technologically Enhanced Naturally-Occurring Radioactive Materials) waste.

7) Analyses of the long-term impact of uranium mining residue disposal will be carried out by the repository licensees in conformity with the applicable regulations. An assessment of the results of this study will be made by 2008.

8) The producers of mixed radiological and chemical waste will be required to continue to stabilise and process this waste, relying on ANDRA assessments with regard to any possible disposal.

2 MANAGEMENT OF VERY LOW LEVEL WASTE

The level of risk from radioactivity is very hard to determine for very low level (VLL) waste. In addition, this level of risk from the waste can be very close to that inherent in its chemical toxicity or possible infectiousness. The procedures for managing VLL waste must therefore take account of this difficulty.

2 | 1

VLL waste management principles

Some countries, such as Germany, have implemented a policy for the discharge of VLL waste based on activity thresholds. The German administration has therefore put into practice an option offered by European Council directive Euratom 96/29 of 13 May 1996.

French policy does not provide for unconditional discharge of VLL waste simply on the basis of universal thresholds. This leads to specific management of this waste and disposal of it in a dedicated repository.

Waste management in the BNIs is mainly regulated by the order of 31 December 1999. Any basic nuclear installation must be mapped out, with "zoning" of its buildings in which there is a risk of contaminated, activated or non-radioactive waste being produced. The zones likely to lead to the production of radioactive waste are referred to as "nuclear waste zones". The waste originating from nuclear waste zones has to be managed in dedicated channels. The waste from the other zones is, after checking that there is no radioactivity, routed to conventional waste channels (non-specific or special industrial waste). The ASN has published a guide, revised in September 2002, for the production of BNI waste studies. It is available from the ASN web site.

ANDRA – receipt of packages at the Morvilliers very low level waste repository

Recycling of waste from nuclear waste zones is possible. However it would be preferable for such recycling to take place in a channel that is already nuclear, such as the lead recycling from the Marcoule installations to produce biological protections. The reuse of recycled materials in consumer goods and construction products may be authorised by waiver to article R 1333-3 by order of the Minister for Health. Various projects were presented to the nuclear safety authority in 2004 and 2005: recycling of scrap decontaminated by the SOCATRI company and machined by Feursmétal to produce industrial parts, recycling in road-building of the concrete generated by nuclear installation dismantling, recycling of contaminated molybdenum and zircalloy items. The ASN does not at present envisage any waiver to article R. 1333-3 of the Public Health Code and is not favourable to use outside nuclear installations of materials or waste originating from nuclear activities and liable to have been contaminated. The Feursmétal company announced that it intended to give up reusing scrap decontaminated by Socatri in February 2005. Since then, the ASN has suspended investigation of the other dossiers.

2 | 2

The particular case of clean-up when dismantling installations

Dismantling operations can pose safety issues dealt with in chapter 15. This section only deals with operations designed to separate the nuclear parts (which could have been in contact with radioactive substances) from conventional parts (which could not have been in contact with radioactive substances).

2 | 2 | 1

Basic nuclear installations

The clean-up method today preferred by the ASN for nuclear installations is based on a waste zoning methodology. Using a demonstration based on the design of the installation, its operating methods, an analysis of its history (incidents, modifications, periodic radiological checks, etc) or any other empirical type of demonstration, the licensee must determine the waste zoning in its installation by accurately defining the boundary between conventional waste zones and nuclear waste zones.

With regard to complete clean-up of the structures in the nuclear waste zones, a policy note was prepared by the ASN in 2005. The first line of defence to be used must be based on a comprehensive picture of the condition of the installation and an understanding of the physical phenomena involved (activation, migration of contamination for example). Modelling of these phenomena enables a minimum clean-up thickness to be defined, with addition of a fixed safety margin. The total clean-up thickness thus obtained then corresponds to the limit between a nuclear waste zone and a conventional waste zone. The licensee then removes all nuclear waste from the nuclear waste zones, before implementing an appropriate inspection programme on the remaining elements, to confirm that there is no contamination or activation (2nd line of defence). It then proposes to the Director General of the ASN, 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 policy, the licensee of the Monts d'Arrée plant in Brennilis defined a general clean-up methodology based on determination of a minimum depth of concrete to be removed from the walls of the building, by analysing the operating history of this building, combined with modelling of migration of radionuclides through the concrete. After removal of this concrete thickness, a programme to confirm the conventional nature of the remaining walls was implemented.

In 2003 and 2004, EDF used this methodology to clean-up several nuclear buildings: the spent fuel building (BCI) and the effluent treatment station (STE) on the Monts d'Arrée site and all the hillside buildings at Chooz A. The requests for downgrading the nuclear waste zones in these buildings to conventional waste zones were approved by the ASN in 2004. These buildings were demolished using conventional demolition techniques and the resulting products are considered as conventional waste. Furthermore, in the current context of managing industrial sites being dismantled, the need became apparent for conservation of a trace of the past existence of a basic nuclear installation on a site, along with any utilisation restrictions appropriate to the condition of the site. A conventional encumbrance 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 in 2003: the licensee and state representatives signed a conventional encumbrance 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. The same type of encumbrance was put in place in 2005 at delicensing of the SATURNE installation (BNI 48) in the CEA Saclay centre.

2 | 2 | 2

Medical, industrial and research installations

There are as yet few dossiers concerning clean-up of medical, industrial and research installations. In 2004, a dossier for complete dismantling of a former pharmaceutical laboratory owned by Aventis-Pharma was submitted to the ASN for its opinion by the prefect of Seine-Saint-Denis. From 1956 to 2003, this laboratory carried out radioactive labelling of molecules for pharmaceutical research, using carbon 14 and tritium. The clean-up and dismantling methodology chosen is similar to that employed for nuclear installations: the premises are defined according to waste zoning, based primarily on the history of activities on the site and differentiating between nuclear waste and conventional waste. The clean-up targets were set and the waste will be removed to duly authorised channels. The preliminary studies and the operations are carried out in cooperation with the ANDRA.

2 | 3

Morvilliers VLL waste repository

The move to rationalise management of VLL waste initiated by the ASN in 1994 showed that it was necessary to create a repository for this type of waste. At the request of the nuclear licensees, technical studies had been conducted by the ANDRA and by the "ultimate" waste and polluted earth processing and disposal company as of 1996 with a view to creating a repository intended for very low level radioactive waste. The site finally chosen is not far from the Aube waste repository. The Prefect authorised the installation 26 June 2003. This installation classified for environmental protection purposes (ICPE), with a capacity of 650,000 m^3, has been operational since August 2003. In 2005, the installation received 15,000 m^3 of VLL waste. ANDRA plans to increase the monthly input of waste to 2000 m^3 in the coming years.

3 Management of radioactive waste by the producers

3 | 1

Waste management in basic nuclear installations

Once produced and before final disposal, certain radioactive waste undergoes treatments to reduce its volume or harmfulness and, whenever possibly, to recover exploitable materials. These treatments can produce secondary waste. After processing, the waste is packaged and then, depending on its nature, placed in an interim storage facility or sent to a waste repository.

The following paragraphs present the situation in basic nuclear installations.

3 | 1 | 1

CEA waste management

The CEA operates treatment, packaging and interim storage facilities for the main types of waste it produces through its research and dismantling activities as well as through its industrial activities (manufacture of sources). In general, each CEA site has treatment and packaging installations for the waste and radioactive effluent it produces (see chapter 13). The solid wastes for which there are operational channels (reprocessing, elimination by incineration or melting, disposal in approved surface repositories) are removed accordingly (installations of the CEA, Centraco, repository, etc.). Long-lived intermediate and high level waste is generally stored by the CEA in installations with a lifespan limited to a few decades, pending creation of a disposal channel. Very low level waste, a significant volume of which is generated, particularly owing to dismantling of CEA former installations, are stored on site and then taken away to the VLL waste repository. Liquid waste is treated, solidified and packaged in drums. Depending on their activity, the resulting packages are either disposed of in the ANDRA's Aube waste repository (CS-FMA), or stored by the CEA, pending availability of a final disposal channel.

The CEA also possesses solid and liquid legacy waste for which there could be treatment problems (technical difficulties due to problems with bulk collection of effluents from their storage tanks and lack of constituent chemical product characterisation or for which there is no operational disposal channel. The ASN ensures that treatment of this waste is one of CEA's priorities within its waste management policy and that adequate surveillance is maintained on the storage facilities pending treatment.

Nuclear fuel without further use from the civil sectors of the CEA is placed in interim storage, either dry (in a decay pit) or in a pool, pending definition of a disposal channel (reprocessing or storage).

One of the challenges for the CEA in radioactive waste management will be to commission new treatment installations within a time-frame compatible with its commitments to shutting down the older installations, which no longer meet modern safety standards.

The CEA strategy was seriously compromised by the decisions taken in 2003 to abandon the new installation projects such as ECUME for interim storage of spent fuel and irradiating solid waste, and ATENA for treatment of contaminated sodium waste.

In 2005, the CEA also announced a modification of the AGATE project on the Cadarache site, entailing treatment of the concentrates produced in AGATE by the Marcoule effluent treatment station. The ASN will be particularly vigilant concerning shared effluent management by the Marcoule and Cadarache centres, as proposed by the CEA. The ASN contemplates having the CEA's waste and spent fuel management strategy reviewed again by the members of the Advisory Committee for waste.

Aware of the fact that the CEA's decisions to abandon these installation projects were made in a context of budget restrictions, the ASN nonetheless considers that efforts must continue to maintain the aim of removal of waste from interim storage and cessation of treatment activities in the older installations.

3 | 1 | 2

Management of COGEMA waste

The COGEMA spent fuel reprocessing plant at La Hague produces most of this company's radioactive waste. The waste produced at La Hague comprises on the one hand the waste resulting from reprocessing of spent fuel and on the other, the waste linked to operation of the installations.

The waste generated by the spent fuels includes:

– **Fission products and minor actinides (high level)**:

After a decay period in stainless steel tanks, the fission product and minor actinide solutions resulting from spent fuel reprocessing are calcined then vitrified. The resulting molten glass, which contains the fission products and minor actinides, is poured into stainless steel containers. After the glass solidifies, the containers are transferred to an interim storage facility pending disposal or until they are sent to the customer.

This waste contains most of the radioactivity in the waste produced in France.

The annual volume of vitrified waste packages corresponding to reprocessing of EDF fuels, amounts to about 100 m^3.

– **Long-lived intermediate level structural waste**:

This chiefly consists of fuel metal cladding (called "hulls") and metal structures such as fuel assembly end-pieces. The packaging process consists in compacting the waste and placing it in a standard container. The final CSD-C package can also contain metal technological waste.

The authorisation for precommissioning of the hull compacting facility (ACC) and the unit for interim storage of CSD-C containers in E EV south-east was the subject of a ministerial authorisation in 2002.

Fuel assembly hulls, COGEMA La Hague ACC shop

2004 production on behalf of all COGEMA customers, amounted to 1050 CSD-Cs (or about 180 m^3), comprising both line production and recovery of legacy waste stored under water. This waste recovery process should continue in the coming years.

Waste linked to operation of the installations comprising:

– Waste from radioactive effluent treatment

The La Hague site operates two radioactive effluent treatment stations (STE 2 and STE 3). The effluents were treated in them by coprecipitation (still the case for the STE3, but in small quantities). The resulting sludge (STE 3) is evaporated, bitumen encapsulated and then 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 acid effluents are now evaporated in the various fuel reprocessing facilities and the concentrates are vitrified.

– Waste from organic effluent

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.

– Ion exchanger resins

The water in the fuel unloading and interim storage pools is continually purified by means of ion exchange resins. Once spent, these resins become process waste which must be treated. In September 2000, COGEMA was authorised to start operating the resin solidification facility (ACR), which uses a cementing process.

_ Technological waste not handled by the ACC

The technological waste is sorted, compacted and encapsulated or blocked in cement in the AD2 facility. The packages complying with ANDRA technical specifications for surface disposal are sent to the Aube repository. If this can not be the case, they are kept in interim storage pending a final disposal solution.

The volume of waste delivered in 2004 from the La Hague plant to the Aube LL-IL waste repository was about 1880 m^3, with a beta activity of about 60TBq (18% of the activity delivered to this centre in 2004) and an alpha activity of about 3TBq (38% of the activity delivered in 2004). The volume of waste from the La Hague plant delivered in 2004 to the VLL waste repository was 20 m^3.

Legacy waste is also present on the La Hague site. It is generally stored in tanks or in concrete compartments called silos.

Some of these storage areas do not meet currently required safety standards and waste will therefore have to be recovered from them, which could be very expensive.

A review of these interim storages was conducted in 1998 by the Advisory Committees for laboratories and plants and for waste.

Following this review, 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.

In 2003, the ASN asked COGEMA to send it a dossier concerning its management policy for the waste produced by the La Hague facility, including new elements and progress made in the recovery and dismantling programmes since the 1998 meeting of the Advisory committees. COGEMA submitted this dossier in 2004.

The Advisory Committee for laboratories and plants, accompanied by experts from the Advisory Committee for waste, met on this subject on 16 November 2005. The ASN in particular noted the following points following the group's review of the dossier:

On the whole, the present resources of the COGEMA La Hague facility would seem to be sufficient for reprocessing, packaging and storing the waste involved in all the programmes to be carried out in this facility in the coming years (fuel reprocessing, recovery and packaging of legacy waste and programme for final shutdown of UP2400).

However, the situation of the HAO silo and the 130 silo is unsatisfactory because, even though the safety level in these interim storage areas was felt to be inadequate, waste recovery operations have still not started.

Moreover, removal of the drums stored in building 119 needs to begin very soon, given the insufficient level of safety of this building.

With regard to the sludges from past operation of effluent treatment station no. 2 (STE2), the reference solution put forward by COGEMA for their treatment/packaging is bituminisation in STE3 using the existing installations.

A solution such as this would entail verification of the safety of the STE3 installations and setting up the specifications for the future packages.

3|1|3

EDF waste management

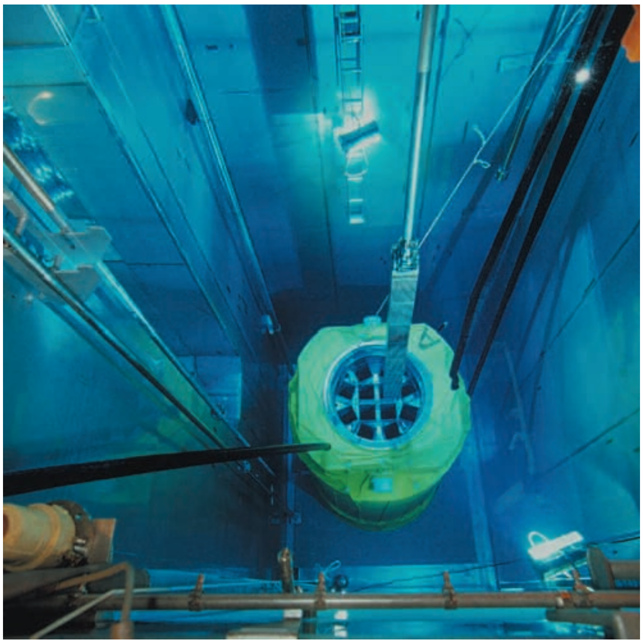
EDF waste comprises the following:

- ultimate waste from spent fuels after reprocessing in the COGEMA plant at La Hague and the share of fuels which are not to be reprocessed (high-level waste), activated waste, including rod control clusters and poison rod assemblies used for reactor control operations (long-lived intermediate level waste);
- waste resulting from plant operation and maintenance (low and intermediate level short-lived waste, and even some very low level waste);
- legacy waste, such as structural waste (graphite sleeves), waste from the former gas cooled reactor technology (GCR), which is long-lived low level waste;
- waste resulting from current dismantling of power plants (primarily very low level);
- the high-level and intermediate level long-lived waste from spent fuel after reprocessing in the COGEMA La Hague plant is described in point 3|1|2 above.

Activated waste, at present stored in pools, represents relatively small quantities and its long-term management is currently the subject of research by the CEA and ANDRA under the terms of the law of 30 December 1991 (articles L. 542-13 and L. 542-14 of the Environment Code).

Waste resulting from nuclear power plant operation and maintenance includes:

- waste from gaseous or liquid effluent treatment used to reduce the activity level prior to discharge. This includes ion exchange resins, water system filters, evaporator concentrates, liquid sludge, pre-filters, absolute filters and iodine traps;
- waste from maintenance operations. It may be solid (rags, paper, cardboard, vinyl sheets or bags, wooden or metal parts, rubble, gloves, protective clothing, etc.) or liquid (oils, decontamination effluents, etc.);
- special waste from exceptional replacement and maintenance operations (vessel heads, steam generators, fuel assembly storage racks, etc.).



Unloading of spent fuel, EDF Chinon

Some of the untreated waste produced is dealt with in the CENTRACO plant in Marcoule (metal melting or incineration of liquids, resins or other incinerable materials), in order to reduce the volume of ultimate waste.

For the other types of operating and maintenance waste, various packaging methods exist, in particular:
- solid waste compacting in the Aube LL-IL waste repository, followed by packaging in metal drums filled with a cement-based material;
- resin encapsulation in a polymer, inside a concrete container;
- filter encapsulation in a cement-based material, inside a concrete container.

This waste is stored in the Aube LL-IL waste repository and some particularly low level waste in the VLL waste centre.

Waste considered to be special owing to its dimensions and weight is also stored in the Aube LL-IL waste repository. This is in particular the case of the vessel heads (see point 6|1|2 below). All this operating and maintenance waste contains beta and gamma emitters and little or no alpha emitters.

It accounts for most of the beta activity delivered to the Aube LL-IL waste repository every year (in 2004, 258 TBq for beta emitters, or 77% of the delivered activity) and a very small amount of the alpha emitters (0.6%), with the total waste delivered amounting to 8520 m^3. Most of the activity is concentrated in the ion exchanger resins used to purify the water systems (pool water treatment system, primary water treatment systems, waste water treatment system) and in the primary coolant systems filters.

Waste from EDF past practices (graphite sleeves) is at present mainly stored at Saint-Laurent. The long-term management solution for this type of waste, as well as for the graphite stacks still in the shutdown GCR reactors, is covered in point 6|1|4 below.

Waste from plants currently being dismantled is mainly very low level waste.

In 2004, about 6870 m^3 of EDF VLL waste were delivered to the VLL waste repository.

The EDF fuel utilization policy, regarding both in-pile irradiation conditions and spent fuel management (see chapter 12), has repercussions on the fuel cycle installations (see chapter 14) and on the quantities and quality of the secondary waste produced. This subject was reviewed by the Advisory Committees for plants and for waste in late 2001 and early 2002.

In July 2002, the ASN asked EDF for additional information concerning the envisaged future management methods of the fuel and the consequences for the fuel buildings in the NPPs, the MELOX plants in Marcoule, FBFC in Romans-sur-Isère and COGEMA La Hague. In 2004 and 2005, the ASN asked EDF for additional data concerning the impact of the new “MOX parity” and “Galice” fuel management systems on the waste package specifications, on management of the waste and organic effluents produced in the various fuel cycle installations and on the “long-duration” dry interim storage project for MOX fuel. The answers are as yet incomplete and further details are required.

In 2002, the waste management policy developed by EDF, both centrally and in the NPPs, both for operating and legacy waste, was jointly reviewed by the Advisory Committees for reactors and for waste. On the basis of this review and the findings made during its own inspections in 2000 and 2001, the ASN asked EDF in December 2002 to improve the safety of the NPP buildings in which most waste management takes place, to start treatment and disposal of used steam generators, to look for channels for disposal of the activated waste stored in the pits, of chemical waste and of graphite waste. The ASN also asked EDF for clarification of its waste management organisation.

In 2004, EDF forwarded a clarification of its waste management organisation. EDF also carried out safety analyses on waste management in the nuclear auxiliary, packaging auxiliary and effluent treatment buildings. It transmitted the results to the ASN.

However, the ASN considers that the improvements required will have to be based on a better definition of the scope of operation for each site and on the measures envisaged by the fire action plan and needed to ensure conformity with the order of 31 December 1999. EDF was asked for additional data in 2005.

The following should be noted with respect to the other requests made by the ASN in 2002:
- EDF submitted a file for creation of a centralised interim storage facility for its activated waste;
- for the Saint-Laurent graphite sleeves, EDF must look for solutions to remedy the delay in the search for a graphite waste disposal site, given the current conditions of storage (see point 4|2 below).

3 | 1 | 4

Other licensees

The waste management by other BNI licensees is reviewed by the ASN on the basis of their waste surveys (see point 1|2).

3 | 2

Radioactive waste management in medical, industrial and research activities

3 | 2 | 1

Origin of waste and radioactive effluent

Many areas of human activity use radioactive sources; this is particularly the case with diagnostic and therapeutic activities. This activity may lead to the production of radioactive waste and effluent.

Sealed sources are mainly used for radiotherapy (telegammatherapy and brachytherapy) and for measurement. Given their characteristics (usually radionuclides with periods of several years and high activity levels) these sources must be recovered by their supplier once they are no longer needed, or by their manufacturer in the event of defaulting by the supplier. Decree 2002-460 of 4 April 2002 reinforced the sealed source recovery requirements previously adopted by the CIREA. These sealed sources are not likely to produce radioactive effluent in normal conditions of use and storage.

The use of unsealed sources in nuclear medicine, biomedical and industrial research is the reason for production of radioactive solid waste and liquid effluent: small laboratory equipment items used to prepare sources (tubes, gloves, etc.), medical equipment used for administration (syringes, needles, cotton swabs, compresses which could be soiled with biological products, etc.), remains of meals consumed by patients who had received diagnostic or therapeutic doses, and so on. The radioactive liquid effluents also come from source preparation (liquid radioactive residues, contaminated material rinsing water, scintillating products used to count certain radionuclides, and so on), as well as from the patients who naturally eliminate the radioactivity administered to them.

To the radioactive risk can be added the chemical and infectious risks, in particular in the biomedical field. The infectious risk is due to pathogens (viruses, bacteria, parasites) contained in certain waste and effluent produced by the health care activities. If this risk is to be controlled, then specific handling rules must be followed and appropriate packaging used, failing otherwise it nosocomial diseases (secondary infections contracted in the health care establishments) are possible.

Faced with this problem of health care waste contaminated by radionuclides, which appeared with the growth of nuclear medicine, the public authorities have initiated a process of supervision of the activities and information of both patients and practitioners concerning good practices to be observed in managing this waste. First, a circular from the Minister for Health (2007/323 of 9 July 2001) therefore clarified the provision of the 30 November 1981 order on the conditions for the use of artificial radionuclides used in unsealed sources for medical purposes. This circular established recommendations for management and disposal of hospital radioactive effluent. Since then, the Ministry for the Environment (DPPR) in 2003 sent the managers of landfills and incineration plants recommendations stating what to do if the alarms are triggered on the radioactivity detection gates now installed in all such installations. The Minister for Health issued a new article on 21 January 2004 instructing nuclear medicine practitioners to advise their patients returning home on how to properly dispose of any radioactive waste they may produce. After publication of this ministerial order, a working group was set up to harmonise practices and accompany the dissemination of these new measures.

3 | 2 | 2

Management and disposal of radioactive waste and effluent produced by biomedical research and nuclear medicine

The disposal of radioactive effluent and waste produced when handling radioactive sources must comply with the provisions of point 1.2 of this chapter, in particular circular 2001/323 of 9 July 2001.

An order concerning waste and effluent produced outside BNIs must be issued to implement article R 1333-12 of the Public Health Code. A working group coordinated by the ASN was set up in September 2004 to make a particularly close review of how the infectious and radioactive risk is dealt with in waste and effluent management, as well as of the regulatory requirements to be established. This working group comprises representatives from the health authorities (DGS, DDASS), from public health and research institutions (Paris public hospitals, Paris municipal hygiene laboratory, INSERM, etc.) and private pharmaceutical laboratories.

The working group reviewed the following:
– drafting and approval of the waste and effluent management plans;

- management using zoning or exemption thresholds;
- the possibility of discharging effluent contaminated with carbon 14 or tritium;
- installation discharge outlet monitoring conditions;
- study of impact of discharges;
- conditions requiring use of a radioactivity detection portal at site exits;
- consistency between requirements applicable to the infection risk and those applicable to the radioactive risk, in particular the conditions for storage and biocidal treatment of waste before it is sent for disposal (incineration).

The collection and management of the radioactive waste and effluent produced by biomedical research and nuclear medicine activities is based on 4 principles:
- the waste are sorted and packaged as soon as possible in the cycle in the producer units, so that separation can take account of the type of waste, the radionuclides it contains as well as their level of activity and half-life. Waste originating from use of radionuclides with a half-life of less than 100 days will be separated from the other waste;
- effluent and waste are stored following this preliminary sorting, for either local disposal (waste marked only by radionuclides with a half-life of less than 100 days), or collection by the ANDRA (presence of radionuclides with a half-life of more than 100 days);
- the radioactivity of the waste and effluent is systematically checked before disposal;
- the waste and effluent are disposed of using appropriate disposal channels. Waste originating from the use of radionuclides with a half-life of less than 100 days may be disposed of - after decay - in the household waste channel, provided that there is no chemical or infectious hazard. If there is, then waste resulting from medical care activities is sent to a specialised disposal channel. Aqueous liquid effluent containing radionuclides with a half-life of less than 100 days may, after decay, be sent to the public sewerage system.

a) With regard to solid waste, it must be collected from the units that produce it in specially reserved containers, designed to counter any radioactive, infectious and chemical hazard (dedicated packaging). This waste must then be routed to an area specially set aside for its storage, pending local disposal after radioactive decay, or collection by the ANDRA. This area must be specifically laid out to ensure secure access and containment of the radioactive materials.

After an interim storage period taking advantage of natural radioactive decay (as a general rule at least 10 half-lives of the radionuclides concerned), waste originating from medical activities can be disposed of in conventional or hospital waste channels, provided that the level of irradiation is low enough (about 1.5 to 2 times the background level) and there is adequate waste traceability. A gate type radiation detection system can be installed by the licensee to ensure compliance with the requirements mentioned above.

b) 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. 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 who have received therapeutic or diagnostic doses. In this latter case, the levels administered do not exceed 740 MBq per application.

To these controlled releases can be added the diffuse radioactivity from the patients, whether hospitalised in the establishment (outside protected rooms), or out-patients.

The procedures for collection of these effluents are as follows:

- effluent from the laboratories is routed to a series of 2 buffer tanks operating alternately with one being filled and the other used for decay storage. This arrangement avoids direct radioactive effluent discharge into the main sewerage system. The capacity of these tanks must be determined such as to allow storage for a time long enough to obtain clean-up of the effluent compatible with its discharge into the main waste water network (see following table presenting maximum activity concentration values on leaving the tanks);
- liquid effluent from the sanitary facilities in protected rooms is also collected in a series of buffer tanks with the same characteristics as those described above and operating in the same conditions. However, given the high activity concentration of this effluent, these tanks must be separate from those collecting laboratory effluent;
- releases from the sanitary facilities reserved for injected patients must pass through a septic tank type decay pit, before being sent to the main sewerage system. Given the short half-life of the radionuclides contained in this effluent (primarily technetium 99m which has a half-life of 6 hours) passing through this tank contributes to their radioactive decay.

Maximum activity concentration values on leaving the tanks

Activity concentration check-points	Activity concentration value adopted	Observations
Diagnostic buffer tanks	7 Bq/l	Tanks for effluent originating primarily in the preparation and administration premises of diagnostic or therapeutic activities (< 740 MBq) using radionuclides.
Therapy buffer tanks	100 Bq/l	Tanks connected to the sanitary facilities for patients receiving therapy > 740 MBq of iodine 131.
Septic tank	–	Septic tank connected to the nuclear medicine department sanitary facilities reserved for patients who have received diagnostic or therapeutic doses (< 740 MBq). As the septic tank functions on a continuous basis, there are no activity concentration values for the effluent output.
Hospital outlet	1,000 Bq/l of ^{99m}Tc 100 Bq/l of ^{131}I	These are reference guide values for checks to be regularly performed (at least 4 times per year, over a minimum period of 8h) or continuously with a device on the outlet. If the values are exceeded, a more complete review over a longer period is required in order to determine an average activity concentration which, if higher than the guide values, will require that the establishment look at ways of improving its effluent release methods.

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 different activity concentration values to be used for drainage of the buffer tanks or at the establishment outlet are given above.

3 | 3

Management of technologically enhanced naturally occuring radiation (TENORM) waste

In the environment, there is already a measurable background radiation due to the presence of radioelements which have been or are still being produced by various physical processes. Their concentration does not in general lead to any major hazard, obviating the need to take particular precautions against the radioactivity hazard. In France, exposure to natural radioactivity varies from region to region but is about 1 mSv/year.

Definition of enhanced natural radioactivity: all materials naturally contain radionuclides. Some, such are rare earths, are particularly rich in uranium and thorium. Handling or transforming them can lead to expose the workers or the population. We then talk of enhanced natural exposure, insofar as the radionuclides are naturally present in the raw materials and are not used for their fissile, fusible or fertile properties, but the industrial activities then enhance exposure of the persons. The raw materials liable to lead to significant doses are commonly called NORM (Naturally-Occurring Radioactive Materials) or TENORM (Technologically Enhanced Naturally-Occurring Radioactive Materials) if the industrial process concentrates the radionuclides.

3 | 3 | 1

Uranium mining waste

Uranium mines handle large quantities of raw materials and thus generate large quantities of VLL waste with enhanced natural radioactivity. These are the uranium mine residues, of which 2 categories must be distinguished:
- low-content ore (about 300 to 600 ppm) treated by static leaching and from which the residues take the form of rocky blocks of varying dimensions with a total average specific activity of 44 Bq/g (about 4 Bq/g of radium 226). These residues are placed either in stockpiles, or in open-cast mines, or used as the first covering layer for disposal of dynamic treatment residues;
- medium content ore (about 1 ‰ to 1% in French mines) processed by dynamic leaching and from which the residues take the form of clayey sand with a total average specific activity of 312 Bq/g

(about 29 Bq/g of radium 226). These residues are either placed in old open cast mines, sometimes with an additional dyke, or in pools with a surrounding dyke, or behind a dyke damming a thalweg.

In France, the treatment residues represent 49 million tons (31 million tons of dynamic treatment residue and 18 million tons of static treatment residue) spread over 17 disposal sites, run as ICPE. The national inventory of uranium mining sites, produced as part of the MIMAUSA programme (Memory and Impact of Uranium Mines: Summary and Archive) run by the Ministry for Ecology and Sustainable Development, can be accessed on the www.irsn.fr website.

Thinking about the safety review of former mining sites and the disposal of mining treatment residues, their long-term surveillance and the consequences of inappropriate future use of the land concerned is ongoing.

Case of the Limousin region uranium mining sites:

To encourage dialogue and debate around the Limousin region's uranium mining sites, the Haute Vienne prefect decided in April 2005 to set up a local information committee (CLI). The process to appoint the chairman and members of this CLI is ongoing.

On 24 December 2004, the Regional Directorate for Industry, Research and the Environment (DRIRE) received Cogema's operating results, which although they meet all the requirements nonetheless need some additional work. The DRIRE therefore asked the licensee to have an external peer-review carried out. At the same time the Minister for Ecology and Sustainable Development, the Minister Delegate for Industry and the Minister for Solidarity, Health and the Family decided to set up a pluralistic expert group (GEP) to regularly monitor the third-party assessment and take part in its coordination (reviewing the rehabilitation of the various sites with a view to their future use and control of short and long term risks, site surveillance procedures, the possible use of materials outside mining sites, and so on). This GEP will consist of about ten French and foreign experts, who should be appointed in the first half of 2006. This GEP's mission will last a limited period of time and should end in early 2007.

3 | 3 | 2

Waste resulting from other activities

The Public Health Code requires that industrial activities which are likely to enhance natural ionising radiation must conduct "exposure supervision [of persons] and a dose estimation". The order of 25 May 2005, concerning professional activities using raw materials containing NORM and which are not used owing to their radioactive properties, lists the professional activities concerned by the provisions of this order and within the next 2 years will lead to a precise inventory of the industries concerned throughout France. However, it should take somewhat longer to complete the assessment required by the order of the doses received by workers exposed to this radiation, as well as the population.

These activities are likely to generate waste which has concentrated the natural radioactivity and may therefore trigger the radiation alarm at the entrance to technical landfills.

For some of these activities, and in particular those leading to mining treatment residues (mines operated for extraction of rare earths, phosphate ore treatment residues produced by the superphosphated fertiliser industry, etc), the same problem can occur as for uranium mine processing residues (see point 3|3|1) concerning the large quantities of waste produced, often managed on-site, and for which there is today no appropriate disposal channel.

Some of these installations are not currently active, however most of them are (or were) regulated by part 1 of book V of the Environment Code. The ASN is cooperating with the relevant classified installations inspection services and in particular is taking part in the working group dealing with the acceptability of enhanced natural radioactivity waste, for which the activity level and concentration could be neglected from the radiation protection standpoint in landfills. The ASN aims to ensure that this waste is sorted and packaged as far upstream as possible, so that it is always routed to the appropriate channel. It should be noted that given the absence of a long-lived low level waste repository, the only channel currently available for the most active waste is interim storage.

In 2004, the ASN asked the Robin des Bois association to conduct a study into the effects of natural occurring radioactivity enhanced by human activities, and the correspondingly polluted sites in France. From 2004 to about mid-2005, the Robin des Bois association therefore sent out about 2300 questionnaires (including reminder letters) to the companies or administrations concerned by TENORM (technologically enhanced naturally-occurring radioactive materials). Each activity sector concerned had a specific questionnaire. These areas involve phosphates, monazite, rare earths, ilmenite, zirconium (refractories, abrasives, sanding, ceramics, foundries), ferrous and non-ferrous metals, mineral and spring waters, drinking water, spas, wells, geothermal activities, oil and gas, coal (combustion ashes), wood (combustion ashes) and papermaking. Finally, a standard questionnaire was also sent out to companies managing class I and II landfills in order to define a typology of the events which triggered the access portal detectors in 2004. These questionnaires are part of the precautionary approach designed to identify the potential sources of exposure to ionising radiation of workers and the public and aimed at providing the public with better protection should they be exposed to significant radiation without being aware of it. The study report was submitted to the ASN at the end of August 2005. This extremely complete report is currently being analysed. It comprises a certain number of recommendations which could be incorporated into the PNGDR-MV.

4 INTERIM STORAGE OF RADIOACTIVE WASTE AND SPENT FUEL

4 | 1

Basic nuclear installations intended for interim storage of radioactive waste and spent fuel

4 | 1 | 1

Solid waste treatment stations

The waste treatment stations on the CEA sites at Saclay (BNI 72), Fontenay (BNI 74) and Grenoble (BNI 79) (see chapters 13 and 15) also provide interim storage capacity for fuel elements or high level waste in pits and/or fuel blocks. The waste is packaged in containers and stored in radioactive decay pits. For BNIs 74 and 79, the CEA is involved in a programme to recover this waste as part of the process to denuclearise the Grenoble and Fontenay-aux-Roses sites.

In BNI 72, fuel is also stored in concrete blocks and is currently being recovered for reconditioning in the STAR facility at Cadarache prior to interim storage in the CASCAD facility in Cadarache.

The radioactive waste storage yard

The main role of the radioactive waste storage yard (BNI 56) in Cadarache is to provide interim storage of radioactive solid waste (IL-LL waste) from the operation or dismantling of CEA installations and which cannot be stored in the CSA.

The waste is stored there in pits, in warehouses and for the VLL waste, in a dedicated area. The start of operations at CEDRA makes it possible on the one hand to empty the recent pits in BNI 56 and the hangars, and on the other to recover waste stored in the old pits (Fosséa project). The ASN will be vigilant concerning implementation of these storage removal programmes.

4 | 1 | 2

CEDRA

Decree 2004-1043 of 4 October 2004 authorised the CEA to create the CEDRA basic nuclear installation (packaging and storage of radioactive waste) on the Cadarache site. CEDRA Unit 1 should enter service in 2006, and will comprise an interim storage unit for low-level packages, an interim storage unit for intermediate level packages and a technical station, which will be delayed for a few years (interim storage unit). This installation will eventually replace some of the CEA's existing installations, in particular BNI 37 for waste treatment, and BNI 56 for interim storage of low and intermediate level packages.

4 | 1 | 3

PEGASE/CASCAD

PEGASE and CASCAD are two installations at CEA Cadarache making up BNI 22.

PEGASE mainly stores spent fuel elements and radioactive substances and materials, either under water or dry. Drums of plutonium-containing by-products are stored in the PEGASE premises pending recovery for treatment.

On the occasion of the PEGASE periodic safety review, the CEA made a commitment to final shutdown of PEGASE operations no later than 2015. The PEGASE periodic safety review in 2003 did not enable the ASN to reach a final decision on continued operation of PEGASE and additional studies into the installation's earthquake resistance and justification of reinforcement works are to be supplied.

Given the scale of the work needed, the CEA preferred in December 2004 to propose final shutdown of the installation, which should close in 2010. In 2005, the CEA transmitted the safety case for the recovery and repackaging of the drums containing plutonium-bearing residues. After repackaging, this waste will be stored in CEDRA.

Total removal of waste from storage in PEGASE over the next five years is felt to be a priority by the ASN, which will be particularly vigilant with regard to compliance with the time-frame announced by the CEA.

The CASCAD installation is dedicated to dry storage of spent fuel. The fuel is placed in containers before being stored in pits, where it is cooled by natural convection.

4 | 2

Legacy waste

4 | 2 | 1

Recovery of waste from trenches in the CEA BNI 56

The Cadarache interim storage area (see point 4|1) is equipped with trenches filled between 1969 and 1974 with low and intermediate 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.). Operational recovery of this legacy waste began in 2005 and should progress at an estimated rate of one trench per year. There are a total of 5 trenches.

The trenches site will then be handled using the methodology employed for sites polluted by radioactive substances.

Waste recovery from pits

BNI 56 also contains old pits in which intermediate level waste is stored in conditions which no longer meet current safety requirements (some waste is not contained in packages appropriate for recovery in normal pit operating conditions and waste characterisation is inadequate or even non-existent). The CEA has initiated the FOSSEA project for recovery and repackaging of all the packages stored in the pits. Eventually, all the waste stored in the pits will be stored in CEDRA, after additional characterisation and repackaging as necessary.

Trench emptying worksite, BNI 56

4 | 2 | 2

The EDF Saint-Laurent silos (BNI 74)

The Saint-Laurent (BNI 74) silos consist of 2 semi-buried reinforced concrete bunkers. They are made tight by steel plating.

From 1971 to 1994, waste was stored in bulk in the silos. This waste was mainly graphite sleeves containing fuel elements from the nearby GCR reactors, plus technological waste.

There is only one containment barrier between the waste and the environment means. Therefore, this installation does not meet current safety criteria. The ASN asked EDF to empty the silos by 2010.

In 2005, EDF presented the ASN with the silo dismantling file for silo emptying operations. However, the solution proposed by EDF requires the availability of a final solution for graphite waste disposal as of 2010. It would however appear that such an installation could not be available before 2013, given the delay in the search for a host site.

Based on the assumption that the silos could not be operated beyond 2010 given their condition and the absence of any guarantee that the integrity of the silo steel plating barrier could be retained in the event of flooding, the ASN asked EDF to look at alternative strategies. The studies conducted by EDF indicate three possible options for which the ASN asked EDF to continue to review the technical feasibility:
- silo emptying deferred until graphite waste disposal facility becomes available, with silo operation beyond 2010, subject to improved surveillance of the installation and implementation of remedial measures;
- silo emptying and graphite disposal in the Aube repository (CSA);
- silo emptying and interim storage on the Saint-Laurent site in a dedicated installation, pending availability of a final disposal solution.

The ASN considers that it is up to EDF to find a satisfactory solution for the safety of its graphite waste.

4 | 3

Management of radioactive waste for which the producer is unknown or insolvent: a public service duty

Every year, radioactive objects for which there is no known owner are found, often when they trigger the radioactivity detection gates in waste disposal facilities and landfills. The objects concerned frequently contain small quantities of radium, a radioactive element commonly used in the early 20th century for its luminescent properties. Localised contamination of the sites following radioactive source handling incidents are also declared to the authorities. The waste management law of 15 July 1975 makes the producer responsible for the disposal of waste liable to harm public health or the environment. However, some of those in possession of radioactive objects or waste are not able to finance the relatively high cost of their disposal in a relevant channel. In such cases the owner of the waste is said to be defaulting.

4 | 3 | 1

Organisation of the public authorities and their various responsibilities

Jointly with the DGS, IPSN and OPRI, the DPPR drafted a circular dated 16 May 1997 on the management of sites contaminated by radioactive substances. The clean-up of these sites can lead to the production of radioactive waste. The DRIREs enforce the arrangements of this circular on behalf of the prefect.

Furthermore, the public authorities, more particularly the prefects, can ask the ANDRA, CEA or IRSN to take charge, at least temporarily, of radioactive waste. The conditions in which the prefects refer matters to these organisations must be specified in a draft circular prepared by the ASN, as regards radiological emergencies outside those about basic nuclear installations. Waste for which the owner defaults and for which responsibility is assumed by the State, will naturally be sent to ANDRA.

4 | 3 | 2

The types of waste concerned and special actions in progress

The waste concerned stems primarily from the widespread use at the beginning of the 20th century of radioactive products, such as radium for its luminescence or its medical applications (needles) and industrial properties (lightning conductors). This use may have led to contamination of land which is no longer used for industrial purposes.

The public authorities created several financing systems to help those in possession of this type of waste (private individuals in particular):

- the radium fund: this fund was set up in June 2001 and is used to provide up to half the cost of clean-up and recovery of waste from sites contaminated by past activities which used radium. The maximum value of the aid was revised at an interministerial meeting on 31 March 2005 and is capped at 75% for the entire clean-up process and 100% for making sites contaminated by radium safe;
- the agreement between the nuclear power sector producers and the ANDRA: this is implemented in order to secure a site contaminated by radioactive substances in accordance with the provisions of the circular of 16 May 1997 aforesaid.

These two measures cannot guarantee the medium-term financing needed to deal with waste for which the licensee is defaulting.

The radium fund was in fact set up for specific cases and can only be used when the contaminating radionuclide is radium. The agreement between ANDRA and the producers in the nuclear electricity generating sector also came to an end in May 2005. Discussions are under way to obtain another operational agreement between the producers in the nuclear electricity generating sector and ANDRA in 2006.

Under the terms of the 2005-2008 four-year services and resources contract which was signed on 1 August 2005 between the State and ANDRA, ANDRA's duties of general public interest will be financed by the Agency from its own resources, topped up as necessary by a subsidy from the Ministry of Industry's budget. The duties of general public interest benefiting from this subsidy are in particular certain activities relating to the collection of dispersed radioactive waste and depollution of contaminated sites entrusted to Andra by the authorities. By the end of 2005, Andra will submit appropriate management and financing arrangements to its supervisory ministries.

4|3|3

Public service storage facilities

The ANDRA does not operate storage facilities. It concludes agreements with other nuclear licensees so that they provide it with interim storage capacity.

The Socatri Company was thus authorised by decree to store low-level long-lived waste on behalf of the ANDRA in 2003. Radium lightning conductors are stored on behalf of the ANDRA in BNI 56 on the CEA's Cadarache installation. The CEA also stores used sources for which there are currently no disposal channels, in BNI 72 in Saclay.

ANDRA and the CEA signed an agreement in 2005 to clarify the conditions in which all the waste stored by the CEA is to be taken over by ANDRA (including radioactive sealed sources).

5 SITES POLLUTED BY RADIOACTIVE SUBSTANCES

5|1

The legal framework of action by the public authorities

5|1|1

Interministerial circular of 16 May 1997

According to this circular, a site polluted by radioactive substances is any site, either abandoned or in operation, on which natural or artificial radioactive substances have been or are employed or stored in conditions such that the site constitutes a hazard for health and the environment.

This circular, for the prefects, describes the administrative procedure applicable to sites polluted by radioactive substances and specifies that the treatment and rehabilitation operations are performed and financed directly by those responsible, as defined by the law of 19 July 1976 concerning installations classified for environmental protection purposes. In the absence of an identified or solvent person responsible, the ANDRA at the request of the ministries concerned, may oversee operations within the framework of procedures to finance rehabilitation of polluted sites defined in this circular. Non-renewal of the agreement covering polluted sites for which the owner has defaulted (see point 4|3|2) at the end of its period of validity, undermines the financing of operations under application of the circular of 16 May 1997. The Directorate for the Prevention of Pollution and Risks (DPPR) is currently looking at ways of updating this circular.

The methodology guide for management of industrial sites potentially contaminated by radioactive substances, which was published in October 2000 (version 0), describes the applicable approach for dealing with the various situations likely to be encountered in the rehabilitation of sites (potentially) contaminated by radioactive substances and explains the circular of 16 May 1997. This guide should be updated soon.

5 | 1 | 2

The law of 30 July 2003

Law 2003-699 of 30 July 2003 concerning industrial hazards updates the legislative framework for operation of an installation classified on environmental protection grounds and also applies to basic nuclear installations. It provides new tools for dealing with and preventing soil pollution and financing de-pollution. It therefore reinforces the regulations about site rehabilitation, including the obligation of information when selling land polluted by an industrial activity.

The 1 March 2005 circular concerning the inspection of classified installations - polluted sites and soils, as a result of the order by the European Court of Justice, referred to as the “Van de Valle” order of 7 September 2004, recalls that regardless of the action taken further to this order and whether or not materials are classified as waste, it appeared vital to preserve the principles of polluted soil management according to the use and the actual risk.

5 | 2

The inventories of polluted sites in France

Several complementary inventories are available to the public.

5 | 2 | 1

The ANDRA national inventory

Since 1993, the ANDRA has published a national inventory of radioactive waste giving information on the condition and location of radioactive waste around the country, including on sites identified as being polluted by radioactive substances. The November 2004 edition is available on the ANDRA website, www.andra.fr.

A new edition is planned for early 2006.

5 | 2 | 2

Databases of the Ministry for Ecology and Sustainable Development

The Ministry for Ecology and Sustainable Development set up a web portal dedicated to polluted or radiation contaminated sites and soils (www.sites-pollues.ecologie.gouv.fr). This portal gives access to two databases, according to the nature (chemical or radioactive) of the polluted site. They are:

• “BASOL” which is an inventory of the sites polluted or likely to be polluted and requiring preventive or remedial action on the part of the public authorities. In 2004, it contains about 3660 sites and is updated on a quarterly basis. A summary of the inventory is accessible on the Ministry for Ecology and Sustainable Development web site, www.ecologie.gouv.fr.

• "BASIAS" which is a record based on regional historical inventories of former industrial sites, a trace of which must be retained. Its purpose is to maintain inventoried site records in order to provide information of use for town planning, land transactions and environmental protection. This inventory should be completed for most departments by 2005/2006 and should contain between 200,000 and 300,000 sites. The information collected is input into a data base managed by the BRGM and available on the website, www.basias.brgm.fr.

5 | 3

Actions performed and dossiers in progress

5 | 3 | 1

General

The action diversity carried out by the ASN since 2002 as regards sites polluted by radioactive substances illustrates the great variety of situations encountered. The pollution can be due to former activities for which the industrial operator has disappeared (radium industry), "declining" economic activities (uranium mines, rare earths extraction sites) or new industrial activities. The health and environmental impacts also vary widely and the de-pollution targets to be defined depend on the future use (industrial, housing estate, school, park, etc.) chosen for the site concerned. After checking the de-pollution of the site and in order to preserve a history of the location, constraints must be put in place to confirm the possible uses and set utilisation restrictions as necessary.

5 | 3 | 2

Action taken

The "Radioactive contamination: how to deal with polluted sites? " symposium on 4 May 2004 in Paris.

On 4 May 2004, the ASN and the DPPR organised a symposium on the subject "Radioactive contamination: how to deal with polluted sites?", which brought together some 200 people and led to an exchange of views by the public authorities, industry, environmental protection associations and departmental and regional local government; it concerned general policy and the legal framework, hazard assessment, cleanup objectives and methodologies, real estate consequences, media coverage of both polluted site discovery and clean-up. It was an opportunity for presentation of a first inventory of radioactive polluted sites in France and how they are managed, with experience feedback on the management of radioactive polluted sites abroad, in order to compare the treatment of chemically polluted sites with those affected by radioactive pollution.

The collection of the papers submitted on this occasion constitutes an initial "white paper" on the management of polluted sites in France and abroad. The papers and proceedings of the symposium are available on the ASN web site. The ASN also devoted its magazine "Contrôle" issued on December 2004 to the follow-up on this 4 May symposium.

A 7-point plan of action for sites polluted by radioactive substances was drafted at the 4 May 2004 symposium (see above point). The action taken is listed below:

1. to consolidate and complete the inventory of potentially contaminated sites, the MIMAUSA mines inventory was distributed in April 2004, the Andra waste inventory in November 2004, and the TENORM inventory made progress following the study carried out by the Robin des Bois association and the order of 25 May 2005;


From left to right: former mining site of Bellezane (Haute-Vienne) before and after its redevelopment

Radioactive lightning conductor

2. to continue with action in progress concerning former uranium mining sites, by reviewing the safety aspect of the disposal sites, as necessary. The report by the radiation protection section of the CSHPF distributed in January 2005 gives an overview of the current situation of the uranium mining sites and presents various recommendations. The PNGDR-MV duly notes Cogema's commitments to the long-term future of its mining residue and a pluralistic expert group should be set up by the end of 2005 for the uranium mining sites in the Limousin region;

3. to increase prevention through measures requiring mandatory removal of radioactive objects (radioactive lightning conductors, radioactive smoke detectors). Technical studies into faster recovery of these objects will be reviewed by the PNGDR-MV;

4. to build channels for disposal of radioactive waste appropriate to clean-up of polluted sites: role of the National radioactive waste management plan;

5. to increase transparency by creating a dedicated web portal. A web portal dedicated to polluted or radiation contaminated sites and soils has been available since 2005 at the address www.sites-pollues.ecologie.gouv.fr;

6. to produce a method for determining action priorities for the authorities;

7. to review the applicable texts, in particular the 1997 circular, taking account of institutional changes, greater involvement by locally elected representatives, the financing mechanisms to be set up, and participation by the public as soon as possible in the process. The "methodological guide for management of industrial sites potentially contaminated by radioactive substances of October 2000 (version 0)" will have to be updated.

5 | 3 | 3

Some of the dossiers in progress

a) Coudraies area in Gif-sur-Yvette (Essonne)

Review of the files on the properties in the Coudraies area in Gif-sur-Yvette (91), which began in 2002, enabled the Essonne prefect to propose allocation of technical and financial aid for the simpler cases. Two clean-up projects were carried out in 2004. For the more complex cases, the committee in 2003 produced summary technical data sheets covering all the solutions reviewed, along with their technical and economic advantages and drawbacks, leaving it up to the ministries concerned to choose the most appropriate solution for each property, given the economic context. In 2005, the decision was made to purchase a property and make the site safe after purchase. Two dossiers are still to be dealt with.

The Essonne sub-prefecture for its part sent the Gif-sur-Yvette town hall a notification document in mid-2005 as part of the revision of the local urban development plan, which specifies the health requirements concerning the petite Coudraie district. This document was submitted to the ASN for its opinion.

Making safe the Isotopchim site in Ganagobie (Alpes-de Haute-Provence):

From 1987 to the end of 2000, the Isotopchim Company was involved in carbon 14 and tritium labelling of molecules intended for medical applications in Ganagobie (04). In 2000, the company went into liquidation, leaving a contaminated environment (incidental release of carbon 14 into the atmosphere and aqueous releases into the sewers) along with a large amount of chemical and radioactive waste on site.

Since the end of 2000, several inventories have been produced and an initial rehabilitation project reviewed. In December 2002, the ANDRA/producers programming committee for "orphan" sites, rejected funding of this project owing to the anticipated cost and the lack of any commitment from the local authority.

Since June 2003, the ASN has been associated with the search for solutions and various meetings have been held with all the stakeholders in order to make the site safe, look for appropriate disposal channels for removal of the priority waste present on the site and present this new rehabilitation project to the ANDRA/producers programming committee. A feasibility study was entrusted to ANDRA for depollution of the site. The security of the site was also improved in 2005.

b) DANNE property in Bandol (Var)

This property had been cleaned up in the past and the site is today a wasteland. The waste resulting from the decontamination operations carried out in 1992 is still on the site and residual hot spots still exist. The Var tax office is responsible for the site as administrator. In mid-2005, the decision was taken to make the site safe (brush clearance, removal of hot spots as required to allow easy maintenance of this plot, etc.). The site could be rehabilitated during a second phase, in particular through a redevelopment project.

5 | 3 | 4

Management of incidental contamination

The obligation of systematic installation of detection gantries in the industrial waste disposal or recycling centres has on several occasions in recent years revealed traces of radioactivity in the waste to be treated, leading to management of incidental radioactive contamination. Initial experience feedback from the incidents that have occurred since 2003 and which led to radioactive contamination in establishments which normally use no radioactivity (metal foundry) or in which radionuclides are not normally used in unsealed form, showed the need to be able to notify the establishment manager rapidly of his responsibilities and of the radioactive contamination hazards. The ASN drafted a memo in 2003 intended for rapid distribution to all managers of establishments in which unexpected radioactive contamination is detected.

A second memo should be sent out in 2006. It will specify the good practices to be implemented by the contractors responsible for the clean-up, decontamination and non-BNI dismantling operations.

This memo will guarantee:

- effective decontamination, consistent with clean-up policies used in installations using radionuclides in unsealed form;
- radioactive waste quality management, consistent with the existing waste disposal channels.

Situation in the Budin foundry in Aubervilliers (93) and the Métal Blanc lead treatment company in Bourg-Fidèle (08).

Following discovery of the radioactive content of the load on two lorries by the Métal Blanc company in Bourg-Fidèle (Ardennes *département*[1]), incidental uranium contamination had been revealed in the Budin works at Aubervilliers (Seine-St-Denis *département*) in 2003. Initial decontamination was carried out, but some parts of the installation retained traces of contamination. A second decontamination phase is awaiting financing.

The trailers containing radioactive substances immobilised for several months in the Métal Blanc company's car park were taken away in January 2005 after their content had been recovered. The radioactive waste resulting from these operations was managed in the authorised channels.

This type of incident raises the problem of monitoring the fate of radioactive objects contained in industrial or medical appliances which had received no specific radiation protection authorisation and which now have to be managed in authorised channels.

6 LONG-TERM MANAGEMENT OF RADIOACTIVE WASTE BY DISPOSAL

6 | 1

Long-term management by surface or subsurface disposal of radioactive waste

Most short-lived (less than 30 years) intermediate and low level waste is sent for final disposal to the surface waste repositories owned by the ANDRA (National Agency for Radioactive Waste Management).

These repositories operate on a principle whereby waste is confined and sheltered from hazards, notably water circulation, during what is known as a surveillance period, fixed by convention to last 300 years, until such time as their activity level has become negligible. There are two such repositories in France.

Surface or subsurface storage projects are being defined for other types of low-level waste.

6 | 1 | 1

Manche waste repository

The Manche waste repository, with its 530,000 m^3 capacity, was set up in 1969 at Digueville and operated until July 1994. The final covering (leaktight and grass-covered), to protect the structures containing the waste against all water infiltration, was completed in June 1997. The localised settling of this covering layer detected in September 1999 would not appear to have worsened significantly since. However, this aspect remains under close surveillance.

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 discharge licence application, revised in 1999.

1. Administrative division of the size of a county.

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 discharge licence. The regulations 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, the ASN also authorised the ANDRA to modify the separation network so that it could be resized to take account of the throughput of effluent during the surveillance period. In 2004, ANDRA sent the ASN the surveillance phase safety report, which is currently being reviewed.

ANDRA – Manche waste repository

6 | 1 | 2

Aube waste repository

The low and intermediate level short-lived waste (LL-ILW-SL) repository

The low and intermediate level waste (LL-IL) repository, which until 2005 was known as the Aube repository, was created in 1989. It is located on the communes of Soulaines-Dhuys and La Ville-aux-Bois in the Aube *département*. It covers a surface area of about one hundred hectares.

Since 1992, this Centre has taken over from the Manche repository. Its design has benefited extensively from feedback relating to the construction and operation of the former plant.

ANDRA – Aube waste repository

The reduction at source in the volume of waste produced by nuclear licensees and the ramp-up of the CENTRACO facility means that the continued operation of this centre for several more decades can be envisaged.

The waste packages are stored in concrete structures connected to a drainage network for possible water infiltration (separate free-falling subsurface system), which is permanently monitored. The site capacity is 1,000,000 cubic metres of waste packages, entailing about 400 structures.

In addition to the disposal structures, the repository also has a waste packaging facility in which 2 types of operations are carried out: compacting of 200 litre drums in a 1000 ton press and grouting of the 5 or 10 m^3 metal drums containing waste.

In 2001, the ANDRA was authorised by the ASN to accept for storage 55 EDF reactor vessel heads which had been replaced. The construction of the structures designed to take the vessel heads began in 2003. The first vessel heads were stored in 2005. The LL-IL waste repository currently contains 9 vessel heads.

In December 1999, the ASN authorised the ANDRA to use the Aube waste repository to store sealed radioactive sources from the CEA, with a half-life of less than that of cobalt 60. In January 2002, the ANDRA submitted an application for generic acceptance of radioactive sources meeting certain criteria, justified by a safety analysis based on the principles of RFS III.2.e. In 2004, the ASN gave the ANDRA authorisation in principle, although this did require that additional information be forwarded, in particular with respect to the packaging of used sealed sources. This additional information was provided by ANDRA in 2005 and the ASN authorised disposal of certain sources (radioactive half-life of less than 30 years, compliance with activity limits per source and per package).

In June 2002, the ANDRA sent the ministers in charge of nuclear safety an application to modify the authorisation decree of the LL-IL waste repository and a discharge licence application for this repository, to bring it into conformity with the provisions of the Environment code and its implementing decrees. This dossier was completed in 2004, and then submitted to a public inquiry. The dossiers dealing with these applications were the subject of a public inquiry from 30 November 2004 to 8 January 2005. The regulations authorising ANDRA to discharge effluent should be published in the Official Gazette in early 2006.

6 | 1 | 3

Package acceptance rules

In May 1995, in Basic Safety Rule III.2.e, the ASN defined requirements for radioactive waste package acceptance in a surface repository.

Prior to package acceptance in a waste repository, the ANDRA, which is responsible for the long term safety of the repository, must implement an approval procedure. The file presented by the waste producer must comprise a description of the packaging process used, the technical characterisation documents, an assessment of the activity contained and the quality assurance programme. The characteristics of each package must be in compliance with the technical specifications drawn up by the ANDRA.

Within this process, the ASN carries out surveillance inspections to check that the ANDRA acceptance procedure complies with Basic Safety Rule III.2.e requirements and to ensure that the procedure is correctly implemented. Inspections also take place on the premises of the nuclear licensees to supervise the ANDRA's surveillance of waste producers considered to be ANDRA contractors, as provided for in the order of 10 August 1984.

In 1999, the ASN initiated a project to update the RFS III.2.e. This RFS project will be submitted to the Advisory Committee for waste after the Aube repository safety review by the Advisory Committee scheduled for June 2006.

6 | 1 | 4

Surface or subsurface disposal projects

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 reviewing how to eliminate this waste. It is mainly working on a subsurface disposal concept (about fifteen metres below ground level).

For safety reasons, it is important to be able to dispose of this type of waste as soon as possible, as it is currently stored in unsatisfactory conditions. At the end of 2002, the ASN took a stand concerning the concepts proposed by the ANDRA. These concepts are felt to be acceptable but rely on theoretical geological models. The ASN considers that these studies can now only be taken a stage further within the framework of a study of a real site.

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 subsurface 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 search for a site announced at the 4 June 2004 meeting of the PNGDR-MV working group came to nothing, for a variety of reasons. The decision was taken to suspend this search during the debate on radioactive waste management and preparation of the bill on the management of HL-LL waste. The site search could therefore resume in 2007, so that a HL-LL waste repository could be available in 2012 - 2013.

Graphie assembly in graphite gas reactor

6 | 2

High-level long-lived waste disposal: application of the provisions of chapter II of part IV of the Environment Code as a result of law 91-1381 of 30 December 1991 concerning research into radioactive waste management

Articles L. 542-1 to L. 542-14 of the Environment Code set the broad outlines for research into 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:
- 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.

Most of 2005 was devoted to preparation for this deadline.

Those involved in the research work, the CEA and ANDRA, prepared a set of dossiers summarising the fourteen years of research in their respective areas: areas 1 and 3 for the CEA, and area 2 for ANDRA. A preliminary version of these dossiers was submitted in June 2005 and the final version in December 2005.

The Parliamentary Office for the Assessment of Scientific and Technological Options (OPECST) organised a series of hearings at the beginning of 2005, to review the current state of research in the various areas. The 15 March 2005 report took a clear stance on key subjects.

The National Assessment Commission will in early 2006 submit a summary of the quality of the work done and the results obtained and will specify a number of recommendations for future areas of work.

Based in particular on a review of the above-mentioned dossiers, the ASN will be required to submit an opinion to the Government at the beginning of 2006, concerning the safety of the various management solutions for high-level, long-lived waste.

As foreseen by the OPECST, Parliament could therefore give its approval in principle for a geological disposal type solution, for which the authorisation process has yet to be defined.

The ASN would clearly have a major role to play in determining whether the repository project offered the vital safety guarantees, prior to its construction.

The debate organised from September 2005 to January 2006 by the National Public Debates Committee, convened by the ministers for Industry and the Environment, should be a means of obtaining the opinion of the public concerning the general topic of radioactive waste.

All these elements should therefore be in place by early 2006 so that Parliament can reach a decision on this subject in 2006, the deadline set by the law of 30 December 1991.

The lessons learned from reviewing the results of the research by the players concerned are presented in the following chapters.

6 | 2 | 1

Separation/transmutation

Separation/transmutation processes are aimed at isolating and transforming long-lived radionuclides in nuclear waste into short-lived radionuclides and stable elements.

Separation covers a number of processes, the purpose of which is to recover separately certain long-lived transuranians or fission products. These radionuclides, after repackaging, will be incinerated (by fission) to give short-lived nuclides, or transmuted (by capture) into stable atoms. Ongoing studies in this area are complementary to those performed by the ANDRA on a deep repository design insofar as they could lead to a reduction in the potential harmfulness of the waste placed in the repository.

Laboratory results have been obtained with separation of actinides (americium, neptunium, curium) and long-lived fission products (iodine 129, technetium 99, caesium 135). With regard to transmutation, simulations of various reactor populations were conducted, for transmutation of minor actinides: PWR, fast neutron reactors, 4th generation reactors which will be capable of producing energy by incinerating their own waste and that of the previous generation of reactors. The transmutation strategy requires access to a large nuclear installed base for long periods. The industrial feasibility of these projects still however has to be explored, in particular in the field of transmutation, in which considerable research will still be needed.

The ASN ensures that the experimentations involved in this research programme, performed notably in the Phénix and Atalante installations, are carried out under satisfactory safety conditions. With regard to Phénix, after major reactor renovation work and a final review by the Advisory Committee for reactors at the end of 2002, the ASN informed the CEA in January 2003 that it had no objections to resumption of operation, which took place in July 2003. At a later stage in this research, the implications of possible industrialisation of the separation and transmutation processes will have to be reviewed. Given the scale of the research still to be carried out, it can be assumed that no industrial application of these processes could be possible before about 2040.

6 | 2 | 2

Underground laboratories

Article L. 542-3 of the Environment Code requires that the possibility of reversible and irreversible disposal of radioactive waste in deep geological formations must be reviewed, in particular by building underground laboratories.

To date, only a single site (Bure, Meuse) has been designated for location of an underground laboratory and authorised by a decree in 1999.

On the basis of this review, the ANDRA received approval of the shaft sinking conditions on 7 August 2000 from the Ministers for Industry and the Environment. In December 2005 the two laboratory shafts reached the target depth of 490 m. In the main shaft, at a depth of 445 m, a 40-metre long experimentation niche was built and equipped starting in September 2004. It has been operational since December 2004. Since this niche was built, 40 boreholes have been made to obtain information on the mechanical behaviour of the rock and the composition of the fluids in the clay, plus an experiment on the diffusion of tracers. Sensors were also installed to monitor disturbances during excavation of the main shaft down to 490 m. The auxiliary shaft reached its nominal depth of 490m in October 2004 and in December 2005, more than 200 m of drifts had been excavated. A multi-experiment drift was equipped in October 2005 and the results of the KEY experiment into the feasibility of sealing the drift are currently being analysed. Construction of the laboratory, with the two shafts being joined up, should end in late 2006. The drilling of 5 diverted boreholes in 2003-2004 confirmed the homogeneity of the host rock.

On 24 August 2004, ministerial approval was given for construction of the experimentation niche after review of the dossiers concerning the summary of mechanical and hydraulic disturbances caused by construction of the shafts and the construction and experimentation programmes concerning this niche. Ministerial approval for construction of the laboratory drifts followed by their actual construction took place on 2 February 2005 after review of the corresponding application forwarded by the ANDRA.

Through inspections at ANDRA head office and on the Bure site, the ASN is ensuring that all quality assurance steps are being taken to make sure that the experiments carried out during excavation of the shafts and in the experimental drifts provide the hoped for results and that the steps have been taken to limit hydraulic and mechanical disturbances in the shaft environment.

The preliminary versions of the 2005 Clay and Granite Dossiers were sent to the ASN in June 2005. In the second half of 2005, these dossiers were reviewed by the IRSN and the Clay dossier was reviewed by the Advisory Committee for waste.

At the same time, a peer review of the 2005 Clay dossier was organised by OECD/NEA at the request of the ministers for the Environment and for Industry.

Bure laboratory – experimental drift at a depth of 445 metres

Bure laboratory – experimental arrangement for sealing test

As they currently stand, the results submitted by ANDRA concerning the feasibility of a repository on the Bure site, indicate that there is nothing to oppose the possible construction of a repository in the geological formation reviewed at Bure. Additional information will however be required as part of the new investigative phase after 2006.

With regard to revision of the regulatory texts, the ASN - in association with the IRSN and the ANDRA - set up a working group responsible for updating RFS III.2.f on deep geological disposal of radioactive waste. The aim is to update the specifications for deep geological disposal by 2006. This updating of Basic Safety Rule III.2.f should allow consideration of design advances obtained notably in the radiation protection field, the importance attached to the notion of reversibility, together with feedback from various modelling exercises carried out in France and abroad. This work benefits from the extensive exchanges between French and Belgian experts. Franco-Belgian collaboration in particular led to the production of a joint document on "Elements of the safety approach to deep geological storage of radioactive waste". This document was translated into English, sent out to eight European partners active in this field and debated at a seminar organised at the Paris head offices of the ASN on 5 November 2004 under the chairmanship of the ASN and the AFCN. The Franco-Belgian document was also presented to the Advisory Committee for waste on 9 November 2004 to clarify the context for updating of RFS III.2.f.

Future actions to harmonise geological disposal safety rules were discussed and a further meeting was held on 20 May 2005 in Brussels. During this meeting, the decision was taken to create a working group with responsibility for conducting a pilot study on the regulatory analysis of a safety case for a geological repository. The working group consists of representatives from 8 European safety agencies, a representative of EU-DG/TREN and a representative of the IAEA. Two meetings were held, the first in Brussels on 30 June 2005 and the second in Stockholm on 27 and 28 October 2005.

6 | 2 | 3

Long-term storage

The CEA sent the Government its report on the packaging and long-term storage of high-level, long-lived waste. The report describes the research work carried out and the results achieved. The aim of the research into long-term storage is to design a system able to offer long-duration containment of radioactivity (the CEA envisages interim storage periods of from 100 to 300 years), while ensuring that it is still possible to recover the packages and guaranteeing compatibility with possible subsequent disposal.

It would seem that long-term storage is an unavoidable stage prior to a final management solution. However, the interim storage installations must be maintained such that the integrity of the barriers confining the radioactivity in the waste packages is preserved.

6 | 2 | 4

Specifications and approval certificates for waste packages unsuitable for surface disposal

Since 1996, the ANDRA has initiated a system of specifications and approval certificates which should in 2005 result in package approval certificates indicating conformity with the preliminary design specifications of a deep geological repository.

The ANDRA, together with the waste producer, has chosen a step-by-step procedure whereby initially, and until 2001, the only specifications required are those related to knowledge. It also defined requirements concerning qualification of the process and control of production by all waste producers, so that supervision could be implemented and non-conforming packages identified. 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. These specifications were distributed in their entirety in 2004 and 2005.

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.

7 OUTLOOK

The aim of the ASN is to ensure that radioactive waste is dealt with safely, unambiguously and exhaustively, regardless of its origin or the means of disposal. The ASN therefore prepared a National Radioactive Waste and Reusable Materials Management Plan (PNGDR-MV) with the assistance of a working group of waste producers and disposal facility managers, administrations, representatives of elected officials and of environmental protection associations. The draft plan was made available for consultation by the public on the ASN website, www.asn.gouv.fr.

With regard to management of high-level, long-lived radioactive waste, within the framework specified in the law of 30 December 1991, the parties involved in research met the deadline set by the law and submitted an initial version of their final report in June 2005. The national review board will in early 2006 submit a summary of the research done under the terms of the law of 30 December 1991 and the ASN will then submit a report on the safety and radiation protection of the various management solutions proposed.

At a parliamentary level, the Parliamentary Office for the Assessment of Scientific and Technological Options (OPECST) organised a series of hearings at the beginning of 2005 to review the current situation of the research carried out under the terms of the law of 30 December 1991 and formulated its recommendations and its stance in a report published on 15 March 2005 “For the long term: a 2006 law on the sustainable management of radioactive waste”, in which the OPECST expressed clear and ambitious stances on key issues.

Finally, the public debate on the management options for high-level, long-lived radioactive waste, organised by the National Public Debates Commission from September 2005 to January 2006, at the request of the ministers for Industry and for the Environment, aimed to collect the opinion of the citizens on the general topic of radioactive waste.

On the basis of the information collected in this way, it is important for Parliament to be able to decide in 2006 on how to manage radioactive waste. So that the scope of the decision by Parliament is not limited to high-level, long-lived waste alone, the guidelines of the National Radioactive Waste and Reusable Materials Management Plan could, as recommended by the OPECST in its March 2005 report, be approved by the future bill. The PNGDR-MV would thus be recognised as a key element in radioactive waste management in France.

A BASIC NUCLEAR INSTALLATION INSPECTORS

B LIST OF BASIC NUCLEAR INSTALLATIONS

C ACRONYMS AND ABBREVIATIONS

APPENDIX

BASIC NUCLEAR INSTALLATION INSPECTORS

(as at 31 December 2005)

MANAGEMENT
Jean-Luc LACHAUME

LEGAL AFFAIRS AND ORGANISATION
Philippe BORDARIER
Jean-René JUBIN

GENERAL SECRETARIAT
Luc CHANIAL

SD1
Jacques AGUILAR
Martine BAUDOIN
Guillaume BELOT
Marianne BERNE
Hervé BOEYAERT
Fabien FERON
Emmanuel JACOB
Jean JARAUDIAS
Olivier LEFORT
Sylvie RODDE
Séverine SOWINSKI
Sophie STRAWA

SD2
Yvan BARTHEZ
Yves BOULAIGUE
Fabrice CANDIA
Pierre CHARPENTIER
Jacques DAUBLANC
Olivier DESCHILDRE
Philippe DUPUY
Céline FASULO
Laurent FOUCHER
Laurent GALEGO
Christian GERMAIN
Sébastien GRENINGER
Olivier GUPTA
Muriel ISAFFO
Anne-Laure JOYE
Etienne KALALO
Marie-Eve NASSER
Ioana NEAMU
Stéphane RICHARD
Jacques SEEMANN
Daniel TASSET
Manuel VERMUSE
Céline VERNIER

SD3
Patrick BAUDOIN
Céline BLARY
Philippe BODENEZ
Dorothée CONTE
Olivier LAREYNIE
Cédric MESSIER
Odile PALUT-LAURENT
Philippe RAIMBAULT
Laurence TABARD
Claire TRONEL

SD4
Marc AMMERICH
Claude ASSALIT
Yvan AUJOLLET
Caroline BONDOIS
Jean-Marie CHABANE
Joseph CHAMBRAGNE
Jean-Jacques DIANA
Patrick FAVE
Marie-Noëlle LEVELUT
Marc STOLTZ

SD5 AND DSNR DIJON
Olivier ALLAIN
Dominique ARNAUD
Xavier BUSCOT
François COLONNA
Yves LAPOSTOLLE
Sophie MOURLON
Pascal MUTIN
Christophe QUINTIN
Anne-Cécile SIGWALT
Laurent STREIBIG
Cédric TESTANIERE
Jean-Charles VAN HOECKE
Rachel VAUCHER
Gilles VERNIER
Jean VOISIN

SD6
Claude BARBALAT
André JOUVE

SD7
Vincent DELPORTE
Anne PILLON

SD9
David KREMBEL

DSNR BORDEAUX
Erick BEDNARSKI
Julien COLLET
Jérôme GOLETTO
Thierry LECOMTE
Jean-Christophe LUC
Alain RIVIERE
Jean-Luc ROUSSEAU

DSNR CAEN
Valentin BLONDEL
Thierry CANLER
Philippe CHARTIER
Christine DARROUY
Jean DELMOND
Jean-Claude ESTIENNE
Emilie JAMBU
Dominique LEROY
Hélène MACH
Vincent MONNIER
Cécile SCHRIQUI
Naïma SEFSOUF
Olivier TERNEAUD

DSNR CHALONS-EN-CHAMPAGNE
Michel BABEL
Pierre-Yves GESLOT
Nicolas INCARNATO
Olivier MESUREUR
Alain THIZON

DSNR DOUAI
Jessie FOURCHE
François GODIN
Thierry GUERVILLE
Michel MARBAIX
Mathieu RIQUART
Philippe TALLENDIER

DSNR LYON
Jérôme BAI
Stéphane CALPENA
Marc CHAMPION
Jean-François DENIS
Sophie FORNER
Patrick HEMAR
Aline MORIN
Robert RIVOIRE
Christian ROBERT
Jean-Pierre SCALIA
Luc VENEAU
Benoît ZERGER

DSNR MARSEILLE
Guy CORNILLAUX
Magalie ESCOFFIER
Pierre JUAN
Hervé LAMOTTE
David LANDIER
Alexandre LION
Hélène PROVENS
Christian TORD
Pierre VULLIEZ

DSNR NANTES
Pierre SIEFRIDT

DSNR ORLÉANS
Serge ARTICO
Hubert BARATIN
Virginie BREBION
Nicolas CHANTRENNE
Yann DEFFIN
Yann DERRIEN
Patrice EDEY GAMASSOU
Michel FAUGERON
Pascal GALLON
Romuald GARDELLE
David MAGNIER
Christelle MARNET
Vincent PERCHE
Olivier VEYRET
Rémy ZMYSLONY

DSNR PARIS
Adeline CLOS

DSNR STRASBOURG
Olivier BONNER
Philippe BOUGIT
Philippe GRESS
Olivier KLEIN
Xavier LESAGE
Xavier MANTIN
Sébastien MATHIEUX
Guillaume WACK

LIST OF BASIC NUCLEAR INSTALLATIONS* (on 31.12.05)

No in the list	NAME AND LOCATION OF THE INSTALLATION	Licensee	Type of installation	Declared on:	Authorised on:	Official Gazette (O.G.) of:	OBSERVA-TIONS
18	ULYSSE (Saclay) 91191 Gif-sur-Yvette Cedex	CEA	Reactor	27.05.64			
19	MÉLUSINE 38041 Grenoble Cedex	CEA	Reactor	27.05.64			Shutdown on 30.06.88. Modification prior to dismantling and decommissioning: decree of 08.01.04 O.G. of 09.01.04
20	SILOÉ 38041 Grenoble Cedex	CEA	Reactor	27.05.64			Shutdown on 23.12.97. Final shutdown and dismantling decree of 26.01.05 O.G. of 02.02.05
21	SILOETTE 38041 Grenoble Cedex	CEA	Reactor	27.05.64			Final shutdown and dismantling: decree of 26.01.05 O.G. of 02.02.05
22	TEMPORARY DISPOSAL FACILITY (PÉGASE) AND SPENT NUCLAR FUEL DRY STORAGE INSTALLATION (CASCAD) (Cadarache) 13115 Saint-Paul-lez-Durance	CEA	Disposal of radioactive substances	27.05.64	17.04.80	27.04.80	Former reactor shutdown on 19.12.75. Modification: decree of 04.09.89 O.G. of 08.09.89 (creation of Cascad)
24	CABRI and SCARABÉE (Cadarache) 13115 Saint-Paul-lez-Durance	CEA	Reactors	27.05.64			
25	RAPSODIE/LDAC (Cadarache) 13115 Saint-Paul-lez-Durance	CEA	Reactor	27.05.64			Shutdown on 15.04.83
29	ARTIFICIAL RADIONUCLIDES PRODUCTION FACILITY (Saclay) 91191 Gif-sur-Yvette Cedex	CEA (Oris-Industrie)	Fabrication or transformation of radioactive substances	27.05.64			
32	PLUTONIUM TECHNOLOGY FACILITY (ATPu) (Cadarache) 13115 Saint-Paul-lez-Durance	CEA	Fabrication or transformation of radioactive substances	27.05.64			
33	SPENT FUEL REPROCESSING PLANT (UP2 and AT1) (La Hague) 50107 Cherbourg	COGEMA	Transformation of radioactive substances	27.05.64			Modification: decree of 17.01.74 O.G. of 05.02.74. Change in licensee: decree of 09.08.78 O.G. of 19.08.78 Boundary change: decree of 10.01.03 O.G. of 11.01.03

LIST OF BASIC NUCLEAR INSTALLATIONS* (continuation)

No in the list	NAME AND LOCATION OF THE INSTALLATION	Licensee	Type of installation	Declared on:	Authorised on:	Official Gazette (O.G.) of:	OBSERVA-TIONS
34	EFFLUENT AND SOLID WASTE TREATMENT STATION 92265 Fontenay-aux-Roses Cedex	CEA	Transformation of radioactive substances	27.05.64			
35	LIQUID EFFLUENT MANAGEMENT ZONE (Saclay) 91191 Gif-sur-Yvette Cedex	CEA	Transformation of radioactive substances	27.05.64			Modification: decree of 08.01.04 O.G. of 09.01.04
36	EFFLUENT AND SOLID WASTE TREATMENT STATION 38041 Grenoble Cedex	CEA	Transformation of radioactive substances	27.05.64			
37	EFFLUENT AND SOLID WASTE TREATMENT STATION (Cadarache) 13115 Saint-Paul-lez-Durance	CEA	Transformation of radioactive substances	27.05.64			
38	EFFLUENT AND SOLID WASTE TREATMENT STATION "STE2" AND SPENT NUCLEAR FUELS REPROCESSING FACILITY (AT1) (La Hague) 50107 Cherbourg	COGEMA	Transformation of radioactive substances	27.05.64			Change in Licensee: decree of 09.08.78. O.G. of 19.08.78 Boundary change: decree of 10.01.03 O.G. of 11.01.03
39	MASURCA (Cadarache) 13115 Saint-Paul-lez-Durance	CEA	Reactor		14.12.66	15.12.66	
40	OSIRIS - ISIS (Saclay) 91191 Gif-sur-Yvette Cedex	CEA	Reactors		08.06.65	12.06.65	
41	HARMONIE (Cadarache) 13115 Saint-Paul-lez-Durance	CEA	Reactor		08.06.65	12.06.65	Final shutdown and dismantling decree of 12.01.04 O.G. du 13.01.04
42	ÉOLE (Cadarache) 13115 Saint-Paul-lez-Durance	CEA	Reactor		23.06.65	28 and 29.06.65	
43	LINEAR ACCELERATOR (Saclay) 91191 Gif-sur-Yvette Cedex	CEA	Particle accelerator		08.10.65	13.10.65	Final shutdown and dismantling decree of 08.01.04 O.G. of 09.01.04
44	STRASBOURG UNIVERSITY REACTOR 67037 Strasbourg Cedex	Université Louis Pasteur	Reactor		25.06.65	01.07.65	
45	BUGEY NUCLEAR POWER PLANT (reactor 1) 01980 Loyettes	EDF	Reactor		22.11.68	24.11.68	Boundary change: decree of 10.12.85 O.G. of 18.12.85. Reactor shutdown on 27.05.94 Final shutdown decree of 30.08.96 O.G. of 07.09.96

LIST OF BASIC NUCLEAR INSTALLATIONS* (continuation)

No in the list	NAME AND LOCATION OF THE INSTALLATION	Licensee	Type of installation	Declared on:	Authorised on:	Official Gazette (O.G.) of:	OBSERVATIONS
46	SAINT-LAURENT-DES-EAUX NUCLEAR POWER PLANT (reactors A1 and A2) 41220 La Ferté-Saint-Cyr	EDF	Reactors		22.11.68	24.11.68	Boundary change: decree of 10.12.85 O.G. of 18.12.85 Final shutdown decree of 11.04.94 O.G. of 16.04.94
47	ELAN IIB FACILITY (La Hague) 50107 Cherbourg	COGEMA	Transformation of radioactive substances		03.11.67	09.11.67	Change in licensee: decree of 09.08.78 O.G. of 19.08.78
49	HIGH ACTIVITY LABORATORY (Saclay) 91191 Gif-sur-Yvette Cedex	CEA	Use of radioactive substances	08.01.68			Extension: decree of 22.02.88 O.G. of 24.02.88
50	SPENT FUEL TEST LABORATORY (LECI) (Saclay) 91191 Gif-sur-Yvette Cedex	CEA	Use of radioactive substances	08.01.68			Modification: decree of 30.05.00 O.G. of 03.06.00
52	ENRICHED URANIUM PROCESSING FACILITY (ATUE) (Cadarache) 13115 Saint-Paul-lez-Durance	CEA	Fabrication of radioactive substances	08.01.68			
53	ENRICHED URANIUM AND PLUTONIUM WAREHOUSE (Cadarache) 13115 Saint-Paul-lez-Durance	CEA	Radioactive substances depot	08.01.68			
54	CHEMICAL PURIFICATION LABORATORY (Cadarache) 13115 Saint-Paul-lez-Durance	CEA	Transformation of radioactive substances	08.01.68			
55	ACTIVE FUEL EXAMINATION LABORATORY (LECA) AND SPENT FUEL REPROCESSING, CLEAN-UP AND REPACKAGING STATION (STAR) (Cadarache) 13115 Saint-Paul-lez-Durance	CEA	Use of radioactive substances	08.01.68			Modification: decree of 04.09.89 O.G. of 08.09.89 (creation of STAR)
56	RADIOACTIVE WASTE INTERIM STORAGE AREA (Cadarache) 13115 Saint-Paul-lez-Durance	CEA	Disposal of radioactive substances	08.01.68			
57	PLUTONIUM CHEMISTRY LABORATORY (LCPu) 92265 Fontenay-aux-Roses Cedex	CEA	Use of radioactive substances	08.01.68			Final production shutdown: 01.07.95
59	LABORATORY FOR PLUTONIUM BASED FUEL STUDIES (RM2) 92265 Fontenay-aux-Roses Cedex	CEA	Use of radioactive substances	08.01.68			Shutdown on 31.07.82
61	ACTIVE MATERIAL ANALYSIS LABORATORY (LAMA) 38041 Grenoble Cedex	CEA	Use of radioactive substances	08.01.68			

LIST OF BASIC NUCLEAR INSTALLATIONS* (continuation)

No in the list	NAME AND LOCATION OF THE INSTALLATION	Licensee	Type of installation	Declared on:	Authorised on:	Official Gazette (O.G.) of:	OBSERVA-TIONS
63	FUEL ELEMENTS FABRICATION PLANT 26104 Romans-sur-Isère	FBFC	Fabrication of radioactive substances	09.05.67			Change in licensee: decree of 02.03.78 O.G. of 10.03.78 Modification: decree of 09.08.78 O.G. of 08.09.78
65	NUCLEAR FUELS FABRICATION PLANT 38113 Veurey-Voroize	SICN	Fabrication of radioactive substances	27.10.67			
66	MANCHE WASTE REPOSITORY (CSM) 50448 Beaumont-Hague	ANDRA	Disposal of radioactive substances		19.06.69	22.06.69	Change in licensee: decree of 24.03.95 O.G. of 26.03.95 Modification: decree of 10.01.03 O.G. of 11.01.03
67	HIGH FLUX REACTOR (RHF) 38041 Grenoble Cedex	Institut Max von Laue Paul Langevin	Reactor		19.06.69 05.12.94	22.06.69 06.12.94	Boundary change: decree of 12.12.88 O.G. of 16.12.88
68	DAGNEUX IONISATION PLAN Z.I. Les Chartinières 01120 Dagneux	IONISOS	Use of radioactive substances		20.07.71	25.07.71	Increase in maxi-mum activity of ionisation source: decree of 15.06.78 O.G. of 27.06.78 Change in licensee: decree of 23.10.95 O.G. of 28.10.95
71	PHÉNIX NUCLEAR POWER PLANT (Marcoule) 30205 Bagnols-sur-Cèze	CEA	Reactor		31.12.69	09.01.70	
72	SOLID RADIOACTIVE WASTE MANAGEMENT ZONE (Saclay) 91191 Gif-sur-Yvette Cedex	CEA	Radioactive substances disposal or depot		14.06.71	22.06.71	
73	SOLID RADIOACTIVE WASTE INTERIM STORAGE FACILITY 92265 Fontenay-aux-Roses Cedex	CEA	Radioactive substances disposal or depot		14.06.71	22.06.71	
74	INTERIM STORAGE OF IRRADIATED GRAPHITE SLEEVES (Saint-Laurent-des-Eaux) 41220 La Ferté-Saint-Cyr	EDF	Radioactive substances disposal or depot		14.06.71	22.06.71	Change in licensee: decree of 28.06.84 O.G. of 06.07.84
75	FESSENHEIM NUCLEAR POWER PLANT (reactors 1 and 2) 68740 Fessenheim	EDF	Reactors		03.02.72	10.02.72	Boundary change: decree of 10.12.85 O.G. of 18.12.85
77	POSÉIDON-CAPRI IRRADIA-TION FACILITIES (Saclay) 91191 Gif-sur-Yvette Cedex	CEA	Use of radioactive substances		07.08.72	15.08.72	

LIST OF BASIC NUCLEAR INSTALLATIONS* (continuation)

No in the list	NAME AND LOCATION OF THE INSTALLATION	Licensee	Type of installation	Declared on:	Authorised on:	Official Gazette (O.G.) of:	OBSERVA-TIONS
78	BUGEY NUCLEAR POWER PLANT (reactors 2 and 3) 01980 Loyettes	EDF	Reactors		20.11.72	26.11.72	Boundary change: decree of 10.12.85 O.G. of 18.12.85
79	DECAY INTERIM DECAY STORAGE PITFACILITY 38041 Grenoble Cedex	CEA	Radioactive substances disposal or depot		20.12.72	01.02.73	
80	HAO (HIGH LEVEL OXIDE) FACILITY (La Hague) 50107 Cherbourg	COGEMA	Transformation of radioactive substances		17.01.74	05.02.74	Change in licensee: decree of 09.08.78 O.G. of 19.08.78 Boundary change: decree of 10.01.03 O.G. of 11.01.03
84	DAMPIERRE NUCLEAR POWER PLANT (reactors 1 and 2) 45570 Ouzouer-sur-Loire	EDF	Reactors		14.06.76	19.06.76	
85	DAMPIERRE NUCLEAR POWER PLANT (reactors 3 and 4) 45570 Ouzouer-sur-Loire	EDF	Reactors		14.06.76	19.06.76	
86	BLAYAIS NUCLEAR POWER PLANT (reactors 1 and 2) 33820 Saint-Ciers-sur-Gironde	EDF	Reactors		14.06.76	19.06.76	
87	TRISCATIN NUCLEAR POWER PLANT (reactors 1 and 2) 26130 Saint-Paul-Trois-Châteaux	EDF	Reactors		02.07.76	04.07.76	Boundary change: decree of 10.12.85 O.G. of 18.12.85
88	TRICASTIN NUCLEAR POWER PLANT (reactors 3 and 4) 26130 Saint-Paul-Trois-Châteaux	EDF	Reactors		02.07.76	04.07.76	Boundary change: decree of 10.12.85 O.G. of 18.12.85 Boundary change: decree of 29.11.04 O.G. of 02.12.04
89	BUGEY NUCLEAR POWER PLANT (reactors 4 and 5) 01980 Loyettes	EDF	Reactors		27.07.76	17.08.76	Boundary change: decree of 10.12.85 O.G. of 18.12.85
90	PELLET FABRICATION FACILITY 38113 Veurey-Voroize	SICN	Fabrication of radioactive substances		27.01.77	29.01.77	Modifications: decrees of 15.06.77 O.G. of 19.06.77 and 14.10.86 O.G. of 17.10.86

LIST OF BASIC NUCLEAR INSTALLATIONS* (continuation)

No in the list	NAME AND LOCATION OF THE INSTALLATION	Licensee	Type of installation	Declared on:	Authorised on:	Official Gazette (O.G.) of:	OBSERVA-TIONS
91	SUPERPHÉNIX REACTOR 38510 Morestel	EDF	Fast neutron reactor		12.05.77 10.01.89	28.05.77 12.01.89	Boundary change: decree of 24.07.85 O.G. of 31.07.85 Commissioning postponement: decree of 25.07.86 O.G. of 26.07.86 Final shutdown and change in licensee decree of 30.12.98 O.G. of 31.12.98
92	PHÉBUS (Cadarache) 13115 Saint-Paul-lez-Durance	CEA	Reactor		05.07.77	19.07.77	Modification: decree of 07.11.91 O.G. of 10.11.91
93	GEORGES BESSE PLANT FOR URANIUM ISOTOPE SEPARA-TION BY GASEOUS DIFFUSION (Eurodif) 26702 Pierrelatte Cedex	EURODIF PRODUC-TION	Transforma-tion of radioactive substances		08.09.77	10.09.77	Boundary change: decree of 22.06.85 O.G. of 30.06.85
94	IRRADIATED MATERIALS FACILITY (Chinon) 37420 Avoine	EDF	Use of radioactive substances	29.01.64			Modification: decree of 15.04.85 O.G. of 19.04.85
95	MINERVE (Cadarache) 13115 Saint-Paul-lez-Durance	CEA	Reactor		21.09.77	27.09.77	
96	GRAVELINES NUCLEAR POWER PLANT (reactors 1 and 2) 59820 Gravelines	EDF	Reactors		24.10.77	26.10.77	Boundary change: decree of 29.11.04 O.G. of 02.12.04
97	GRAVELINES NUCLEAR POWER PLANT (reactors 3 and 4) 59820 Gravelines	EDF	Reactors		24.10.77	26.10.77	Boundary change: decree of 29.11.04 O.G. of 02.12.04
98	NUCLEAR FUELS FABRICATION UNIT 26104 Romans-sur-Isère	FBFC	Fabrication of radioactive substances		02.03.78	10.03.78	
99	CHINON INTERREGIONAL WAREHOUSE 37420 Avoine	EDF	Interim storage of new fuel		02.03.78	11.03.78	Modification: decree of 04.06.98 O.G. of 06.06.98
100	SAINT-LAURENT-DES-EAUX NUCLEAR POWER PLANT (reactors B1 and B2) 41220 La Ferté-Saint-Cyr	EDF	Reactors		08.03.78	21.03.78	
101	ORPHÉE (Saclay) 91191 Gif-sur-Yvette Cedex	CEA	Reactor		08.03.78	21.03.78	
102	BUGEY INTERREGIONAL WAREHOUSE 01980 Loyettes	EDF	Interim storage of new fuel		15.06.78	27.06.78	Modification: decree of 04.06.98 O.G. of 06.06.98
103	PALUEL NUCLEAR POWER PLANT (reactor 1) 76450 Cany-Barville	EDF	Reactor		10.11.78	14.11.78	

LIST OF BASIC NUCLEAR INSTALLATIONS* (continuation)

No in the list	NAME AND LOCATION OF THE INSTALLATION	Licensee	Type of installation	Declared on:	Authorised on:	Official Gazette (O.G.) of:	OBSERVA-TIONS
104	PALUEL NUCLEAR POWER PLANT (reactor 2) 76450 Cany-Barville	EDF	Reactor		10.11.78	14.11.78	
105	URANIUM HEXAFLUORIDE PREPARATION PLANT (COMURHEX) 26130 Saint-Paul-Trois-Châteaux	COMU-RHEX	Transforma-tion of radioactive substances	22.03.79			Classified secret until 31.12.78 (décision de déclassement du 10.07.78)
106	LABORATORY FOR THE USE OF ELECTROMAGNETIC RADIATION (LURE) 91405 Orsay Cedex	CNRS	Particle accelerator				Change in licen-see: decree of 08.07.85 O.G. of 12.07.85 Modification: decree of 02.07.92 O.G. of 08.07.92
107	CHINON NUCLEAR POWER PLANT (reactors B1 and B2) 37420 Avoine	EDF	Reactors		04.12.79	08.12.79	Modification: decree of 21.07.98 O.G. of 26.07.98
108	FLAMANVILLE NUCLEAR POWER PLANT (reactor 1) 50830 Flamanville	EDF	Reactor		21.12.79	26.12.79	
109	FLAMANVILLE NUCLEAR POWER PLANT (reactor 2) 50830 Flamanville	EDF	Reactor		21.12.79	26.12.79	
110	BLAYAIS NUCLEAR POWER PLANT (reactors 3 and 4) 33820 Saint-Ciers-sur-Gironde	EDF	Reactors		05.02.80	14.02.80	
111	CRUAS NUCLEAR POWER PLANT (reactors 1 and 2) 07350 Cruas	EDF	Reactors		08.12.80	31.12.80	Boundary change: decree of 10.12.85 O.G. of 18.12.85 Boundary change: decree of 29.11.04 O.G. of 02.12.04
112	CRUAS NUCLEAR POWER PLANT (reactors 3 and 4) 07350 Cruas	EDF	Reactors		08.12.80	31.12.80	Boundary change: decree of 29.11.04 O.G. of 02.12.04
113	LARGE NATIONAL HEAVY ION ACCELERATOR (GANIL) 14021 Caen Cedex	G.I.E. GANIL	Particle accelerator		29.12.80	10.01.81	Modification: decree of 06.06.01 O.G. of 13.06.01
114	PALUEL NUCLEAR POWER PLANT (reactor 3) 76450 Cany-Barville	EDF	Reactor		03.04.81	05.04.81	
115	PALUEL NUCLEAR POWER PLANT (reactor 4) 76450 Cany-Barville	EDF	Reactor		03.04.81	05.04.81	

LIST OF BASIC NUCLEAR INSTALLATIONS* (continuation)

No in the list	NAME AND LOCATION OF THE INSTALLATION	Licensee	Type of installation	Declared on:	Authorised on:	Official Gazette (O.G.) of:	OBSERVA-TIONS
116	REPROCESSING PLANT FOR SPENT FUEL ELEMENTS FROM LIGHT WATER REACTORS "UP3 A" (La Hague) 50107 Cherbourg	COGEMA	Transformation of radioactive substances		12.05.81	16.05.81	Commissioning postponement: decree of 28.03.89 O.G. of 07.04.89 Modification: decree of 18.01.93 O.G. of 24.01.93 Modification: decree of 10.01.03 O.G. of 11.01.03 Boundary change: decree of 10.01.03 O.G. of 11.01.03
117	REPROCESSING PLANT FOR SPENT FUEL ELEMENTS FROM LIGHT WATER REACTORS "UP2 800" (La Hague) 50107 Cherbourg	COGEMA	Transformation of radioactive substances		12.05.81	16.05.81	Commissioning postponement: decree of 28.03.89 O.G. of 07.04.89 Modification: decree of 18.01.93 O.G. of 24.01.93 Modification: decree of 10.01.03 O.G. of 11.01.03 Boundary change: decree of 10.01.03 O.G. of 11.01.03
118	LIQUID EFFLUENT AND SOLID WASTE TREATMENT STATION "STE3" (La Hague) 50107 Cherbourg	COGEMA	Transformation of radioactive substances		12.05.81	16.05.81	Commissioning postponement: decree of 27.04.88 O.G. of 03.05.88 Modification: decree of 10.01.03 O.G. of 11.01.03 Boundary change: decree of 10.01.03 O.G. of 11.01.03
119	SAINT-ALBAN-SAINT-MAURICE NUCLEAR POWER PLANT (reactor 1) 38550 Le Péage-de-Roussillon	EDF	Reactor		12.11.81	15.11.81	
120	SAINT-ALBAN-SAINT-MAURICE NUCLEAR POWER PLANT (reactor 2) 38550 Le Péage-de-Roussillon	EDF	Reactor		12.11.81	15.11.81	
121	CADARACHE IRRADIATOR (IRCA) 13115 Saint-Paul-lez-Durance	CEA	Use of radioactive substances		16.12.81	18.12.81	Final shutdown and dismantling decree of 12.01.04 O.G. of 13.01.04
122	GRAVELINES NUCLEAR POWER PLANT (reactors 5 and 6) 59820 Gravelines	EDF	Reactors		18.12.81	20.12.81	Boundary change: decree of 10.12.85 O.G. of 18.12.85

LIST OF BASIC NUCLEAR INSTALLATIONS* (continuation)

No in the list	NAME AND LOCATION OF THE INSTALLATION	Licensee	Type of installation	Declared on:	Authorised on:	Official Gazette (O.G.) of:	OBSERVA-TIONS
123	LABORATORY FOR THE EXPERIMENTAL DESIGN AND FABRICATION OF ADVANCED NUCLEAR FUELS (LEFCA) (Cadarache) 13115 Saint-Paul-lez-Durance	CEA	Fabrication of radioactive substances		23.12.81	26.12.81	
124	CATTENOM NUCLEAR POWER PLANT (reactor 1) 57570 Cattenom	EDF	Reactor		24.06.82	26.06.82	
125	CATTENOM NUCLEAR POWER PLANT (reactor 2) 57570 Cattenom	EDF	Reactor		24.06.82	26.06.82	
126	CATTENOM NUCLEAR POWER PLANT (reactor 3) 57570 Cattenom	EDF	Reactor		24.06.82	26.06.82	
127	BELLEVILLE NUCLEAR POWER PLANT (reactor 1) 18240 Léré	EDF	Reactor		15.09.82	16.09.82	
128	BELLEVILLE NUCLEAR POWER PLANT (reactor 2) 18240 Léré	EDF	Reactor		15.09.82	16.09.82	Boundary change: decree of 29.11.04 O.G. of 02.12.04
129	NOGENT NUCLEAR POWER PLANT (reactor 1) 10400 Nogent-sur-Seine	EDF	Reactor		28.09.82	30.09.82	Boundary change: decree of 10.12.85 O.G. of 18.12.85
130	NOGENT NUCLEAR POWER PLANT (reactor 2) 10400 Nogent-sur-Seine	EDF	Reactor		28.09.82	30.09.82	Boundary change: decree of 10.12.85 O.G. of 18.12.85
132	CHINON NUCLEAR POWER PLANT (reactors B3 and B4) 37420 Avoine	EDF	Reactors		07.10.82	10.10.82	Modification: decree of 21.07.98 O.G. of 26.07.98
133	CHINON A1D 37420 Avoine	EDF	Radioactive substances disposal or depot		11.10.82	16.10.82	Former reactor shutdown on 16.04.73
134	URANIUM WAREHOUSE 13140 Miramas	COGEMA	Interim storage of products containing uranium		16.11.83	19.11.83	
135	GOLFECH NUCLEAR POWER PLANT (reactor 1) 82400 Golfech	EDF	Reactor		03.03.83	06.03.83	Boundary change: decree of 29.11.04 O.G. of 02.12.04
136	PENLY NUCLEAR POWER PLANT (reactor 1) 76370 Neuville-lez-Dieppe	EDF	Reactor		23.02.83	26.02.83	
137	CATTENOM NUCLEAR POWER PLANT (reactor 4) 57570 Cattenom		Reactor		29.02.84	03.03.84	

LIST OF BASIC NUCLEAR INSTALLATIONS* (continuation)

No in the list	NAME AND LOCATION OF THE INSTALLATION	Licensee	Type of installation	Declared on:	Authorised on:	Official Gazette (O.G.) of:	OBSERVA-TIONS
138	URANIUM CLEAN-UP AND RECOVERY FACILITY (Tricastin) 26130 Saint-Paul-Trois-Châteaux	EDF SOCATRI	Factory		22.06.84	30.06.84	Modifications: decrees of 29.11.93 O.G. of 07.12.93 and 10.06.03 O.G. of 17.06.03
139	CHOOZ B NUCLEAR POWER PLANT (reactor 1) 08600 Givet	EDF	Reactor		09.10.84	13.10.84	Commissioning postponement: decrees of 18.10.1993 O.G. of 23.10.93 and 11.06.99 O.G. of 18.06.99
140	PENLY NUCLEAR POWER PLANT (reactor 2) 76370 Neuville-lez-Dieppe	EDF	Reactor		09.10.84	13.10.84	
141	FUEL EVACUATION FACILITY (Creys-Malville) 38510 Morestel	EDF	Radioactive substances disposal or depot		24.07.85	31.07.85	Commissioning postponement: decree of 28.07.93 O.G. of 29.07.93 Change in licensee decree of 30.12.98 O.G. of 31.12.98
142	GOLFECH NUCLEAR POWER PLANT (reactor 2) 82400 Golfech	EDF	Reactor		31.07.85	07.08.85	
143	NUCLEAR MAINTENANCE FACILITY (SOMANU) 59600 Maubeuge	SOMANU	Nuclear maintenance		18.10.85	22.10.85	
144	CHOOZ B NUCLEAR POWER PLANT (reactor 2) 08600 Givet	EDF	Reactor		18.02.86	25.02.86	Commissioning postponement: decrees of 18.10.93 O.G. of 23.10.93 and of 11.06.99 O.G. of 18.06.99
146	POUZAUGES IONISATION PLANT Z.I. de Monlifant 85700 Pouzauges	IONISOS	Ionisation installation		30.01.89	31.01.89	Change in licensee: decree of 23.10.95 O.G. of 28.10.95
147	GAMMASTER IONISATION PLANT – M.I.N. 712 13323 Marseille Cedex 14	GAMMAS-TER	Ionisation installation		30.01.89	31.01.89	
148	ATALANTE CEN VALRHO Chusclan 30205 Bagnols-sur-Cèze	CEA	R&D labora-tory and study of actinides production		19.07.89	25.07.89	Commissioning postponement: decree of 22.07.99 O.G. of 23.07.99
149	AUBE WASTE REPOSITORY (CSA) Soulaines-Dhuys 10200 Bar-sur-Aube	ANDRA	Radioactive substances surface repository		04.09.89	06.09.89	Change in licensee: decree of 24.03.95 O.G. of 26.03.95

LIST OF BASIC NUCLEAR INSTALLATIONS* (continuation)

No in the list	NAME AND LOCATION OF THE INSTALLATION	Licensee	Type of installation	Declared on:	Authorised on:	Official Gazette (O.G.) of::	OBSERVA-TIONS
151	NUCLEAR FUELS FABRICA-TION PLANT (MELOX) BP 2 - 30200 Chusclan	COGEMA	Fabrication of radioactive substances		21.05.90	22.05.90	Modifications: decrees of 30.07.99 O.G. of 31.07.99, 03.09.03 O.G. of 04.09.03 and 04.10.04 O.G. of 05.10.04
153	CHINON A2 D 37420 Avoine	EDF	Radioactive substances disposal or depot		07.02.91	13.02.91	Former reactor shutdown on 14.06.85
154	SABLÉ-SUR-SARTHE IONISATION PLANT Z.I. de l'Aubrée 72300 Sablé-sur-Sarthe	IONISOS	Ionisation installation		01.04.92	04.04.92	Change in licensee: decree of 23.10.95 O.G. of 28.10.95
155	INSTALLATION TU 5 BP 16 26701 Pierrelatte	COGEMA	Transformation of radioactive substances		07.07.92	11.07.92	Modification: decree of 15.09.94 O.G. of 24.09.94
156	CHICADE (Cadarache) BP 1 13108 Saint-Paul-lez-Durance Cedex	CEA	R&D laboratory		29.03.93	30.03.93	
157	TRICASTIN OPERATIONAL HOT UNIT (BCOT) 84504 Bollène Cedex	EDF	Nuclear maintenance		29.11.93	07.12.93	Modification: decree of 29.11.04 O.G. of 02.12.04
158	CIVAUX NUCLEAR POWER PLANT (reactor 1) BP 1 – 86320 Civaux	EDF	Reactor		06.12.93	12.12.93	Commissioning postponement: decree of 11.06.99 O.G. of 18.06.99
159	CIVAUX NUCLEAR POWER PLANT (reactor 2) BP 1 – 86320 Civaux	EDF	Reactor		06.12.93	12.12.93	Commissioning postponement: decree of 11.06.99 O.G. of 18.06.99
160	CENTRACO Codolet 30200 Bagnols-sur-Cèze	SOCODEI	Radioactive waste and effluent processing		27.08.96	31.08.96	
161	CHINON A3 D 37420 Avoine	EDF	Radioactive substances disposal or depot		27.08.96	31.08.96	Former reactor shutdown on 17.03.93 Modification: decree of 25.11.05 O.G. of 02.12.05
162	MONTS D'ARRÉE EL4 D Brennilis 29218 Huelgoat	EDF	Radioactive substances disposal or depot		31.10.96	08.11.96	Former reactor shutdown on 31.07.85 Change in licensee: decree of 19.09.00 O.G. of 26.09.00 Modification: decree of 12.01.04 O.G. of 13.01.04

LIST OF BASIC NUCLEAR INSTALLATIONS* (continuation)

No in the list	NAME AND LOCATION OF THE INSTALLATION	Licensee	Type of installation	Declared on:	Authorised on:	Official Gazette (O.G.) of:	OBSERVA-TIONS
163	ARDENNES NUCLEAR POWER PLANT CNA-D 08600 Givet	EDF	Radioactive substances disposal or depot		19.03.99	21.03.99	Former reactor shutdown on 17.03.93 Modification: decree of 27.10.04 O.G. of 28.10.04
164	CEDRA (Cadarache) 13115 Saint-Paul-lez-Durance Cedex	CEA	Packaging and interim storage of radioactive substances		04.10.04	05.10.04	

* The missing numbers correspond to facilities which were included in previous editions of the list but which are no longer basic nuclear installations or which have changed categories (new basic nuclear installation).
The declared BNIs are those which existed prior to publication of decree n° 63-1228 of 11 December 1963 concerning nuclear installations and for which said decree did not require authorisation but simply notification to the Minister in charge of Atomic Energy.
As of 31.12.05 there are 125 installations with BNI status.

RCC-E	RCC for electrical equipment
RCC-G	RCC for civil engineering
RCC-M	RCC for mechanical equipment
RCD	waste recovery and packaging
RCV	chemical and volume control system (PWR)
PWR	Pressurised Water Reactor
RESERVOIR	aqueous radiaoctive effluent storage installation (CEA - Saclay)
REX	experiencefeedback
RFS	basic safety rule
RGE	general operating rules
RHF	high flux reactor (Institut Laue-Langevin - Grenoble)
RIA	Radio Immunology Assay
RIC	in-core instrumentation system (PWR) - Regulatory Information Conference (annual public conference by the United States Nuclear Safety Authority)
RID	regulations concerning the International Carriage of Dangerous Goods by Rail
RIS	safety injection circuit (PWR)
RIVM	Dutch National Institute for Public Health and the Environment
RJH	Jules Horowitz reactor (irradiation reactor project: CEA - Cadarache)
RM2	former radiometallurgy laboratory No. 2 (CEA - Fontenay-aux-Roses)
RNA	ribonucleic acid
ROTONDE (la)	solid waste management installation project (CEA - Cadarache)
RPII	Radiological Protection Institute of Ireland
RHRS	residual heat removal system (PWR)
RSE-M	rules for in-service monitoring of mechanical equipment
RSN	regulation concerning the safety of ships
RTGV	steam generator tube rupture
RTR	Research and Test Reactors (fuel assemblies known as “aluminides” used in research reactors)
RTV	main steam rupture

ACRONYMS AND ABBREVIATIONS

ACC	hulls and end-pieces compaction facility (COGEMA - La Hague)
ACO	Orsay collider ring (LURE - CNRS - Orsay)
ACR	Resins conditioning facility (COGEMA - La Hague)
ACRO	Association pour le contrôle de la radioactivité dans l'ouest (Association for the Control of Radioactivity in the West)
ADNR	European Agreement concerning International Carriage of Dangerous Goods on the Rhine
ADR	European Agreement concerning the International Carriage of Dangerous Goods by Road
AERB	Indian nuclear safety authority
AFCEN	*Association française pour les règles de conception et de construction des matériels des chaudières électronucléaires* (French Association for NSSS Equipment Construction Rules)
AFCN	*Agence fédérale de contrôle nucléaire* (Belgian Federal Nuclear Supervision Agency)
AFSSA	*Agence française de sécurité sanitaire des aliments* (French Food Product Safety Agency)
AFSSAPS	*Agence française de sécurité sanitaire des produits de santé* (French Health Product Safety Agency)
AFSSE	*Agence française de sécurité sanitaire environnementale* (French Environmental Health Safety Agency - became the AFSSET in September 2005)
AFSSET	*Agence française de sécurité sanitaire de l'environnement et du travail* (French Environmental and Labour Health Safety Agency (since September 2005)
AGATE	Effluent advanced management and processing facility (CEA project - Cadarache)
ALARA	As Low As Reasonably Achievable
ALCADE	Nuclear fuel management method (EDF)
ALS	Saclay linear accelerator (CEA)
AMI	Irradiated materials facility (EDF - Chinon
ANAES	*Agence nationale d'accréditation et d'évaluation des soins* (French National Agency for Health Care Accreditation and Assessment)
ANCLI	*Association nationale des commissions locales d'information* (National CLI Association)
ANDRA	*Agence nationale pour la gestion des déchets radioactifs* (French National Agency for Radioactive Waste Management)

ANSTO	Australian Nuclear Science and Technology Organisation
APE	State-based approach
APEC	Fuel evacuation facility (EDF - Creys-Malville - Isère)
AP-HP	*Assistance Publique - Hôpitaux de Paris* (Public Health Service - Paris Hospitals)
AQG	Atomic Questions Group (European Union)
ARE	Steam generator feedwater system (PWR)
AREVA	Industrial group active in the nuclear fuel cycle and construction of nuclear installations
ARPE	Water intake and discharge licence (for BNIs)
ASG	Steam generator emergency feedwater system (PWR)
ASN	French nuclear safety authority
ASR	Refuelling outage
ASSET	Assessment of Safety Significant Events Team (IAEA expertise)
ATALANTE	Alpha facility and laboratory for transuranian elements analysis and reprocessing studies (CEA - Marcoule)
ATENA	Former contaminated sodium waste processing installation project (CEA)
ATPu	Plutonium technology facility (COGEMA - Cadarache)
AT1	Former pilot reprocessing plant for spent fuel from fast neutron reactors (CEA - La Hague)
ATUE	Enriched uranium processing facility(CEA - Cadarache)
AVN	*Association Vinçotte nucléaire* (technical support organisation for the Belgian Nuclear Safety Authority and approved organisation for supervision of nuclear installations in this country)
AZF	Former name of the company operating the fertiliser plant destroyed in the 21 September 2001 accident in Toulouse
BAC	Packaging auxiliaries building
BAG	Glovebox
BAM	German Federal Institute for Materials Research and Testing
BAN	Nuclear auxiliaries building
BASIAS	French former industrial sites and department activity database
BASOL	French database of polluted sites and soils requiring action by the public authorities

BCCN	*Bureau de contrôle des chaudières nucléaires* (French NSSS Control Office - ASN)
BCI	Spent fuel building
BCOT	Tricastin operational hot unit
BECQUEREL	Name of a nuclear exercise held in 1996 in Saclay - unit of activity
BEIR	Biological Effects of Ionizing Radiation (United States Academy of Science Committees)
BMU	German Ministry for the Environment and Nuclear Safety
BNFL	British Nuclear Fuels Limited
BNI	Basic Nuclear Installation
BNIS	Classified basic nuclear installation
BO	Official bulletin
Bq	Becquerel (unit of radioactivity)
BRGM	*Bureau de recherches géologiques et minières* (Geological and Mining Research Office)
BTE	Effluent treatment building
BWR	Boiling Water Reactor
CABRI	research reactor (CEA - Cadarache)
CADA	*Commission d'accès aux documents administratifs* (Administrative Documents Access Commission)
CAPE	*Centre d'appui au parc en exploitation* (Operating Plant Support Centre - EDF/DPN)
CAPRA	increased consumption of plutonium in fast neutron reactors (Plutonium Burnup Research Programme - CEA)
CASCAD	Cadarache bunker research reactor spent fuel storage facility (CEA)
CCAP	*Commission centrale des appareils à pression* (French Central Committee for Pressure Vessels)
CCS	component cooling system (PWR)
CCSN	Canadian Nuclear Safety Commission (CNSC)
CDE	Final shutdown
CDH	*Conseil départemental d'hygiène* (Departmental Health Council) "CE marking": mandatory, regulatory marking for certain products in the European Union, guaranteeing product conformity with the "essential requirements" defined by a European directive
CEA	*Commissariat à l'énergie atomique* (French Atomic Energy Agency)

CEDRA	Radioactive waste packaging and interim storage unit (CEA - Cadarache)
CEIDRE	Construction and Operation Appraisal and Inspection Centre (EDF)
CELIMENE	Former unit used to examine EL3 reactor fuel (CEA - Saclay)
CENAL	National Alarm Centre (division of the Swiss federal population protection office: the Confederation's technical organisation for unusual events such as a rise in radioactivity or various other technological accidents)
CENTRACO	Low-level waste processing and packaging centre (CEA - Marcoule)
CEPN	*Centre d'études sur l'évaluation de la protection dans le domaine nucléaire* (Study Centre for Nuclear Protection Assessment)
CERCA	*Compagnie pour l'étude et la réalisation des combustibles atomiques* (Company for the Design and Fabrication of Atomic Fuel)
CERN	European organization for nuclear research
CETEN-APAVE	*Centre technique national et international des associations de propriétaires d'appareils à vapeur et électriques* (National and International Technical Centre of Associations of Owners of Electric Equipment and Pressure Vessels)
CFCa	Cadarache fabrication complex (COGEMA - MOX facility)
CFU	Colony forming unit (CFU per litre is the unit used to measure the concentration of legionella)
CHICADE	Chemistry, waste characterization (CEA Cadarache)
CHU	University hospital, (treatment, education and research)
CHUV	Vaudois region university hospital (Lausanne)
CICNR	*Comité interministériel aux crises nucléaires ou radiologiques* (French Interministerial Committee for Nuclear or Radiological Emergencies - since 2003)
CIDEN	*Centre d'ingénierie déconstruction environnement* (Engineering Centre for Dismantling and Related Environmental Issues - EDF)
CIGEET	*Commission d'information auprès des grands équipements énergétiques du Tricastin* (Tricastin major energy facility information committee - name of the CLI on the Tricastin site)
CIINB	*Commission interministérielle des installations nucléaires de base* (Interministerial Commission for Basic Nuclear Installations)
CIPN	*Centre d'ingénierie du parc nucléaire* (Engineering Centre for Operating Plants)
CIREA	*Commission interministérielle des radioéléments artificiels* (French Interministerial Commission for Artificial Radioelements) (activities taken over by the ASN in 2002)
CIRIL	*Centre interdisciplinaire de recherche ions lasers* (Interdisciplinary ion laser research centre - CNRS & CEA - Caen)

CIS-Bio International	Company specialising in biomedical technologies, especially radiopharmaceuticals
CISN	*Comité interministériel de la sécurité nucléaire* (French Interministerial Committee for Nuclear Security - replaced by the CICNR in 2003)
CITMD	*Commission interministérielle du transport des matières dangereuses* (French Interministerial Commission for the Carriage of Dangerous Goods)
CLE	*Commission locale d'environnement* (Local environment committee - name of the CLI at the FBFC plant in Romans/s/Isère)
CLI	*Commission locale d'information* (Local Information Committee)
CLIO	Free electron laser (LURE - CNRS - Orsay)
CLIS	*Comité local d'information et de suivi* (Local Committee for Information and Follow-up - name of the CLI for underground laboratories)
CLS	*Commission locale de surveillance* (Local Surveillance Committee - name of the CLI at the Fessenheim plant)
CMIR	Mobile radiological intervention unit
CMS	Maximum design flood level (flood protection)
CNA	*Centrale nucléaire des Ardennes* (Ardennes first French PWR - Chooz A reactor - EDF)
CNA-D	Equipment storage facility during decommissioning of the Chooz A reactor (EDF - Chooz)
CNDP	*Commission nationale du débat public* (French National Public Debates Commission)
CNEN	*Centre national d'équipement nucléaire* (National Centre for Nuclear Equipment - EDF)
CNEPE	*Centre national d'équipement de production électrique* (National Electricity Generating Equipment Centre - EDF)
CNPE	*Centre nucléaire de production d'électricité* (Nuclear Power Generation Site - EDF)
CNRA	Committee on Nuclear Regulatory Activities (NEA)
CNRS	*Centre national de la recherche scientifique* (French National Centre for Scientific Research)
CNS	Council for Nuclear Safety (South African Nuclear Safety Authority until 1999)
Codex alimentarius	Collection of food health safety and consumer protection standards produced by a commission set up by the FAO and the WHO
CODIR-PA	Steering committee for managing the post-accident phase of a nuclear accident or radiological emergency situation

COFRAC *Comité français d'accréditation* (French Accreditation Committee)

COFREND *Confédération française pour les essais non destructifs* (French Non-Destructive Testing Confederation)

COGEMA *Compagnie générale des matières nucléaires* (Nuclear Materials Company, AREVA group)

COGEMA LOGISTICS Nuclear materials packaging and transport company (COGEMA subsidiary)

COGIC *Centre opérationnel de gestion interministérielle des crises* (French Interministerial Emergency Management Operational Centre)

COMURHEX *Société pour la conversion de l'uranium en métal et en hexafluorure* (Company for the conversion of uranium into metal and hexafluoride)

CONCERT Concertation on European Regulatory Tasks (grouping of the nuclear safety authorities from eastern and western European countries)

Contrôle Magazine published by the ASN

CO_2 carbon dioxide

CPA Special authorisation conditions - radiation sources

CPE Special utilisation conditions - radiation sources

CPP Main primary system (PWR)

CPY Second series of 900 MWe PWRs (EDF)

CP0 First series of 900 MWe PWRs (EDF)

CP1 1st subdivision of the CPY series

CP2 2nd subdivision of the CPY series

CRIIRAD *Commission de recherche et d'information indépendantes sur la radioactivité* (Committee for Independent Research and Information on Radioactivity)

CRPPH Committee on Radiation Protection and Public Health (NEA)

CSA Aube waste repository (ANDRA)

CSD-C Standard compacted waste package

CSHPF *Conseil supérieur d'hygiène publique de France* (French High Public Health Council)

CSNI Committee on the Safety of Nuclear Installations (NEA)

CSN Spanish Nuclear Safety Authority

CSP
- Main secondary system (PWR)
- Public Health Code

CSPI	*Commission spéciale et permanente d'information près l'établissement COGEMA de La Hague* (Special and Permanent Information Committee for the COGEMA La Hague facility - name of the La Hague CLI)
CSS	– Commission on Safety Standards (IAEA) – Containment spray system (PWR)
CSSIN	*Conseil supérieur de la sûreté et de l'information nucléaires* (French High Council for Nuclear Safety and Information)
CSTB	*Centre scientifique et technique du bâtiment* (Building Industry Scientific and Technical Centre)
CSTFA	Morvilliers VLL waste repository (ANDRA)
CT	Labour Code
CTC	Technical Emergency Centre
CYCLADES	Nuclear fuel management method (EDF)
DAC	Authorisation decree (BNI procedure)
DANS	Director delegate for nuclear safety activities at Saclay (CEA)
DAPE	Operation extension approval dossier
DARPE	Effluent discharge and water intake licence application (for BNIs)
DARPMI	*Direction de l'action régionale et de la petite et moyenne industrie* (Directorate for Regional Action and Small and Medium-sized Enterprises - French Ministry of the Economy, Finance and Industry - until 2005)
DARQSI	*Direction de l'action régionale, de la qualité et de la sécurité industrielle* (Directorate for Regional Action, Quality and Industrial Safety - French Ministry of the Economy, Finance and Industry - since 2005)
DDAC	Community law adaptations bill
DDASS	*Direction départementale des affaires sanitaires et sociales* (Departmental Health and Social Action Directorate)
DDSC	*Direction de la défense et de la sécurité civiles* (Directorate for Civil Security and Defence - French Ministry of the Interior)
DDTEFP	*Direction départementale du travail, de l'emploi et de la formation professionnelle* (Departmental Labour, Employment and Professional Training Directorate)
DEM	Decommissioning
DFD	Franco-German Steering Committee for Nuclear Safety Issues
DFK	Franco-German Committee for Nuclear Plant Safety Issues
DGAC	*Direction générale de l'aviation civile* (General Directorate for Civil Aviation - French Ministry for Transport)

DGCCRF *Direction générale de la concurrence, de la consommation et de la répression des fraudes* (General Directorate for Competition Policy, Consumer Affairs and Fraud Control - French Ministry of the Economy, Finance and Industry)

DGEMP *Direction générale de l'énergie et des matières premières* (General Directorate for Energy and Raw Materials - French Ministry of the Economy, Finance and Industry)

DGS *Direction générale de la santé* (General Directorate for Health - French Ministry for Health)

DGSNR *Direction générale de la sûreté nucléaire et de la radioprotection* (General Directorate for Nuclear Safety and Radiation Protection - ASN central structure)

DG/TREN Directorate General for Energy and Transport (European Commission)

DHOS *Direction de l'hospitalisation et de l'organisation des soins* (Directorate for Hospitalisation and Health Care Organisation - French Ministry for Health)

DIDEME *Direction de la demande et des marchés énergétiques* (Directorate for Energy Demand and Energy Markets - French Ministry of the Economy, Finance and Industry)

DIN – *Division ingénierie nucléaire* (Nuclear Engineering Division - EDF)
– *Division des installations nucléaires* (Nuclear Installation Department - replaced by the DSNR in 2002)

DNA deoxyribonucleic acid

DOE Department of Energy (United States)

DPMA *Direction du personnel, de la modernisation et de l'administration* (Personnel, Modernisation and Administration Directorate - French Ministry of the Economy, Finance and Industry)

DPN *Division production nucléaire* (Nuclear Generating Division - EDF)

DPPR *Direction de la prévention des pollutions et des risques* (Directorate for the Prevention of Pollution and Risks - Ministry for Ecology and Sustainable Development)

DRASS *Direction régionale des affaires sanitaires et sociales* (Regional Health and Social Action Directorate)

DRIRE *Direction régionale de l'industrie, de la recherche et de l'environnement* (Regional Directorate for Industry, Research and the Environment)

DRL diagnostic reference level

DRT *Direction des relations du travail* (Directorate for Labour Relations - French Ministry for Employment, Social Cohesion and Housing)

DRTEFP *Direction régionale du travail, de l'emploi et de la formation professionnelle* (Regional Labour, Employment and Professional Training Directorate - French Ministry for Employment, Social Cohesion and Housing)

DRYPAC sludge drying process

DSIN	*Direction de la sûreté des installations nucléaires* (Nuclear Installation Safety Directorate - replaced by the DGSNR in 2002)
DSN	*Division principale de la sécurité des installations nucléaires* (Main Nuclear Installations Safety Division - Swiss Nuclear Safety Authority)
DSND	*Délégué à la sûreté nucléaire et à la radioprotection pour les activités et installations intéressant la défense* (Delegate for Nuclear Safety and Radiation Protection for National Defence Installations and Activities - French Ministries of Defence and of the Industry)
DSNR	*Division de la sûreté nucléaire et de la radioprotection* (Nuclear Safety and Radiation Protection Division - ASN regional entity)
DSS	*Direction de la sécurité sociale* (Directorate for Social Security - French Ministry for Health)
DTPA	diethylene-triamine-penta-acetate (substance used in nuclear medicine)
DUP	*Déclaration d'utilité publique* (declaration of public interest procedure)
EAN	European Alara Network (the aim of which is to promote implementation of the ALARA principle)
EBRD	European Bank for Reconstruction and Development
EC	European Community
ECUME	former spent fuel and radioactive solid waste interim storage facility project (CEA)
EDE	containment annulus ventilation system (PWR)
EDF	*Électricité De France*
EDS	Solid waste interim storage area
EEC	European Economic Community
EGRA	Expert Group on Regulatory Authorisation (sub-group of the NEA's CRPPH)
EIS	element important for safety
ELAN II B	Former sealed source fabrication installation (CEA - La Hague)
EL3	heavy water reactor No. 3 (former experimental reactor - CEA - Saclay)
EL4	heavy water reactor No. 4 (former Monts d'Arrée nuclear power plant - EDF - Brennilis)
EL4-D	equipment interim storage installation for decommissioning of the Monts d'Arrée nuclear power plant
ENT	Ear Nose and Throat
EOLE	research reactor (CEA - Cadarache)

E.ON	electricity and gas production and distribution company (Germany, various countries in Europe and the United States)
EPA	Environmental Protection Agency (United States)
EPN	Nuclear Capacity Operation Department (EDF)
EPR	European Pressurized Water Reactor (new type of nuclear reactor developed by FRA-MATOME-ANP)
EPRD	Revenue and spending forecast (public establishment "budget")
ERNET	Emergency Response Network
ERP	Establishment open to the public
ESP	Pressure vessel
ESS	Event significant for safety
ESWS	Essential service water system (PWR)
EU	European Union
EURATOM	European AtoMic Energy Community
EUROFAB	Fabrication in Europe (experimental programme to produce MOX fuel from military plutonium under the terms of the American-Russian agreement to reduce plutonium stocks)
EURODIF	European gaseous diffusion enrichment plant
FAIOp	Operator fire action sheet
FAO	Food and Agriculture Organization (UN)
FBFC	*Société franco-belge de fabrication de combustibles* (Franco-Belgian Fuel Fabrication Company)
FBR	Fast breeder reactor
FDG	fluorodeoxyglucose (substance used in nuclear medicine)
FMEA	Failure Modes and Effects Analysis
FP	fission products
FRAMATOME	French NSSS builder (AREVA Group)
FRAMATOME-ANP	Framatome - Advanced Nuclear Power (company set up by AREVA and SIEMENS to develop the new EPR reactor type)
FRAREG	Framatome Regulators (Association of nuclear safety authorities in countries operating power plants of French design)
GALICE	nuclear fuel management method (EDF)

GAN	Russian nuclear safety authority
GANIL	Large National Heavy Ion Accelerator (Caen)
GB I	Georges Besse Plant I - EURODIF
GB II	Georges Besse Plant II - planned
GBq	gigaBecquerel (thousand million Becquerels)
GEMMES	nuclear fuel management method (EDF)
Génération IV	International “Forum” of ten countries and the European Union to develop future nuclear reactors, known as 4th generation (GEN IV)
GEP	Pluralistic experts group
GIAG	*Guide d’intervention en accident grave* (serious accident action guide)
GP	Advisory Committee (reporting to the ASN)
GV	Steam generator
Gy	gray (unit of absorbed dose)
G7	Group of the 7 leading industrial nations (Canada, France, Germany, Italy, Japan, United Kingdom and United States)
G8	Group of the 8 leading industrial nations (G7 + Russia)
HAO	oxide high activity facility (COGEMA - La Hague)
HARMONIE	former fast neutron source reactor (CEA - Cadarache)
HAS	*Haute Autorité de santé* (French High Health Authority - since 2005)
HLLLW	High level long-lived waste
HFD	*Haut Fonctionnaire de défense* (Defence High Official) (at each French ministry)
HSE	Health and Safety Executive (United Kingdom)
HSK	Main Nuclear Installations Safety Division - DSN (Swiss Nuclear Safety Authority)
HTR	High Temperature Reactor
Hydrotéléray	network for continuous measurement of radioactivity in major rivers (IRSN)
IAEA	International Atomic Energy Agency (UN)
IARC	International Agency for Research on Cancer (part of the WHO and located in Lyons)
ICAO	International Civil Aviation Organisation

ICCRB	International Consultative Committee of Regulatory Bodies (group comprising representatives from the Regulatory authorities of Canada, Finland, France, Germany, Italy, Spain, Switzerland, United Kingdom and United States for the purpose of advising the Ukrainian Nuclear Safety Authority with respect to the Chernobyl site)
ICPE	installation classified on environmental protection grounds (owing to its potential impact on the public and the environment, installation subject to the regulations defined in part I of book V of the French Environment Code)
ICRP	International Commission on Radiological Protection
IDSP	weighted scanner dose index
IEC	International Electrotechnical Commission
IFSI	*Institut de formation en soins infirmiers* (Nursing Training Institute)
ILE	ITER Legal Entity (international body to be created to operate ITER)
ILL	Institut Laue-Langevin (Laue-Langevin Institute - Grenoble)
IMDG	International Maritime Code for Dangerous Goods
IN	Nuclear Inspectorate (EDF)
INERIS	*Institut national de l'environnement industriel et des risques* (French National Institute for the Study of Industrial Environments and Risks)
INES	International Nuclear Event Scale
INEX	International Nuclear Emergency Exercise (in particular carried out by the NEA)
INRA	– International Nuclear Regulators' Association (comprising the regulators from Canada, France, Germany, Japan, Spain, Sweden, United Kingdom and the United States) – *Institut national de recherche agronomique* (French National Agronomy Research Institute)
INSAG	International Nuclear Safety Advisory Group (IAEA)
INSERM	*Institut national de la santé et de la recherche médicale* (French National Health and Medical Research Institute)
INSTN	*Institut national des sciences et techniques nucléaires* (French National Institute for Nuclear Science and Techniques - CEA)
InVS	*Institut de veille sanitaire* (French Health Watch Institute)
IPN	*Institut de physique nucléaire* (Nuclear Physics Institute - Orsay)
IPSN	*Institut de protection et de sûreté nucléaire* (Institute for Nuclear Safety and Protection - replaced by the IRSN in 2002)
IRCA	Cadarache irradiator (CEA)
MRI	magnetic resonance imaging

IRPA	International Radiation Protection Association
IRRT	International Regulatory Review Team (organised by the IAEA to audit a safety authority) see PROSPER
IRSN	*Institut de radioprotection et de sûreté nucléaire* (French Institute for Radiation Protection and Nuclear Safety - since 2002)
ISIS	research reactor (CEA - Saclay)
IS Ouest	*Institut de Soudure Ouest*
ISO	International Standard Organisation
ISOE	Information System on Occupational Exposure (OCDE)
ISR	safety and radiation protection engineer (EDF)
ITER	International Thermonuclear Experimental Reactor (to be installed in Cadarache)
JAA	Joint Aviation Authorities (Association of the national civil aviation authorities of the European countries, attached to the European Civil Aviation Conference. It sets guidelines for civil aviation certification, operations, maintenance and licensing)
JAR	Joint Aviation Requirements (rules drafted by the JAA)
JAR-OPS	Rules drafted by the JAA concerning aircraft operations
JFR	French radiology days) (conferences organised annually by the SFR)
JNES	Japan Nuclear Energy Safety Organisation (technical support organisation for the Japanese Nuclear Safety Authority)
JO	French Official Gazette
KEY	experimental sealing of drifts by pouring an “anchoring key” (ANDRA - Bure)
K€	kiloeuros (thousand euros) cf Meuros
kW	kiloWatt
KEPCO	Kansai Electric Power Company (Japanese electricity production utility)
KER	Nuclear Island Liquid Effluent Monitoring and Discharge System (PWR)
KINS	Korean Institute of Nuclear Safety (technical support organisation for the South Korean Nuclear Safety Authority)
KKU	Unterweser nuclear power plant (Germany)
K1	equipment qualification category (PWR)
LAMA	Active Materials Analysis Laboratory (CEA Grenoble)
LCC	Central Product Quality Control Laboratory (COGEMA La Hague)

LCPu	Plutonium Chemistry Laboratory (CEA - Fontenay-aux-Roses)
LDAC	Fuel Assembly Shearing Laboratory (CEA - Cadarache)
LECA	Active Fuel Examination Laboratory (CEA - Cadarache)
LECI	Spent Fuel Testing Laboratory (CEA - Saclay)
LEFCA	Laboratory for research and experimentalfabrication of advanced nuclear fuels (CEA - Cadarache)
LEP	Large Electron Positron Collider (CERN - Geneva)
LHA	High Activity Laboratory (CEA - Saclay)
LHC	Large Hadron Collider (CERN - Geneva)
LILW	low and intermediate level waste (LL - IL waste)
LLW-LL	low level long-lived waste (LL - LL waste)
LOLF	French constitutional bylaw on budget acts
LPC	Chemical Purification Laboratory (COGEMA - Cadarache)
LUDD	Laboratories, Plants, Waste and Dismantling
LURE	Electromagnetic Radiation Laboratory (CNRS - Orsay)
MAD	decommissioning
MAGENTA	cellular nuclear materials storage facility project (CEA)
MAGNUC	nuclear viewdata magazine (replaced by the ASN website, with publication halted in 2006)
MAPu	medium level Plutonium (MAPu facility: COGEMA - La Hague)
MARN	*Mission d'appui à la gestion du risque nucléaire* (Nuclear Risk Management Aid Committee - French Ministry of the Interior/DDSC)
MAS alpha	special intermediate level alpha effluent
MASURCA	Cadarache fast-breeder mockup (research reactor - CEA - Cadarache)
MAU	medium level uranium activity (MAU facility: COGEMA - La Hague)
MBq	megaBecquerel (million Becquerels)
MCMF	central fissile material warehouse (CEA - Cadarache)
MDB	*Mission déléguée de bassin* (River authority)
MDS	organic solvent mineralisation facility (COGEMA - La Hague)
M€	mégaeuros (million euros)

MELOX	MOX fuel fabrication plant (Marcoule)
MELUSINE	research reactor (CEA - Grenoble)
MEM	Moroccan Ministry for Energy and Mines
METI	Japanese Ministry of Economy, Trade and Industry
MIBI	2-methoxy isobutyl isonitrile (substance used in nuclear medicine)
MIMAUSA	History and impact of uranium mines: Summary and Archive - Programme for an inventory of uranium mining sites
MINEFI	French Ministry of the Economy, Finance and Industry
MINERVE	research reactor (CEA - Cadarache)
MIR	inter-regional fuel stores (EDF Gugey and Chinon)
MMS	– mobile emergency equipment – Main Steam System (PWR)
MOST	Ministry of Science and Technology (South Korean Nuclear Safety Authority)
MOX	mixed uranium and plutonium oxide fuel
mSv	millisievert (thousandth of a sievert)
MWe	megawatt electrical (unit of electrical power)
NATURA 2000	All the natural sites protected by various European directives concerning birdlife and "natural habitats"
NEA	Nuclear Energy Agency (OECD)
NERSA	*"centrale nucléaire européenne à neutrons rapides SA"* company (former operator of Superphénix)
NF	– Naeglaria Fowleri (species of amoeba) – French standard
nGy	nanogray (thousand millionth of a gray)
NII	Nuclear Installations Inspectorate (HSE - United Kingdom)
NISA	Nuclear Industrial Safety Agency (METI - Japan)
NNEMA	National Nuclear Emergency Management Administration (China)
NNR	South African Nuclear Safety Authority(since 1999)
NNSA	Chinese Nuclear Safety Authority
NORM	Naturally Occurring Radioactive Materials
NOx	nitrogen oxides

NPH	spent fuel element unloading and interim storage facility (plant UP2 800 - COGEMA - La Hague)
NRBC	Nuclear, Radiological, Biological, Chemical (NRBC hazard)
NRC	American Nuclear Safety Authority
NRPB	National Radiological Protection Board (United Kingdom - in April 2005 incorporated into the “Health Protection Agency”)
NRR	Nuclear Reactor Regulation (NRC office in charge of reactor safety)
NSC	Japanese Nuclear Safety Authority
NSD	United Kingdom Nuclear Safety Authority
NSSG	Nuclear Safety and Security Group (G8)
nSv	nanosievert (thousand millionth of a sievert)
NSWG	Nuclear Safety Working Group (G7)
NUPEC	Technical expertising organisation of the NISA (METI - Japan)
NUSSC	Nuclear Safety Standards Committee (IAEA)
NuPEER	Nuclear Pressure Equipment Expertise & Regulation (nuclear pressure vessel symposium)
N4	1450 MWe nuclear reactor series (EDF)
OA	approved organisation for supervision
OASIS	name of the ASN intranet
OECD	Organization for Economic Cooperation and Development
OHF	organisational and human factors
OMF	reliability centred maintenance
OPECST	*Office parlementaire d’évaluation des choix scientifiques et technologiques* (French Parliamentary Office for the Assessment of Scientific and Technological Options)
OPRI	*Office de protection contre les rayonnements ionisants* (Office for Protection Against Ionising Radiation - until 2002)
OPS	see JAR-OPS
ORCADE	Project set up by COGEMA for decommissioning of the La Hague installations
ORPHEE	research reactor (CEA - Saclay)
ORSEC	general plan organising the emergency services at departmental, defense zone, or maritime prefecture level, should a disaster be declared by the State

OSART	Operational Safety Review Team (IAEA)
OSIRIS	research reactor (CEA - Saclay)
OSPAR	Convention for the Protection of the Marine Environment of the North-East Atlantic (signed in 1992 and combining and updating the Oslo 1972 and Paris 1974 conventions)
PAI	fire-fighting action plan
PAP	annual performance plan (within the framework of the LOLF - document appended to the finance bill and for a given programme, presenting in particular the objectives and the expected results of the various programme actions)
PAREX	post-accident experience feedback
PASEPRI	action plan for monitoring patient exposure to ionising radiation
PBMR	Pebble Bed Modular Reactor (reactor project - South Africa)
PC	command post
PCC	command and control post (evaluation of consequences and measures)
PCD	strategic management command post
PCL	local command post (installation operation)
PCM	logistic management command post)
PCR	person with competence for radiation protection
PEGASE	spent fuel and radioactive substances interim storage installation (CEA - Cadarache)
PET	Positron Emission Tomography (see TEP)
PETSCAN	PET camera coupled with a scanner
PHARE	Poland and Hungary Assistance for Reconstruction of Economy (European Union programme for aid to the countries of central and eastern Europe)
PHEBUS	research reactor (CEA – Cadarache)
PHENIX	fast neutron reactor (CEA – Marcoule)
PIC	Additional Investigation Programme (EDF)
PIRATOME	defence plan designed to counter the malicious use or threatened malicious use of radioactive or nuclear materials against people, the environment or property
PMSI	Medicalised Programme for Information Systems
PNGDR-MV	National Radioactive Waste and Reusable Materials Management Plan
PNSE	French National Health Environment Plan (to reduce the effects of environmental damage on the health of the population)

PPI	off-site emergency plan (specific plan established by the State to address risks linked to the existence and the functioning of specific installations or facilities)
PRECIS	Programme for recovery of spent fuel elements stored in fuel assembly block
PRER	*Pôle de radioprotection environnement et risques* (Radiation Protection, Environment and Risks Centre)
PRI	integrated radiological protection
Procédé	name of BNI 165 project (CEA - Fontenay-aux-Roses)
PROSPER	Peer Review of Operational Safety Performance Experience (organised by the IAEA)
PSA	probabilistic safety study
PSI	Irradiation Monitoring Programme (PWR)
PSR	preliminary safety report (BNI procedure)
PSRPM	medical radiophysics specialist
PSS	specialised emergency plan
PSS-TMR	specialised emergency plan for the transport of radioactive materials
PTB	low operating range (PWR)
PTD	technical documentation series
PTR	reactor cavity and spent fuel pit cooling and treatment system (PRW)
PUI	on-site emergency plan (established by a BNI licensee to manage a possible emergency situation)
PuO2	plutonium oxide
P4	first series of 1300 MWe nuclear reactors (EDF)
P'4	second series of 1300 MWe nuclear reactors (EDF)
RADWASS	Radioactive Waste Safety Standards (IAEA)
RAMG	Regulatory Assistance Management Group (group set up by the European Commission to advise it on technical assistance requests from the nuclear regulators of Eastern European states)
RAPSODIE	former fast neutron experimental reactor (CEA - Cadarache)
RASSC	Radiation Safety Standards Committee (IAEA)
RaSSIA	Radiation Safety and Security Infrastructure Appraisal (IAEA)
RBE	Relative Biological Effectiveness
RCC	design and construction rules

RUS Louis Pasteur University reactor (Strasbourg)

RWMC Radioactive Waste Management Committee (NEA)

R & D Research and Development

SCR Radiation Protection Department

SAFARI South African nuclear reactor

SAMU French Emergency Medical Service

SATURNE former particle accelerator (CEA - Saclay)

SCHAPI *Service central d'hydrométéorologie et d'appui à la prévision des inondations* Central Hydrometeorology and Flood Prediction Support Department - French Ministry for Ecology and Sustainable Development / Water Directorate)

SCSIN *Service central de sûreté des installations nucléaires* (Central Nuclear Installations Safety Department - replaced by the DSIN in 1991)

SEIVA Valduc information exchange structure (Association created around the CEA centre at Valduc)

SEK conventional island liquid waste discharge system (PWR)

SENA Ardennes Franco-Belgian nuclear energy company (operated the first Chooz plant until 1996)

SEPTEN Design Department for Thermal and Nuclear Projects (EDF/DIN)

SFBMN *Société française de biophysique et de médecine nucléaire* (French Society for Biophysics and Nuclear Medicine)

SFEN *Société française d'énergie nucléaire* (French Nuclear Energy Society)

SFMNIM *Société française de médecine nucléaire et d'imagerie moléculaire* (French Nuclear Medicine and Molecular Imaging Society)

SFPM *Société française de physique médicale* (French Medical Physics Society)

SFR *Société française de radiologie* (French Radiological Society)

SFRO *Société française de radiothérapie oncologique* (French Oncology Radiotherapy Society)

SFRP *Société française de radioprotection* (French Radiation Protection Society)

SGCISN *Secrétariat général du comité interministériel de la sécurité nucléaire* (French General Secretariat of the Interministerial Commission for Nuclear Security - until 2003)

SGDN *Secrétariat général de la défense nationale* (French General Secretariat for National Defence)

SHFJ *Service hospitalier Frédéric Joliot* (CEA hospital service located in Orsay hospital - Essonne)

SICN	*Société industrielle de combustible nucléaire* (Industrial Nuclear Fuel Company)
SIGIS	Source Inventory Management Information System)
SILOE	CEA research reactor (Grenoble)
SILOETTE	CEA research reactor (Grenoble)
SIRCOM	*Service de la communication* (Communication Department - Ministry of the Economy, Finance and Industry)
SISE-Habitat	Environment Habitat Health Information System
SISE-RI	Environment-Ionising Radiation Health Information System
SISE-Eau	Environment-Water Health Information System
SITA FD	"ultimate" waste and polluted earth processing and disposal company (SITA Group)
SITOP	SITe Optimisation (SITOP project about organisation change at COGEMA La Hague)
SKI	Swedish Nuclear Safety Authority
SMHV	maximum historically probable earthquake
SNCS	Norman Company for Sterilization
SNM	military nuclear system
SNRCU	Ukrainian Nuclear Safety Authority
SOCATRI	*Société auxiliaire du Tricastin* (company operating a clean-up and uranium recovery installation at Bollène - Vaucluse)
SOCODEI	Company for industrial effluent and waste treatment
SOMANU	Nuclear Maintenance Company (Maubeuge)
SOx	sulphur oxides
SPF	fission products disposal (SPF facilities - COGEMA - La Hague)
SPIN	in-pile separation and incineration (Actinides Incineration Research Programme - CEA)
SPIRAL	radioactive accelerated ion beam production source (GANIL - Caen)
SPN	*Section permanente nucléaire de la CCAP* (standing section of the CCAP for nuclear matters)
SPRA	*Service de protection radiologique des armées* (French Army Radiological Protection Service)
SPS	Super Proton Synchrotron (CERN - Geneva)
SSI	Swedish Radiation Protection Authority

STA	Science and Technology Agency (Japan)
STAR	treatment, cleanup and reconditioning station (CEA - Cadarache)
STD	waste treatment station
STE	– effluent treatment station – technical operating specifications
STED	effluent and waste treatment station
STEDS	radioactive effluent and solid waste treatment station
STEL	liquid effluent treatment station
STELLA	active liquid effluent treatment station project (CEA - Saclay)
STUK	Finnish Nuclear Safety Authority
SÚJB	Czech Nuclear Safety and Radiation Protection Authority
Superphénix	Fast neutron nuclear power plant currently being decommissioned (Creys-Malville - Isère)
Support	Name of BNI 166 project (CEA - Fontenay-aux-Roses)
Sv	sievert (equivalent dose unit and effective dose unit)
TACIS	Technical Assistance to the Commonwealth of Independent States (EU)
TAR	cooling tower
TBq	teraBecquerel (million million Becquerels)
Téléhydro	network for continuous monitoring of waste water radioactivity in major cities (IRSN)
Téléray	ambient radioactivity measurement network (IRSN)
TENORM	Technologically Enhanced Naturally Occurring Radioactive Materials
TEP	primary effluent treatment system (PWR)
PETSCAN	PET camera coupled with a scanner
TER	liquid waste discharge system (PWR)
TID	total indicative dose
TRANSAS	Transport Safety Appraisal Service (IAEA)
TRANSSC	Transport Safety Standards Committee (IAEA)
TU5	fuel cycle installation (COGEMA - Pierrelatte)
TVO	Finnish electricity utility

Ualx	mixture of uranium and aluminium
UF4	uranium tetrafluoride
UF6	uranium hexafluoride
UJD	Slovak Nuclear Safety Authority
UKEA	United Kingdom Environmental Agency (England and Wales)
ULYSSE	"Teaching" reactor (CEA - Saclay)
UN	United Nations
UNGG	former French gas-cooled reactor technology
UNIPE	corporate NPP operational engineering department (EDF)
UNSCEAR	United Nations Scientific Committee on the Effects of Atomic Radiation
UOX	uranium oxide
UP2-400	1st spent fuel reprocessing unit (COGEMA - La Hague)
UP2-800	spent fuel reprocessing unit (COGEMA - La Hague)
UP3	spent fuel reprocessing unit (COGEMA - La Hague)
URE	enriched reprocessing uranium (fuel assemblies)
USSR	Union of Soviet Socialist Republics (until 1991)
UTE	*Union technique de l'électricité et de la communication* (Technical Union of Electricity and Communication)
UTO	operational technical unit (EDF)
UO2	uranium oxide
UO2(NO3)2	uranyl nitrate
U3O8	uranium oxide (yellowcake)
VATESI	Lithuanian Nuclear Safety Authority
VLLW	Very Low Level Waste
W	fuel cycle plant (COGEMA - Pierrelatte)
WANO	World Association of Nuclear Operators
WASSC	Waste Safety Standards Committee (IAEA)
WATRP	Waste Management Assessment and Technical Review Programme (IAEA)

WENRA	Western European Nuclear Regulators' Association (extended in 2003 to all "nuclear" States that are members of the European Union or currently negotiating membership)
WGIP	Working Group on Inspection Practices (NEA)
WGWD	Working Group on Waste and Decommissioning (WENRA)
WHO	World Health Organization (UN)
WPAQ	Working Party on Atomic Questions (Council of the European Union)

Photos :

Foreword: ASN – Main topics: ANDRA, AREVA, La Poste – Chapter 1: ANDRA, ASN, IRSN, Le Radium – Paris, UNSCEAR – Chapter 2: ASN – Chapter 3: ASN, La Poste – Chapter 4: ASN – Chapter 5: ASN, IRSN – Chapter 6, 7 and 8: ASN – Chapter 9: ASN, CEGELEC, CIS BIO International, GE Medical Systems SCS, La Poste, NUCLETRON – Chapter 10: ARELCO, CEGELEC, FONDIS ELECTRONIC, Institut Pasteur de Paris, Laboratoires Protec, Oxford Instrument – Chapter 11: ADR, AREVA, ASN, CEGELEC, COGEMA Logistics, IMDG, OACI, PROTEC, RID, SCHERING – Chapter 12: AREVA, ASN, AVE MULTIMEDIA, EDF, P. Bauduin, M. Morceau, OD, C. Pauquet, R. Quatrain, Registres réglementaires, J.-P. Salomon – Chapter 13: AREVA, AREVA/COGEMA, AREVA/COMURHEX, AREVA/FBFC, AREVA/JEZEQUEL (Sidney), AREVA/MELOX, AREVA/TAILLAT (Jean-Marie), ASN, URENCO/ETC – Chapter 14: CEA, ILL – Chapter 15: ASN, CEA, EDF – Chapter 16: ANDRA, ASN, CEA, COGEMA.

ISSN 1249-4755
Dépôt légal 197 – December 2005
Printing office Caractère – 15000 Aurillac

André-Claude LACOSTE

Paris, February 27th, 2006

The ASN (Nuclear safety authority) considers that 2005 was a satisfactory year in terms of nuclear safety and radiation protection. However, further progress can and must be made.

The safety of EDF nuclear reactors is satisfactory overall even though progress is needed in terms of operational method. The ASN has mixed views on the way the CEA operates its facilities and fulfils its commitments. The ASN continues to have a positive view on the strict method and purpose with which COGEMA operates its facilities at the site at La Hague. In the medical field, the ASN finds that the consideration of radiation protection is satisfactory overall in radiotherapy and nuclear medicine. The ASN notes some improvements in the radiology field, though further efforts must be made to better integrate the requirements of radiation protection into the management of other medical risks. In industry, the ASN considers that efforts made in radiation protection training and awareness-raising should be pursued and notes that considerable efforts are required on the part of gammagraphy users.

In 2005, the ASN pursued its significant investment in radiation protection and reaffirms its ambition to become as efficient in radiation protection as it is in nuclear safety as of 2009. 2005 was a year of great progress for the ASN as it consolidated its organisation and working methods, in accordance with the 2005-2007 strategic plan it set for itself. The ASN's continued progress in the field of radiation protection has given rise to various new regulations to improve the legislative and regulatory framework in this area. The ASN plans to step up its efforts to ensure better monitoring of patient exposure to ionizing radiation and to provide better management of radon-related risks, particularly in housing. Fully aware that its newfound power in this area requires outside evaluation, the ASN has asked the International Atomic Energy Agency (IAEA) to organise an IRRS (Integrated Regulatory Review Service) assignment consisting of a peer-conducted audit. The IAEA has confirmed that this audit will take place in November 2006. Another milestone was the announcement by the French President on January 5, 2006 of the creation of an independent authority, thus pursuing the ongoing development of the ASN.

2005 was marked by significant progress in the process of harmonising national nuclear safety policies. Indeed, the Western European Nuclear Regulators Association (WENRA) has finalised its reports on a common policy. These reports, to which the ASN made significant contributions, will be made public in February 2006. By 2010, each country must use these documents defining standard levels for nuclear safety to revise its technical regulations and practices in view of harmonisation. More generally, in the field of international relations, I would like the ASN to continue an active policy geared towards establishing, itself as an international reference.

Against a backdrop of the preparation of a bill on management of radioactive materials and waste, to be presented to Parliament in March 2006, 2005 was a year of important milestones. These include firstly the publication in March of a report from the OPECST (Parliamentary Office for Scientific and Technology Choices Assessment), prepared by députés Mr Birraux and Mr Bataille. Secondly, at the Government's request, a public debate was held from September 2005 to January 2006 on the issue of radioactive waste management to provide better information to the French population. Lastly, the ASN has prepared and provided for public consultation a national plan for management of radioactive waste and reusable materials (PNGDR-MV) drawing on the efforts of a working group including waste producers and eliminators, administrative bodies, representatives of elected officials and environmental protection associations. These elements, in addition to the report submitted by the ASN to the Government on

February 1, 2006, will be taken into account in preparing the above-mentioned bill. In this report, the ASN specifies in particular that disposal in deep geological repositories is an essential management solution for high-level long-lived radioactive waste.

Finally, the ASN's operating context is changing. Thus in 2005 the French Government confirmed that the nuclear option would remain open until 2020 in accordance with law no. 2005-781 of July 13, 2005, setting the focus for energy policy. This law provides for construction of an EPR-type reactor. The plan to build a reactor in Flamanville (Manche region) was put to public debate between September 2005 and February 2006 as a necessary public information exercise before EDF can proceed with the administrative procedures prior to construction of the new nuclear plant. Moreover, on January 5, 2006, the French President announced the design of a fourth-generation nuclear reactor prototype. Another important factor in the nuclear field is EDF's capital opening. The ASN will make particular efforts to prevent any negative effects of these developments on nuclear safety and will ensure that EDF sets out adequate provisions to assume its responsibilities as operator until the full dismantling of its nuclear reactors.

*

* *

Control of nuclear facilities and transport of radioactive materials

Operations in EDF nuclear reactors in 2005 were satisfactory overall and improvements were found in terms of radiation protection, environmental protection and supervision of service providers. However, the operating method improvement initiatives undertaken by EDF following the ASN's findings in 2004 must continue and will be closely monitored by the ASN in 2006. In 2005, the second ten-yearly visits to the 900-megawatt reactors continued, and will be completed in 2010. The 1300-megawatt reactor visits began in the spring and will continue until 2014. In early 2005, EDF implemented an internal authorisation process which is discussed hereafter, particularly for restarting reactors following shutdowns with no significant maintenance. The smooth operation of these systems has been controlled by the ASN and their scope could be extended in 2006. Lastly, an anomaly that could impact the safety of 900-megawatt reactors in the event of accidental leaks on the primary cooling circuit has been ranked this year at level 2 on the INES scale (International nuclear event scale). It affects the back-up system pumps (RIS (safety injection system) and EAS (spray containment system) circuit pumps). Its discovery during bench testing emphasises the importance of periodical equipment compliance checks to guarantee satisfactory safety levels.

No significant events occurred this year in the nuclear facilities operated by the CEA. However, the ASN would like the CEA to take better account of nuclear safety and radiation protection priorities prior to making budget decisions and believes that it should develop its internal skills in evaluating safety of facilities. The ASN also considers that the CEA must make further progress in re-inspecting the safety of its facilities, both in preparation and in providing the ASN with more reliable forecasts on the future of facilities, as well as better observance of the ten-yearly re-inspections. Lastly, the CEA must fully implement the commitments made to the ASN, particularly in terms of projects for improving in old facilities safety.

Furthermore, as in previous years, we must mention the specific case of the CisBio International facilities which produce radio-elements for biomedical purposes on the Saclay site (Essonne region). The ASN has noted significant improvement in these facilities' operating method due to considerable investment by the Schering group, the owner of CisBio. Schering sold CisBio at the end of the year. The ASN will ensure that this sale has no negative impact on nuclear safety. Indeed, the ASN will only complete the handover of CEA's Saclay facilities to CisBio if the new owners undertake to continue the investment and reorganisation plan for the facilities.

In the research field, the Cadarache site (Bouches-du-Rhône region) has been chosen to host the ITER facility (International

Thermonuclear Experimental Reactor). Although the ASN is not particularly concerned about nuclear safety, it will monitor the ability of the international entity in charge of the project to fully assume its responsibilities as nuclear operator, without excessive protection under diplomatic immunity.

In terms of the nuclear fuel cycle, as in previous years, the ASN continues to have a positive view on the strict method and purpose with which COGEMA operates its facilities at the La Hague site. On this site, the ASN is paying particular attention to the recovery of old waste as well as the definitive closure and dismantling of the old workshops of the UP2-400 plant, for which COGEMA's commitments must be met as quickly as possible. The ASN has checked that the serious incident which occurred this year at the Thorp plant in Sellafield (UK) could not happen in La Hague. Moreover, the ASN is currently dealing with the request from AREVA for authorisation to build the Georges Besse II plant for enrichment via ultracentrifugation technology on the Tricastin site. The law authorising creation of this facility could be passed in early 2007.

With respect to nuclear facilities in general, the ASN is working towards implementation of an internal authorisation process. Which gives operators, for certain operations that do not jeopardise the facility's safety demonstrations, the responsibility for making their own decision without requesting authorisation from the ASN. The operator analyses the safety of the authorisations and keeps the ASN informed. This new procedure presents two advantages. On the one hand, it allows the ASN to focus its efforts on genuine safety challenges and on the other hand it makes operators responsible since they no longer rely on the ASN and its technical support to audit the quality of their requests. The system was initially implemented in CEA facilities and the scope of application has gradually been extended to other nuclear operators. Thus the restarting of EDF nuclear reactors following shutdowns with no significant maintenance is no longer subject to prior approval from the ASN.

Lastly, in terms of safety in radioactive material transport, there were no significant events in 2005. The ASN however acknowledge that while the number of contaminated irradiated fuel convoys is low, it is increasing slightly. The ASN will ensure that this increase is not due to a fall-off in EDF's efforts over the last few years in terms of cleanliness. Furthermore, the ASN has made efforts to implement the recommendations of the TranSAS audit (Transport Safety Appraisal Service) performed at its request by the IAEA in 2004. This resulted essentially in the existing practices being formalised. The ASN will use this experience of a peer-conducted audit to prepare for the IRRS audit scheduled for November 2006.

Control of small-scale nuclear activity and radiation protection regulations

The ASN notes that implementation of radiation protection measures in the medical field is not uniform. In radiotherapy and nuclear medicine, the ASN considers application of radiation protection regulations to be satisfactory overall, even though accidents, such as the radiotherapy accident at the Grenoble university hospital, show that caution must be exercised. In radiology, where risks are lower, the ASN has observed improvements though further efforts must be made to better incorporate the requirements of radiation protection into the management of other medical risks. With this aim in mind, the ASN has developed exchange forums with health professionals, particularly with their professional societies, in order to inform them on the obligations of the regulations and to encourage them to extend their initiatives to optimise exposure, in particular that of patients, once the procedures have been justified. Moreover, the ASN is closely tracking the development of medical techniques to ensure that radiation protection is implemented as far upstream as possible for projects involving new machinery or the use of new radio-nuclides.

In industry, which is characterised by high numbers of applications and users of ionizing radiation, the ASN considers that the efforts made in radiation protection training and awareness-raising should continue. The most worrying and high-risk area is that of gammagraphy. This danger is illustrated by the December 15 accident in Chile in which a Chilean worker was seriously irradiated. The victim is currently undergoing treatment at the Percy hospital in France. During the meetings held by the COFREND (French confederation for non-destructive testing), I clearly indicated that professionals working with gammagraphy must become more meticulous in the operation and transport of gammagraphs, otherwise the justification of this application may be questioned.

In 2002 the ASN launched an ambitious programme to update radiation protection legislation and regulation within the context of the transposition of community directives. As of the end of 2005, the transposition of the Euratom directives 89/618, 96/29 and 97/43 is considered to be complete, after publication in 2005 of a final decree and seven orders taken in application of the public health code and the labour code. Among these is the order of October 26 setting out the terms for technical control of radiation protection.

The ASN has also prepared an order to transpose the Euratom 2003/122 directive on the control of high-activity sealed radioactive sources and orphan sources. This order, to be published in the first half of 2006, is an opportunity for the ASN to simplify nuclear activity declaration and authorisation procedures to simplify procedures for users of ionizing radiation and make them more efficient by limiting administrative tasks that have no added value for radiation protection.

In parallel to its work on producing regulations and dealing with administrative procedures, the ASN continues its efforts to implement an inspection system for medical and industrial nuclear activities.

In application of law no. 2004-806 of August 9, 2004, relating to public health policy, the ASN has prepared a setting out the guidelines for designating radiation protection inspectors. Without awaiting the publication of this decree, expected in early 2006, the ASN has developed an inspection methodology specific to for the nuclear field, giving particular emphasis to future guidelines for control and radiation protection of patients. The methodology also takes into account the technical controls performed by approved bodies, whose skill and effectiveness will be guaranteed by the ASN.

Generally speaking, in small-scale nuclear activity, the ASN is committed to simplifying administrative procedures, specifically by pooling the various authorisations from major establishments; moreover, this simplification is included in the above-mentioned proposed order.

Control of exposure to ionizing radiation

Medical applications using ionizing radiation and naturally occurring ionizing radiation, including radon, are the two main sources of exposure of individuals in France. I would like efforts to focus on improving monitoring of this exposure to identify the most exposed categories of the population for whom this exposure can be optimised.

For this reason, the plan action plan to monitor patient exposure to ionizing radiation (PASEPRI) introduced by the ASN last year, in cooperation with the IRSN and the InVS (national health monitoring body), has begun this year to provide new and more accurate information on the estimation of doses administered to patients.

This year the ASN has also implemented an action plan on radon-related risks in housing. This plan will help prepare the measures required to incorporate radon measurement into the housing health standards required for real estate transactions. For new housing, an initiative is underway to develop building standards to prevent high levels of radon in top-priority districts.

Lastly, training and information initiatives will be geared towards building professionals in order to better structure bids for construction projects after an initial diagnosis highlighting high radon concentrations.

The ASN's efforts in focusing research and improving knowledge of radiation protection

In order to adapt regulations to developing knowledge in health and ionizing radiation, I believe it is important for the ASN to be involved in monitoring research and deliberations, both at national and international level. Indeed, the ASN is closely monitoring international projects conducted by the UNSCEAR (United Nations Scientific Committee on the Effects of Atomic Radiation), aimed at periodically updating knowledge on the health effects of ionizing radiation and also the work of the ICRP (International Commission on Radiological Protection) which aims to update radiation protection recommendations. The monitoring of these projects is particularly important at a time when the IAEA and the European Commission have revealed they will coordinate their efforts to update "basic standards" related to radiation protection.

Management of radioactive waste

2005 was marked by intense activity to prepare the debate to be held in Parliament in the second quarter of 2006 on the bill concerning the search for channels for eliminating high-level long-lived waste (HLLL) called for by law no. 91-1381 of December 30, 1991 on research into radioactive waste management, known as the "Bataille" law. Firstly the report by the OPECST (Parliamentary Office for Scientific and Technology Choices Assessment), published on March 15 by Mr Birraux and Mr Bataille must be acknowledged. The report was the result of an intense and long-term investment on the part of its authors and takes stock of the research conducted on the various themes contained in the above-mentioned law. It is a valuable tool for preparing the bill as it provides a true roadmap for the management of HLLL waste after 2006. Furthermore, the Government, in the aim of providing better public information on radioactive waste, asked the national public debate commission to hold a debate on the subject. This debate took place from September 2005 to January 2006.

The ASN's objective is to ensure that all radioactive waste, of any type and origin, is managed safely and uniformly and has devised a draft plan entitled PNGDR-MV (National plan for management of radioactive waste and reusable materials) through the creation of a working group made up of representatives of elected officials, waste producers, managers of radioactive or non-radioactive waste, representatives from the ministries concerned, technical specialists and environmental protection associations. The draft plan is available for public consultation on the ASN website (www.asn.gouv.fr). The major perspectives of this plan are likely to be approved by the bill to be presented to Parliament in the second half of 2006.

Within the framework of the preparation of the above-mentioned bill, on February 1, 2006, the ASN submitted its report to the Government on both management of high-level long-lived radioactive waste and management of radioactive waste and reusable materials. This report clearly indicates that, although the areas of research covered by the above-mentioned law of December 30, 1991 are complementary, disposal in deep geological repositories is undeniably the definitive solution for high-level long-lived radioactive waste. The report also covers the focus areas of the PNGDR-MV.

Emergency situations involving radiology

An inter-ministerial directive was published on April 7 relating to the actions of public authorities in the event of an incident leading to an emergency situation involving radiology. This directive puts the ASN in charge of preparing the terms of the response to a situation caused by a nuclear accident. Until now, public authorities have focused their efforts on preparing to manage the emergency phase of a nuclear accident; the emphasis must now be on preparing to solve complex problems such as health issues for the population, economic impact and rehabilitation of contaminated areas. I therefore decided to set up a post-accident management committee to develop a policy on this matter within the next two years. This management committee will draw on the various national and international projects conducted on this subject and on five

"PAREX" seminars held by the ASN in late 2005 and early 2006.

In order to prepare for managing less serious accident situations in small-scale nuclear activities, the ASN, in conjunction with the interior ministry and other ministry departments responsible for health and the environment, has drafted a document addressed to prefects specifying the breakdown of skills and the procedures to be followed by local authorities if such events occur. This document was published December 23 and a emergency exercice will be organised during 2006 to test these terms.

Public information

On of the ASN's vital roles is informing the public. It pursued an active public information policy in 2005, during which 500,000 homes located near nuclear plants received information brochures presenting local organisation for the supervision of nuclear safety and radiation protection in France, constituting a large-scale public initiative for the ASN. Similar initiatives involving residents near other nuclear sites will be organised in 2006.

In 2005, an opinion barometer to gauge awareness of the ASN and the level of satisfaction of various categories of the general public regarding the ASN's information initiative was introduced, marking an important step in the development of these initiatives. The initial results, showing that the ASN is relatively well-known by the general public, should serve as a guide for the way ASN informs the public.

The growing numbers of visitors to the www.asn.gouv.fr website in 2005 confirms that the Internet is now the general public's main source for the public to get information about ASN. New sections were created in 2005 and public consultation projects on various law proposals were organised. These initiatives will continue in 2006, with a new version of the site coming online during the year.

Important initiatives were undertaken in 2005. The ASN will pursue its active policy in this area in 2006.

Technical support for the ASN

To implement its control of nuclear safety and radiation protection, the ASN calls on the assistance of technical expertise bodies, the main one being the Radiation protection and nuclear safety institute (IRSN). The quality and relevance of the IRSN's support are essential to the ASN's efficient control. The ASN and the IRSN worked together in 2005 to improve the efficiency of their working relationship, specifically via development of good practice documents and initiatives aiming to better define the nature of the ASN's requests to the IRSN. This work is set to continue in 2006 and will help the ASN, with the support of the IRSN, make more predictable individual decisions within specific deadlines.

*

* *

2006 will be an important phase in the ASN's developing role with the preparation of a programme defining the conditions for achieving harmonised pan-European nuclear safety control as well as the critical eye of the ASN's peers on its organisation and operation during the IRRT audit which I have requested.

In 2006, the bill on managing radioactive materials and waste, which the Government will present to Parliament, will help define the long-term national policy for management of radioactive materials and waste. Although it is to recognise that disposal in deep geological repositories is the definitive management solution for high-level long-lived radioactive waste, it will also create a roadmap for research and studies for all radioactive waste, in line with the principles set out in the law of December 30, 1991.

Within the framework of the preparation of the bill on transparency and security in the nuclear field to be presented to Parliament in March 2006, and in pursuance of initiatives in place for several years, the ASN also plans to prepare to implement the independent authority announced by the French President.

Within this context, the ASN will continue to aspire to ensuring effective, legitimate and credible nuclear control which is recognised by citizens and constitutes an international reference.

*

* *

Faced with the challenges ahead, I am sure that I can count on the enthusiasm, the skill and the motivation of all agents of the ASN to help us move forward together, celebrating our values of competence, independence, discipline and transparency.

André-Claude LACOSTE

COMPETENCE

COMPETENCE

INDEPENDENCE

INDEPENDENCE

AUTORITE DE SURETE NUCLEAIRE

Strategic Plan of the French Nuclear Safety Authority 2005-2007

Making strides in nuclear safety and radiation protection

TRANSPARENCY

TRANSPARENCY

STRINGENCY

STRINGENCY

The Nuclear Safety Authority (ASN, www.asn.gouv.fr) comprises the DGSNR (General Management of Nuclear Safety and Radiation Protection), under the authority of ministers for health, the environment and industry, and the various State departments on which it depends for control of nuclear safety and radiation protection; specifically DRIRE, DRASS and DDASS.

OUR OBJECTIVE

The ASN is a public body that controls nuclear safety and radiation protection for the protection of workers, patients, the general public and the environment against hazards and nuisances related to nuclear activity, and more broadly, to ionizing radiation. This body also helps keep citizens informed in these areas.

OUR VALUES

The ASN, the men and women who work for it, perform their duties in full observance of four essential values:

Competence
Independence
Stringency
Transparency

OUR AMBITION

The facilities, activities and situations portfolio under the authority of the ASN is one of the world's largest and most diversified. It includes a standardised fleet of reactors which produce most of France's electricity, all fuel cycle facilities, research facilities and plants which are practically unique in the world. The ASN also controls thousands of facilities and activities where ionizing radiation sources are used for medical, industrial or research purposes. Lastly, the ASN controls the transport of radioactive materials, with several hundred thousand shipments made annually throughout France.

Furthermore, the ASN strives to develop a broader view of its scope of control, considering material aspects as well as organisational and human factors. It monitors the impact of activities on people and the environment and ensures clear, exhaustive and safe management of radioactive waste.

The aim of the ASN is to ensure efficient, relevant and transparent control of nuclear activities always with the aim of ongoing progress. The ASN is thus responsible for managing issues of major stake for citizens and the environment. At national level, it is responsible for protecting and informing citizens. At international level, it must act as one of the major nuclear safety authorities, taking care to cooperate with its peers and ensure that nuclear safety and radiation protection principles are observed throughout the world.

The ASN's ambition is to ensure effective, legitimate and credible nuclear control which is recognised by citizens and constitutes a international reference.

OUR STRATEGY

OUR ACTIVITIES

The ASN's control activities encompass the following seven areas:

1 - development of general regulations for nuclear safety and radiation protection;

2 - management of individual authorisation requests and receipt of declarations;

3 - inspection of nuclear activities;

4 - organisation of radiological surveillance of individuals and of the environment;

5 - preparation for management of emergency situations and implementation if necessary;

6 - contribution to public information on nuclear safety and radiation protection;

7 - determination of the French position within international community.

OUR AREAS OF FOCUS

To achieve its ambition, the ASN has determined eight strategic focus areas in four fields: our organisation and culture, our resources for action, our legitimacy and credibility, our international presence and actions.

The above-mentioned focus areas do not represent the entire range of the ASN's projects for the period 2005-2007 but constitute the most important ones for achieving our goals.

OUR ORGANISATION AND CULTURE

Continue to develop an ASN culture

One of the ASN's strengths is the diversity of its projects and profiles of its employees. While valuing this diversity, the ASN must strive to develop a common culture geared towards its objective of protecting citizens and the environment.

In terms of operations, the ASN must continue to extend the development of nuclear safety and radiation protection control to the whole of France, achieving this through stronger ties with the other relevant administrations (DSND, DPPR, DRT, DGS, DHOS, DARQSI, etc.) and with State departments in the regions (mainly the DRIRE, but also the DRASS and DDAS).

Improve the ASN's performance

The ASN must ensure it is efficient and effective; it must monitor the quality of its work, the accuracy of its decision-making and the follow-up of its activities. It must develop and maintain a working environment that is conducive to controlling deadlines and decisions. In particular, it needs to develop a management system that makes it permanently responsible for its actions.

The ASN has developed a shared information system to be deployed further and extended to small-scale nuclear activity.

The ASN must also incorporate new budgetary and accounting practices, specifically those relating to the LOLF (French law on finance laws). It needs to consolidate its employment management process and its skill and career development process.

Make our collaboration with the IRSN more professional

The quality and pertinence of the technical support provided to the ASN by the IRSN (Radiation protection and nuclear safety institute) are essential factors in its control of nuclear safety and radiation protection. Thus the ASN must consolidate its collaboration with the IRSN and make it more professional, as an intelligent client. Specifically, the ASN, with the support of the IRSN, must take more predictable individual decisions within controlled deadlines.

OUR RESOURCES FOR ACTION

Develop our work tools

The ASN must improve national regulations on nuclear safety and radiation protection with the aim of efficiency and simplicity. It must determine legal and regulatory guidelines for decision-making, official warnings and sanctions and implement them.

The ASN needs to change its authorisation and declaration procedures to apply the principle of the prime responsibility of operators. It must also continue to develop control procedures for small-scale nuclear activity and transport of radioactive materials and determine the role and terms of intervention of approved bodies.

In addition to the regulatory framework, the ASN must improve its ability to create and formulate a structured appraisal of operator performance in terms of nuclear safety and radiation protection.

The ASN must manage the implementation then the operation of a reliable, pluralistic and transparent national radioactive measuring system and help introduce the tools necessary for surveillance of patient exposure to ionizing radiation and exposure of individuals to radon.

It needs to work on crisis organisation and particularly emergency plans for all situations with a radiological impact as well as help develop a policy then an organisation for post-accident management.

Lastly, it must develop and organise its R&D monitoring system for nuclear safety and radiation protection.

Anticipate and develop our skills in new and high-stake areas

The ASN must ensure that it maintains and develops its skills and anticipates the emergence of new challenges.

In the coming years, the ASN must make particular efforts to strengthen its knowledge, its appraisal methods and its skills in the following areas:

- the impact of organisational and human factors on nuclear safety and radiation protection
- the priority given by operators to nuclear safety and radiation protection in a fiercely competitive climate
- facilities undergoing creation or construction, particularly the EPR, the Georges Besse II facility and ITER
- feedback, aging and dismantling of facilities
- implementation of safe, consistent and clear management channels for all types of radioactive waste
- limitation and optimisation of radiological exposure of workers
- management of radon-related risks in public places, housing and the workplace
- knowledge of doses administered to patients and justification of these procedures in order to optimise doses

OUR LEGITIMACY AND CREDIBILITY

Build up our reputation

Recognition of the ASN is essential to its ability to act effectively. It must thus continue with its public information initiatives and its efforts to achieve transparency. It needs to communicate on its essence in order to clarify its role in the chain of responsibility as well as on its action.

The ASN must strive to develop a radiation protection culture in the professional field of small-scale nuclear activity. In medicine it must first support application of regulations for suitable initiatives, particularly information and awareness-raising. Specifically it must develop its relationships with trade unions as well as professional bodies and societies.

The ASN must pursue and step up its efforts in terms of information to the general public and to specific targets (residents living near facilities, professionals, patients, elected officials, trade unions, etc.). It must also continue and strengthen its information initiatives in the regions, in conjunction with the DRIRE directors.

OUR INTERNATIONAL PRESENCE AND ACTION

Initiate harmonisation of nuclear safety practices

The harmonisation of supervision practices is a legitimate expectation for citizens. Due to the scope of its control, the ASN considers itself responsible for participating in and leading multilateral efforts to harmonise nuclear safety and radiation protection control practices. The ASN must contribute to these efforts, whether they represent initiatives from states or international organisations (IAEA, NEA, European Commission, etc.).

Become an international reference

At international level, the ASN must act as one of the major nuclear safety authorities, taking care to cooperate with its peers and ensure that nuclear safety and radiation protection principles are observed throughout the world. In order to become a reference the ASN must focus on the following:

- assuming its role in international radiation protection regulations
- promoting its organisation and practices in terms of nuclear safety and radiation protection
- submitting to external appraisals such as the one provided by the IRRT audit performed by peers under the authority of the IAEA.

WE REPORT ON OUR ACTIONS

Since its inception, the ASN has reported on its activities, mainly through its publications (www.asn.gouv.fr, the bi-monthly "Contrôle" magazine, annual report on nuclear safety and radiation protection in France).

Qualitative indicators are useful tools for evaluating our action and efficiency and implementing our strategies. They are no substitute for a qualitative analysis but they are a welcome addition.

In the next portion of this document we will present direct indicators such as those that, according to the OECD, relate to the effectiveness and efficiency of nuclear regulations, depending first on the ASN. These will be followed by indirect indicators which also depend on licensees. Indeed, in accordance with France's international commitments, in particular regarding the Convention on nuclear safety, and with the international standards established by the IAEA, the ASN's responsibility in terms of nuclear safety and radiation protection control is a part of a chain of responsibility which includes that of the operator, which takes prime responsibility for the high-risk activities it performs.

OUR CONTEXT

The table below shows the spectrum of nuclear activities controlled by the ASN:

Civilian basis nuclear facilities (BNF):	
- nuclear power reactors	58 out of 19 sites
- fuel cycle facilities	16 out of 6 sites
- research facilities	61 out of 4 sites
- facilities in the dismantling process	10 out of 7 sites
- waste disposal facilities	2 out of 2 sites
Small-scale nuclear activities:	
- medical activity:	
• authorised, such as radiotherapy	1,500
• declared, such as radiology	49,000
- industrial and research activities	5,000
Packages of radioactive materials transported in 2004	300,000

Source : ASN

In addition to nuclear activities, please note that radiation protection also involves situations where natural radioactivity is strengthened, often due to the presence of radon, particularly in housing, public places and workplaces in the districts classified as top-priority.

OUR ACTIVITY

For information purposes, the table below shows activity indicators. We have set target values or ranges where relevant:

Activities during year n	Unit	2003	2004	2005	Target 2006	Target 2007
General regulatory laws and orders published	number	7	14	15	-	-
Authorisations issued in the field:						
- BNFs (water disposal and sampling)	number	6	6	2	-	-
- small-scale nuclear activities	number	1,900	2,100	(*)	-	-
- transport of radioactive materials (TRM)	number	85	100	55	-	-
Inspections (or controls) performed:						
- in the field of BNFs and TRM	number	720	730	730	700	700
- in the field of small-scale nuclear	number	100	200	400	500	750
Emergency drills performed	number	9	10	11	10-12	10-12
Press meetings	number	15	15	15	20	20
Press releases	number	8	9	10	12	15
Community and international initiatives	man. day	1,700	2,000	1,900	2,000	2,000

(*) In 2005, the management of authorisation procedures was transferred from the DGSNR to the DSNRs. Moreover, the experimentation with budgetary structuring implemented by the LOLF (French law on finance laws) in four DSNRs led to uneven allocation of tasks. Creation of a single indicator has been complex. This indicator, with an order of magnitude comparable to that of 2004, will be announced in 2006, which is the first full tax year for the LOLF.

These actions are not merely occasional but must be sustained initiatives. A high level of nuclear safety and radiation protection can never be permanently acquired and in order to maintain and improve this level, nuclear activity control, both old and new, must be part of a long-term approach.

OUR INDICATORS

The following two tables give a very partial, simplified view of nuclear safety and radiation protection in France. Although it is impossible to isolate the contribution of public authorities to these indirect indicators, where relevant we have set targets beyond which an in-depth analysis is required, not only of the actions of operators but also of our own actions.

The table below deals with prevention of risks of incidents and accidents. We must stress that we cannot directly deduce the long-term probability of a serious accident occurring using the number of incidents detected and declared in one year in one country.

Number of events declared during year n	2003	2004	2005	Target 2006	Target 2007
Level 1 incidents	148	92	80	-	-
Level 2 incidents	1	1	1	< 5	< 5
Level 3 incidents	0	0	0	≤ 1	≤ 1
Levels 4 to 7 accidents	0	0	0	0	0

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

The table below deals with limiting exposure of individuals to ionizing radiation. The indicators concerning exposure of patients and exposure to radon in public buildings will be determined and updated as knowledge on exposure improves.

Exposure of individuals during year n	2002	2003	2004	2005	Target 2006	Target 2007
Number of workers exposed to more than 20 mSv during the year (measured)	74	104	51	N.D.	< 120	< 120
Maximum exposure calculated on residents due to a BNF site (µSv/an)	10	10	10	10	< 20	< 20
Patient indicator	In progress					
Public indicator	In progress					

Source : ASN, IRSN database

In addition to the indirect indicators presented above, we have chosen direct indicators to monitor some of the objectives set where this appears relevant. We must remember that, like most indicators, these indicators may be limited and subjective. If used as objectives without any precautions they could give mixed signals, but if used correctly, they can help us improve efficiency.

Most of the individual authorisation requests submitted by operators require a technical analysis prior to a decision. This analysis is based partly on objective criteria and partly on the views of experts. It may last anywhere from a few hours to a few days depending on the complexity of the issues and any uncertainties and questions they may raise. The ASN must make predictable decisions for operators, particularly in terms of deadlines. The indicators chosen help us evaluate observance of these deadlines.

The ASN has a considerable information policy to allow individuals to make up their minds on nuclear risks and take part in decision-making. Thus all letters sent to operators of BNFs following inspections performed by the ASN are available on its website (www.asn.gouv.fr). The same applies to the "report on nuclear safety and radioprotection in France" produced each year by the ASN. This policy must be developed further. The indicators chosen help evaluate the impact of this policy on the various targets.

Focus: to make, with the support of the IRSN, more predictable decisions particularly in terms of deadline **Indicator: *Observing deadlines***	**units**	**2004**	**2005**	**Target 2006**	**Target 2007**
Individual orders for year N:					
- published within deadlines	%	40	50	50	60
- published with a delay of less than 30% of the entire period	%	20	30	40	30
ASN decisions for year N:					
- made within deadlines	%	70	75	80	80
- made with a delay of less than 30% of the entire period	%	20	25	20	20

Focus: to continue public information initiatives and develop public consultation **Indicator: *Awareness and satisfaction rate***	**unity**	**2003**	**2004**	**2005**	**Target 2006**	**Target 2007**
Awareness rate (spontaneous + promted) among:						
- general public (GP)	%	-	-	16%	16%	18%
- specific public (SP, elected officials, associations, media)	%	-	-	61%	61%	63%
- satisfaction rate of individuals who know the ASN concerning the information it provides to the general public (SP)	%	-	-	22%	22%	25%

Main topics in 2005

1 – Government bill on transparency and security in the nuclear field

2 – The challenges and ambitions of the ASN

3 – Controlling exposure to radon

4 – EPR Reactor Project Safety

5 – Working towards a law on radioactive waste in 2006

6 – IRRT: an international audit of ASN in 2006

7 – Harmonisation of nuclear safety in Europe

8 – Chernobyl – what has been achieved over the past 20 years

9 – Informing the Public

10 – Internal authorisations

1 Government bill on transparency and security in the nuclear field

On July 7, 1998, the Meurthe-et-Moselle *député* and former chairman of the Parliamentary Office for Scientific and Technology Choices Assessment, Jean-Yves Le Déaut, delivered a report to the Prime Minister on the French system of radiation protection, control and nuclear security. Subsequent to this, a Government bill on transparency and security in the nuclear field was submitted to the Senate on June 18, 2002 by the minister for ecology and sustainable development. It was then incorporated, following some amendments, into the energy policy strategy bill, of which it constituted Title V, and was made available for public viewing on the ASN website and the ministry for ecology and sustainable development website on November 7, 2003. In March 2004 it was decided that the provisions relating to transparency and security in the nuclear field would be removed from the energy policy strategy bill and examined at a later date.

It has now been decided that the first reading of the bill on transparency and security in the nuclear field will take place in the Senate during the first quarter of 2006.

Furthermore, on January 5, 2006, the French President announced that he had asked the Government "to create, through the law on nuclear transparency (...) an independent authority for control of nuclear security, radiation protection and information." In consideration of this request, and in order to benefit from deliberations on the structure of control systems for these facilities since the bill was submitted on February 22, 2006, the Government submitted a letter of correction to the Senate. The letter requested firstly the insertion into the bill of a title to establish an independent administrative body responsible for control of nuclear safety and radiation protection, and information in these areas, and secondly, an amendment to the title relating to basic nuclear facilities.

Aside from these provisions, the bill completes the general legislative framework of nuclear activities as defined by public health law. The bill aims to prevent the health hazards and inconveniences of nuclear activity for individuals and the environment and to enhance knowledge of the risks related to this activity and of the preventive measures taken.

Defence-related nuclear facilities and activities are subject to an obligation of information and control, as are the facilities and activities covered by this bill. This obligation will be implemented within conditions set by the Conseil d'État which reconcile organisation of nuclear safety and radiation protection with the requirements of national defence.

The bill provides the main definitions and principles to be implemented in terms of nuclear activity

It defines nuclear security, nuclear safety and radiation protection. It sets out the principles to be observed in the operation of nuclear activity: the precaution principle, the preventive action principle and the polluter-payer principle set out in environmental law as well as the general radiation protection principles (justification, optimisation and limitation) set out by public health law.

The bill also pronounces the right of the general public to be informed on the risk of exposure to ionizing radiation caused by nuclear activity and on effluents emitted by facilities, and it requires that the costs of measures to prevent and reduce risks and effluent emissions be met by the parties responsible for nuclear activity.

The bill creates a Higher Nuclear Safety Authority (HASN)

The bill creates a higher nuclear safety authority (HASN) as an independent administrative body. The bill confers responsibility on the HASN for State-wide control of nuclear safety and radiation protection as well as public information in these areas.

The HASN will be consulted on the Government's decisions, particularly on regulatory bills regarding nuclear safety and may specify the terms for technical application. It will be responsible for control of nuclear safety and radiation protection. Information on nuclear safety and radiation protection will also be one of its major areas of activity.

The bill states that the HASN will comprise a college of five members: three of them, including the chairman, will be designated by the French President; one will be designated by the chairman of the National Assembly and the other by the chairman of the Senate.

The bill organises transparency in the nuclear field

The bill establishes the right to access information held by operators of facilities with a source of ionising radiation exceeding certain thresholds and by operators of radioactive materials transport. This measure sets nuclear activity apart from other industrial activities that are not subject to an obligation to transparency.

A CLI (local information commission) is established on each site housing a BNI (basic nuclear facility) and may take the form of an association. Its main role is that of a provider of information and cooperation in terms of nuclear safety and radiation protection for the particular site. It may request the services of specialists and perform measurements or analyses in the environment. It is financed by allocation of a portion of BNF tax revenues and may be eligible for public subsidies. A CLI federation is also established.

A High Committee on nuclear security transparency, made up of members nominated by decree, has been created as the guarantor of information and the transparency principles set out by the bill. The High Committee helps develop and disseminate information and may be consulted on any important issues regarding nuclear safety and radiation protection, control and associated information.

The bill updates the administrative status of nuclear facilities and clarifies and strengthens the control systems and applicable sanctions

A specific system has been established for BNIs and applies to nuclear reactors, to facilities for industrial and commercial enrichment, production, treatment, storage or disposal of nuclear fuels, to facilities containing radioactive or fissile materials, according to thresholds defined by a decree read by the Conseil d'État and to certain particle accelerators.

The authorisation system echoes the notion of the provision of the amended decree 63-1228 of December 11, 1963 relating to nuclear facilities, updating it to meet international standards in this field. It also incorporates new provisions such as the establishment of public easements to maintain a protective scope on existing sites and on the entire land area of facilities after dismantling.

Nuclear safety inspectors are designated by the HASN to police the facilities. They have judiciary police powers and may report on any offences of which they are aware.

The offences are the same as those set out in other risk-prevention legislation, and in particular they appear in the environmental code for classified facilities for environmental protection. The severity of administrative and criminal sanctions depends on the specific nature of the risks presented by BNIs and the transport of radioactive materials. If necessary, a facility may be closed down or its activity suspended.

Lastly, the provisions applicable in the event of an incident or accident - nuclear or otherwise - dictate a general obligation to inform the authorities.

The provisions of the bill to create a new radiation protection inspection system, particularly in healthcare establishments and research centres where radiation sources are used, were incorporated into the public health code by law 2004-806 of August 9, 2004 relating to public health policy. These provisions round out the reform of control of nuclear safety and radiation protection and the reorganisation of services responsible for this control, both performed in 2002.

2 The challenges and ambitions of the ASN

The ASN is a public body that controls nuclear safety and radiation protection for the protection of workers, patients, the general public and the environment against hazards and nuisances related to nuclear activity, and more broadly, to ionizing radiation. This body also helps keep citizens informed in these areas.

The ASN, the men and women who work for it, perform their duties in full observance of four essential values: competence, independence, discipline and transparency.

Responsibilities and aspirations

The facilities, activities and situations portfolio under the authority of the ASN is one of the world's largest and most diversified. It includes a standardised fleet of reactors which produce most of France's electricity, all fuel cycle facilities, research facilities and plants which are practically unique in the world. The ASN also controls thousands of facilities and activities where ionizing radiation sources are used for medical, industrial or research purposes. Lastly, the ASN controls the transport of radioactive materials, with several hundred thousand shipments made annually throughout France.

Furthermore, the ASN strives to develop a broader view of its scope of control, considering material aspects as well as organisational and human factors. It monitors the impact of activities on individuals and the environment and ensures clear, exhaustive and safe management of radioactive waste.

The diversity and significance of the sectors and areas controlled by the ASN confer considerable responsibilities. The ASN must ensure efficient, relevant and transparent control of nuclear activity always with the aim of ongoing progress. At national level, it is responsible for protecting and informing citizens. At international level, it must act as one of the major nuclear safety authorities, taking care to cooperate with its peers and ensure that nuclear safety and radiation protection principles are observed throughout the world. Two years ago, the ASN devised a multi-year strategic plan – "For progress in nuclear safety and radiation protection" – which was made public and which features the main strategic focuses for the coming years.

The ASN's ambition is to ensure effective, legitimate and credible supervision of nuclear activities which is recognised by citizens and constitutes an international reference.

Organisation and operation

As of January 1, 2006, the ASN has 378 agents. One of its strengths lies in the diverse backgrounds of its agents, including engineers in industry and health, doctors and pharmacists, legal experts and administrators and specialists in the social sciences and communication.

This diversity, however, must not lead teams to be detached from one another. The ASN strives to develop a shared culture, based on the principle of ongoing improvement and geared towards its final aim, which is the protection of citizens and the environment.

The ASN is headed by a managing director supported by a staff comprising his deputies and cabinet. It encompasses the central departments responsible for drafting general technical regulations and coordinating regional teams in charge of controlling facility land use and activities. Each of the ASN's entities helps to inform the general public, within its specific field, on nuclear safety and radiation protection.

With a view to structuring internal information exchange and helping to capitalise on information, the ASN began in 2005 to implement a shared information system (ASN-IS). It is being gradually deployed to all fields of the ASN, particularly that of radiation protection. The ASN must now make this tool the basis for its operation.

Performance of control

The ASN, with such major responsibilities, must ensure that it is effective and efficient. It must ensure that the scope and precision of the controls it performs are in proportion to the safety risks and stakes.

During the past few years, the ASN has introduced different levels of intervention in terms of nuclear safety and radiation protection control. It intervenes directly in major issues, specifically by overseeing nuclear safety and radiation protection inspection. It organises and oversees the intervention of approved bodies in the most standardised areas, particularly those concerning control of standardised equipment such as radiology machinery. Lastly, it aims to implement the principle of the prime responsibility of nuclear operators and users of ionizing radiation by extending, within certain limits, the range of decisions that they may make without ASN authorisation.

An international reference

With responsibility for control of one of the world's main nuclear fleets, the ASN's brief extends beyond national borders. There are two main reasons for ASN's resolute investment on the international scene: firstly the comparison of bilateral or multilateral practices and information-sharing techniques will strengthen its nuclear safety and radiation protection control capacity and thus boost its performance and secondly the creation of a world network of Nuclear safety authorities will greatly facilitate management of feedback and emergency situations on an international scale. This principle is illustrated by the responsiveness and efficiency of the various European Nuclear safety authorities and international organisations such as the OECD's international nuclear agency in sharing information at the time of the foundry explosion near the Sosnoby Bor plant in Russia in late 2005.

Lastly, the ASN aspires to be an international reference and at the end of 2006 will undergo an international audit on its organisation and operation, to be conducted by its peers and managed by the IAEA. The audit report will be made public on receipt in early 2007.

Working towards an independent authority

The French President, in his New Year speech to the "Forces Vives de la Nation" (a gathering of key representatives of French civil society, insurance and business associations, trade unions and employers' associations) on January 5, 2006, explained that he had asked the Government "to create, this year, through the law on nuclear transparency, an independent authority for control of nuclear safety, radiation protection and information".

There will thus be a change to the ASN's legal status during 2006. This change stands to confirm and strengthen the organisation and practices adopted by the ASN over the past thirty years and also to reinforce the values on which its actions are based: competence, independence, discipline and transparency.

In 2006, the ASN will work on government projects to prepare this major statutory change and throughout the year will strive to maintain its standards in terms of nuclear safety and radiation protection control.

3 Controlling exposure to radon

Radon-related risks

Exposure to radon, along with medical exposure, is the leading source of the French population's exposure to ionizing radiation. Radon is a certain cause for lung cancer in humans (classified in group I by the International Agency for Research on Cancer (IARC)). According to available estimates, the numbers of lung cancers that can be attributed to radon in France are far fewer than those caused by tobacco. However, according to a recent European study, around 9% of lung cancers in Europe are caused by radon. Thus the number of people exposed has made radon a public health issue which calls for action, especially since exposure can be significantly reduced by often simple measures.

Regulatory initiatives from the ASN since 2002

Beginning in 2002, the ASN began to implement a new regulatory framework for managing radon-related risks in public places. The new system is now fully operational:

• radon measuring campaigns, carried out between September and April, are assigned to approved bodies; 101 bodies, approved for the current campaign, carry out measurements according to the new AFNOR standards;

• the list of the 31 top-priority districts and the categories of establishment where measurements must be performed has been published, and the DDASS departments are responsible for drawing up the local list with the names of these establishments.

These regulatory projects will be completed in early 2006 with the publication by the labour ministry, with support from the ASN, of a law on managing radon-related risks in the workplace.

Inter-ministerial action plan 2005-2008

Based on the initiatives adopted by the Government in June 2004 within the context of the national health and environment plan (PNSE), in 2005, the ASN drew up a plan, in collaboration with the ministry for urban planning and construction, to coordinate the actions of various national bodies involved in this area, such as the radiation protection and nuclear safety institute (IRSN), the health monitoring institute (InVS) and the scientific and technical building institute (CSTB) and also to promote regional initiatives to strengthen the skills of local stakeholders. The aim of the plan is three-fold:

• to create a new policy for managing radon-related risks in the home and in new buildings;

• to support and control the implementation of regulations for managing radon-related risks in public places;

• to improve and disseminate knowledge on exposure and radon-related risks.

Managing radon-related risks in existing housing and in new buildings

The PNSE gives priority to the management of radon-related risks in housing since exposure may be high given that more time is spent in the home than in the workplace, for example.

In 2006, assistance mechanisms will be identified to encourage the reduction of radon levels in housing and a feasibility study will be conducted on incorporating radon measurements into the housing health standards required for real estate transactions. A project underway for new housing in top-priority districts will lead to the establishment of building standards to limit radon concentrations.

Lastly, training and information initiatives will be geared towards building professionals in order to better structure bids for renovation projects following an initial diagnosis indicating high radon concentrations.

Control and monitoring of regulation in public places

An initial campaign carried out between 1999 and 2002 produced diagnoses in more than 13,000 public establishments, particularly schools. The results of these measurements, published by the ASN in 2003, were used to make an initial identification of non-compliant establishments: 8% of the establish-

[1] *"Radon in homes in risk of lung cancer: collaborative analysis of individual data from 13 European case-control studies"* S. Darby, D. Hill, M. Tirmarche, et al., British Medical Journal, December 2004.

ments checked had ambient radon concentrations falling between 400 and 1000 Bq/m^3, and 4% passed the 1000 Bq/m^3 mark. A new report will be produced in late 2006 based on the results of the current campaign, and this will provide new indicators.

Particular emphasis will be placed on the follow-up by DDASS departments of non-compliant establishments to ensure implementation of corrective actions. Within the context of the approvals it issues, the ASN will also organise control of approved bodies in order to check the quality of the measurements performed.

Another important initiative involves updating the list of top-priority areas, using national criteria to be defined, in order to complete or correct the 2004 list of 31 top-priority districts, taking into account the district areas neglected by this classification.

Knowledge on exposure and radon-related risks

The improvement and dissemination of knowledge on radon exposure and the related risk are closely linked to the implementation of a relevant information system. On the initiative of the general health department, the database currently under construction (housing/health), accessible via Internet, will include a section devoted to radon. In the long term this should allow the pooling of existing data and new data collected by the approved bodies.

The Inter-ministerial action plan identifies public information strategy initiatives and studies to be implemented to improve knowledge of radon-related risks and the management of these risks, with an emphasis on studies involving characterisation of the risk of lung cancer in the most exposed regions.

4 EPR Reactor Project Safety

Safety objectives determined

The ASN judges the safety of reactors currently in service in France as satisfactory. It considers, however, that any project involving new generation electronuclear reactors must reach an even higher safety level.

With this in mind, in 1993, French and German Nuclear Safety Authorities jointly determined heightened safety objectives for the EPR reactor project (European Pressurized water Reactor), within the scope of an evolutionary design encompassing experience feedback from currently operating reactors:

• the number of incidents must be reduced, in particular via enhancement of system reliability and better account being taken of aspects related to human factors;

• risk of core meltdown must be reduced even further;

• radioactive releases which may result from conceivable accidents must be minimized:

- for accidents not involving core meltdown, measures to protect people living in the vicinity of the damaged plant must not be necessary (no evacuation or sheltering);

- for accidents involving low-pressure core meltdown, measures to protect people must be very limited with regards to scope and duration (no permanent rehousing, no emergency evacuation beyond the immediate vicinity of the site, limited sheltering, no long-term restriction on consumption of foodstuffs);

- for accidents which might lead to significant early radioactive releases, in particular accidents involving high-pressure core meltdown, these must be “practically eliminated”.

As a result of operational experience acquired from reactors in service, the ASN has also requested that operational constraints and aspects related to human factors be taken into account from the design stage, with the particular aim of enhancing radiation protection for workers and restricting radioactive releases together with the quantity and activity of waste produced.

Examples of improvements brought about by the EPR reactor project

The objectives thus determined have led reactor designers to propose, within the framework of safety options, a certain number of improvements in terms of safety, among which the following may be mentioned as illustrations:

- with regards to reducing accident risks, significant reinforcement at civil engineering level of the nuclear island to afford enhanced protection against external hazards, including earthquakes, industrial explosions and aircraft crashes;

- with regards to taking into account management of serious accidents from the design stage, placing, under the reactor vessel, a dedicated device to recover, contain and cool the melting core;

- with regards to taking into account the human factor in accident management, design-induced longer times left to operators before their intervention becomes necessary.

The EPR reactor project: an opportunity to harmonise safety approaches between European countries

From the outset of the project, French and German Nuclear Safety Authorities, together with their technical supports and the groups of experts attached to them worked in close collaboration to determine the project’s safety requirements and examine the design options put forward.

Although reduced since the German government’s decision in 1998 to abandon the nuclear field, this collaboration has been maintained, and certain German experts continue to take part in work on technical aspects of the project.

In addition, Finnish electricity generating utility TVO submitted a request in 2004 for permission to build an EPR reactor for which the Finnish Nuclear Safety Authority (STUK), after examining the project for a year, gave the go-ahead to the Government who subsequently authorised construction at the beginning of 2005. Against this backdrop, Finnish and French Nuclear Safety Authorities decided to strengthen their collaboration in this field: besides remitting all reports dealing with the assessment already carried out in France with regards to the EPR project to STUK, several joint technical meetings took place. More than a mere mutual sharing of information, these exchanges make it possible to examine the opportunity for harmonising certain design provisions and take into account the differences in approach towards safety issues from which they arose. In addition, in 2004 the ASN appointed a Finnish expert within the Standing Group of experts for nuclear reactors. Finally, on behalf of STUK, the ASN inspected the beginning of production of the major components in the Finnish project such as the vessel and the steam generators.

Olkiluoto nuclear site in Finland. Background: existing reactors. Foreground: simulated image of the EPR reactor

The Nuclear Safety Authority's position

On the 28th September 2004, on behalf of the ministers in charge of nuclear safety, the nuclear safety and radiation protection general manager sent a letter to EDF's CEO setting out the public authorities' position on the safety options for the EPR project.

On the basis of the examination carried out by the ASN with the backing of the Standing Group of experts for nuclear reactors attached to it, the public authorities consider that the safety options chosen satisfy the objective for enhancing safety in comparison to current reactors and request EDF to comply with the two compendia of technical rules appended to the letter. At the safety option stage, this appreciation must, moreover, be confirmed by the examination of certain detailed design studies.

The position of the public authorities, which is of a technical nature, in no way constitutes authorisation to construct an EPR reactor. Such authorisation comes under the procedures established by decree no. 63-1228 of the 11th December 1963 regarding nuclear facilities.

Preparing a possible request for authorisation to set up a nuclear site

The procedure for dealing with a request for authorisation to set up a nuclear site is defined by the aforementioned decree of the 11th December 1963.

In particular, the decree stipulates that, to back up any request for authorisation to set up a nuclear site submitted to the ministers in charge of nuclear safety, the future plant operator must:

- submit for examination by the ASN a preliminary safety analysis report (RPS) encompassing description of the site and the operations that will be carried out there, inventory of the risks that it presents, regardless of the source thereof, analysis of the provisions made to prevent such risks and measures to reduce the probability of accidents and subsequent effects;

- present a documentary file which will be subject to a public enquiry, including various site plans together with, on the basis of RPS contents, a study of hazards and an environmental impact report. This file must also stipulate the provisions aimed at facilitating the future dismantling of the site.

When preparing a request for authorisation, EDF sent the ASN at the beginning of 2004 a so-called generic version of the RPS project, as this included no specific element linked to the choice of the site and, in October 2005 a first complete version of the report. Examination by the ASN of these proposed reports makes it easier to deal with any future request.

The public debate over the pilot EPR project

On the 21st October 2004, EDF announced that it had chosen the Flamanville site for a proposed location of an EPR-type reactor. EDF then referred to the National Commission for Public Debate (CNDP), in accordance with article R. 121-1 of the environment code which provides for a mandatory national public debate to take place on the proposed setting up of a new basic nuclear site. Following this debate which began on the 3rd October 2005 and which is scheduled to end on the 18th February 2006, EDF may submit a file requesting authorisation for setting up an EPR reactor. Then the ASN will deal with the request and in particular examine the safety issues relating to the location of the site of the EPR reactor, and will especially check that site-specific constraints (risk of flooding, earthquake risks, uncertain climatic factors, etc.) have been correctly taken into account at site design and dimensioning levels with a view to ensuring safety.

5 Working towards a law on radioactive waste in 2006

Context

Article L. 542-3 of the environment code states that the Government must submit to Parliament, before December 30, 2006, a summary report on research on the future of high-level radioactive waste, accompanied by a bill authorising, if necessary, the creation of a disposal facility for high-level and long-lived radioactive waste.

2006 will clearly be an important year for the management of radioactive waste in France.

Preparing to meet the deadline

All those involved in radioactive waste have finalised the key elements for preparing to meet the deadline set by article L. 542-3 of the environment code.

The first element was the publication in November 2004 of the *National inventory of radioactive waste and reusable material* produced by the ANDRA (national radioactive waste management agency). This inventory, the first of its kind in France, provides a broad and complete view of the quantities of existing and future waste by 2010 and 2020. It also includes an inventory of materials considered to be reusable, such as spent fuel. The inventory will be updated in early 2006.

The OPECST (Parliamentary Office for Scientific and Technology Choices Assessment) organised a series of hearings at the beginning of 2005, to take stock on research into the management of high-level long-lived waste. In March 2005, the OPECST published the report *To look after the long term, an act in 2006 on the sustainable management of radioactive waste*, which sets out proposals for the improving radioactive waste management in France.

The main players in research, the CEA for enhanced partitioning and transmutation of long-lived radionuclides and long-term storage, and the ANDRA for disposal of waste in deep geological repositories, submitted their reports to the Government in June 2005. These reports present the results of 14 years of research including the results obtained by the ANDRA from its research in the Meuse Haute-Marne underground laboratory in Bure.

National plan for management of radioactive waste and reusable materials: a general framework for managing radioactive waste

Following a recommendation by the OPECST, in 2003 the ASN offered to conduct a feasibility study for the national plan for managing radioactive waste. The minister for ecology and sustainable development announced the launch of the plan during a Cabinet on June 4, 2003. The ASN coordinated the development for public bodies of the National plan for management of radioactive waste and reusable materials (PNGDR-MV) by creating a working group made up of representatives of elected officials, waste producers, managers of radioactive or non-radioactive waste, representatives from the ministries concerned, technical specialists and environmental protection associations.

The main objectives of the PNGDR-MV are as follows:

- to seek solutions for managing all radioactive waste, regardless of who has produced it;

- to ensure consistency of the radioactive waste management system;

- to allow all radioactive waste to be directed into suitable channels, including when the party responsible for the waste is unable to send it to the ANDRA, thus recognising the ANDRA's status as a public service provider.

The efforts made during development of this plan have produced the following strategy:

A long-term management channel for low-level long-lived waste will be developed by the ANDRA and could be commissioned by 2012.

In 2010, the holders of reusable radioactive waste will present the ministers in charge of nuclear safety with studies on possible management channels if these materials were to be considered waste. Studies of reusable radioactive waste for which reconditioning processes are being developed and have never been implemented will be presented in 2008.

The ANDRA and the producers of used sealed radioactive waste are conducting studies to produce long-term management solution sources. The results of these studies will be presented in 2009 to the ministers in charge of nuclear safety.

For tritiated waste that cannot be disposed of on the surface or near surface repositories, the CEA, in conjunction with the ANDRA, will seek the best storage solutions for the decay process required before disposal, in order to present a management strategy to the ministers in charge of nuclear safety by 2008.

The state of solutions for short- and long-term management of waste with enhanced natural radioactivity will be examined upon renewal in 2009.

Analyses of the long-term impact of disposal of uranium mining residues will be conducted by the operator of these repositories. An appraisal of the study results will be presented to the ministers in charge of nuclear safety by January 1, 2008.

Public information and consultation

The Government consulted the national public debate commission on the issue of radioactive waste management. The debate was conducted under the authority of the specific public debate commission from September 2005 to January 2006. It allowed the interested parties, waste producers, disposal facility managers and the relevant administration and environmental protection associations to express their views on the matter. The public debate meetings were held in regions where facilities research on waste management or storage of existing waste are located. The debate provided the opportunity to discuss technical aspects - specifically through meetings held at the Cité des Sciences et de l'Industrie de la Villette in Paris - as well as societal and economic aspects.

The national public debate commission published a preliminary report at the end of January 2006.

Evaluation of research

Article L. 542-3 of the environment code gave rise to the creation of the CNE (national evaluation commission), charged with submitting an annual report to Parliament on the status of research conducted by the ANDRA and the CEA. The CNE also submitted a summary report to the Government in January 2005 on research conducted during the previous 14 years.

The Nuclear safety authority, after consulting its advisory body on waste on the Argile 2005 affair, also submitted its findings to the Government on the safety and radiation protection of cases submitted by research professionals. This report was published on the ASN website: www.asn.gouv.fr. From all the cases submitted, the ASN highlights the following:

- the technological feasibility of partitioning and transmutation is not yet established. Even if such a solution were implemented, high-level long-lived radioactive waste would not be completely eliminated. Another solution is required.

Indeed, research conducted on partitioning and transmutation of long-lived radionuclides contained in waste shows that the industrial application of partitioning and transmutation methods would not be feasible before 2040 and even then could not include all high-level long-lived waste. Furthermore, partitioning and transmutation would still generate residual waste.

Moreover, recovery of waste packages already produced and packaged for treatment by partitioning then transmutation would not be desirable for reasons related to safety, radiation protection and cost. A definitive management solution is therefore necessary for these packages;

- long-term storage is not a definitive solution for managing high-level long-lived waste.

Indeed, research conducted on conditioning and long-term storage of radioactive waste confirms that storage is an essential step to allow cooling of certain waste packages before they are disposed of in deep geological repositories.

On the other hand, the ASN considers that the solution of renewing long-term storage several times should not be chosen as a system of reference, since it requires to control the process over centuries and assumes retrieval of the waste by future generations, which would be difficult to guarantee over a period of several hundred years;

- disposal in deep geological repositories is undeniably a definitive management solution.

This is the long-term management method favoured by many countries with nuclear-based electricity production.

Moreover, the results obtained by the ANDRA in the Bure laboratory on the Callovo-Oxfordian strata and its geological environment show that a safe disposal facility in the transposition zone would be feasible. This “transposition zone”, with a surface area of 200 m^2 to the north and west of the Bure laboratory, would have similar properties to those in the underground laboratory;

- regarding disposal reversibility, the most desirable solution would be a step-by-step disposal management system starting with commissioning of the repository and ending with its closure. The decision to close the disposal facility, and thus rule out reversibility, shall be taken by Parliament.

The ASN believes that, in theory, the reversibility option can have only a limited duration. Indeed, easy access to waste packages must be limited in time since a delay in closing disposal sites may jeopardise the notion, perhaps even in the long term, of the safety of storage, which is based on the ability of the clay strata to confine the radioactivity contained in the waste for long periods of time.

Additionally, it would be difficult to guarantee that provisions allowing reversibility will last beyond a period of more than 300 years. The notion of reversibility requires active management of the disposal facility during the entire reversibility phase to ensure surveillance and maintenance at minimum, along with institutional control to avoid the disposal facility being abandoned before its closure.

A law in 2006 on radioactive waste management

In accordance with article L. 542-3 of the environment code, the Government has prepared a bill that takes account of research findings and opens new perspectives for the management of high-level long-lived waste. It is set to be debated by Parliament some time in 2006.

This bill should not address only high-level long-lived waste. In accordance with the OPECST recommendation of March 2005, the focus of the National plan for management of radioactive waste and reusable materials and the methods for updating it should be approved within the context of the bill submitted to Parliament.

Handling of casks containing cemented hulls and end-pieces in the storage hall at COGEMA's UP3 plant in La Hague

In view of the results obtained, Parliament should make a decision in 2006 on the follow-up to the process initiated in 1991.

6 IRRT: an international audit of ASN in 2006

In 2005, the ASN asked the International Atomic Energy Agency (IAEA) to schedule an ASN audit assignment for the end of 2006. This audit will encompass all of the ASN's nuclear safety and radiation protection activities.

The IAEA is responsible for drafting and publishing international standards regarding safety of nuclear facilities, transport of radioactive materials, management of radioactive waste and protection against ionizing radiation. The IAEA also works to promote and apply these standards.

These standards consolidate the international consensus on matters relating to safety and safety control in terms of the responsibility of operators, control bodies and States. Some of these standards relate specifically to the organisation and legislative and regulatory framework of the nuclear safety authorities.

The IAEA offers member states various services for evaluation and application of their safety standards.

For standards concerning nuclear operators, the Operational safety review team (OSART) audits involve a team of experts from nuclear safety authorities in third countries which audit a nuclear facility. On request from the ASN, all French nuclear plants will undergo an OSART audit before the end of the decade.

The bodies performing audits of nuclear safety authorities include the following: Integrated Regulatory Review Team (IRRT) for the organisation of authorities responsible for nuclear safety control, Radiation Safety and Security Infrastructure Appraisal (RaSSIA) for authorities in charge of radiation protection and Transport Safety Appraisal Service (TranSAS) for those operating in safety of radioactive material transport. Several IRRT audits have been conducted worldwide over the past few years, generally in emerging countries, EU candidate countries or countries with a small nuclear fleet.

The IRRT audit of the ASN will be conducted by a team of at least fifteen peers from other countries' nuclear safety regulatory bodies, coordinated by IAEA specialists. The audit will take place over two weeks in November 2006. It will include presentations, interviews with ASN agents, the ministers to which it reports, its technical support and particularly with the Institute of radiation protection and nuclear safety (IRSN), as well as with the ASN's main stakeholders (administrative bodies, operators, professional corporations, professional societies, associations, etc.). It will also involve appraisals of the ASN's organisation and practices at national and regional level. The auditors will also accompany the ASN inspectors in their field assignments, whether these are inspections, technical meetings or emergency situation management drills.

As mentioned above, the audit will focus on all the businesses of the ASN in terms of nuclear safety and radiation protection. However, since the ASN underwent a TranSAS audit in 2004, the portion of the IRRT audit relating to transport of radioactive materials will be applied to follow-up of the implementation of action plans following this audit.

The audit will produce a report to be published in early 2007, prepared by the IAEA. The report will feature a list of recommendations, comments and good practices. The recommendations generally involve discrepancies with regard to IAEA standards and require action. The suggestions are guidelines for improving the efficiency and effectiveness of the authority being audited. Good practices are included for information, particularly for any other nuclear safety authorities which may consult the report. The ASN is responsible for putting them into practice.

The ASN will publish the full report in early 2007, probably simultaneously with the publication of the report on nuclear safety and radiation protection in France in 2006.

A follow-up assignment will be scheduled to evaluate the implementation of IAEA recommendations and standards.

* * *
*

The ASN has a three-fold objective in pursuing this first worldwide-scale IRRT audit of a nuclear safety authority responsible for control of a major, diversified nuclear fleet.

Firstly, it wishes to undergo external evaluation by its peers to ensure that its organisation and practices comply with international standards and, by fully incorporating recommendations made by its peers, to improve its relevance and efficiency.

Secondly, it wishes to present to its peers a number of its practices, particularly those which it believes go beyond IAEA recommendations. Specifically, although this is not routine in an IRRT audit, the ASN has asked the IAEA that the audit also evaluate its role and practices in terms of public information, communication and transparency.

Lastly, the ASN hopes to start up a movement which would lead all major nuclear safety authorities to request an IRRT audit in the coming years. The performance of these multiple audits should lead each authority to provide specialists to make up audit teams. This international peer network will be a platform for debate and discussion on the organisation, efficiency and practices of the nuclear safety authorities and the control activities they perform. It could lead to a very positive comparison of nuclear safety authorities and thus "upward" standardisation of the organisations and practices relating to control of nuclear safety and radiation protection.

7 Harmonisation of nuclear safety in Europe

Background

To begin with, nuclear energy is developed mainly on a national basis and consequently applied national safety standards. It soon became apparent that when confronted with the same safety problem, two countries could come forward with different technical responses, possibly reflecting the fact that a nuclear facility which was judged as being satisfactory in one country might not be considered as compliant with practices or regulations in the other.

Over and beyond the potentially cross-border nature of harmful effects and risks of accidents, the necessity to harmonise approaches on nuclear safety and radiation protection issues is also a result of the economic environment. Liberalisation of the electricity market and the global nature of the economy (well illustrated by the recent choice of Finnish electricity utility TVO of a Franco-German designed EPR reactor) are good reasons for such harmonisation. The Nuclear Safety Authorities of different countries must see that enhanced competition does not give rise to down-levelling of safety. On the contrary, it must ensure that safety levels continue to improve. With this in mind, it is important to foster a joint approach in the nuclear safety field, without making the least concession on the essential point: nuclear safety must be the first priority.

The ASN's position

In terms of objectives, for the ASN, harmonisation of safety in Europe must not serve as a pretext for developing detailed European safety standards in parallel with those that exist at world level drawn up by the International Atomic Energy Agency (IAEA): how legitimate would such standards be, if they were not recognized outside Europe and were not the result of a wider consensus?

In terms of methods, harmonisation could not be carried out separately from existing safety approaches, nor without the link with organisations which today exert control. Currently, expertise on nuclear safety issues is situated at the level of each country, and it is for this reason that national Nuclear Safety Authorities are in the best position to carry out such a process efficiently.

From a practical point of view, the level of detail aimed for within the scope of harmonisation must be tailored to the target: safety requirements must be sufficiently close to offer the same level of safety, with comparable industrial constraints, which means that a sufficiently accurate level should be reached without, however, seeking to harmonise detailed points which do not provide any added value.

The means to the end

The IAEA is an organisation within the United Nations set-up. Its activities include drafting texts which set out safety principles and practices and which Member States (totalling 139) may use as a basis for their own national regulations. Drafting of these texts is a slow process as consensus must be reached between States and is supervised by the Commission on Safety Standards (CSS), chaired since 2005 by André-Claude Lacoste, which coordinates the work of technical committees.

So as to meet the request for harmonisation between relatively homogeneous countries (from a political, scientific, technical and economic point of view), at the beginning of 2003, the European Commission put forward two proposed joint directives called “the nuclear package”, one of which defines general principles in the field of nuclear site safety, and the other deals with management of spent fuel and radioactive waste. It proved impossible to adopt these texts due to opposition of several EU Member States.

For their part, members of the WENRA association, created in 1999 on an ASN initiative and which brings together the 17 Safety Authority heads of the European Union’s “nuclear” countries and Switzerland, have for several years been undertaking a programme aimed at harmonising technical rules in these two fields.

The WENRA approach

According to the definition used within the scope of WENRA’s work, harmonisation will be achieved when there no longer exists any substantial difference between countries with regards to national safety requirements and subsequent application to sites. The task is, therefore, on the one hand, to define a minimum regulatory or para-regulatory framework for all countries concerned by the harmonisation process, and, on the other hand, to ensure that defined requirements are actually implemented by operators in these countries.

For WENRA members, harmonisation must not bring about any reduction in the level of safety; rather, when it is felt suitable, it must be able to make it possible to raise the level. It is not a question of seeking the least common denominator for different countries where safety is concerned. On the other hand, purely and simply stacking up different regulations would lead to inapplicable, even contradictory requirements. Thus, within the scope of WENRA’s harmonisation work, the safety level targeted is that represented by the “top quarter”. In addition, it would be acceptable for a country with stricter requirements than those which serve as reference for comparison and such a country would not be requested to lower its sights.

WENRA’s harmonisation programme is developed by two work groups. The first deals with existing electronuclear reactors and the second (created after obtaining the first encouraging results in the reactor field) with radioactive waste management and dismantling. The ASN is taking an active part in the work of these two groups and one of its representatives chaired, up to January 2005, the working group on radioactive waste management and dismantling.

The results WENRA’s work

During their most recent plenary meeting in Stockholm, in December 2005, WENRA members examined the reports submitted by the two working groups. They decided to publish them on their websites and present them to the different interested parties during a seminar in Brussels in February 2006.

It is clear that the two groups have fulfilled their mandate. A set of joint safety “reference levels”, largely based on IAEA standards, was worked out and the situation of each individual country examined. The reports show that most of the “reference levels” have already been implemented on sites, but that a number of them are not formally required by documents recognized within the scope of the WENRA study. Consequently, if harmonisation is to be achieved, there must be significant effort towards developing regulatory or para-regulatory texts.

In accordance with commitments made, each WENRA member will, before the end of 2006, present an action plan which, with regards to technical fields where differences have been noted, aims at aligning its national practices with the defined “reference levels”. The final objective is that national practices be harmonised by 2010.

Perspectives

The different approaches dealt with above are complementary and, in different ways, all lead to the harmonisation of nuclear safety in Europe. In particular, the European Commission’s “nuclear package” initiative and the steps taken by the WENRA association are bound, in the long run, to converge.

Without waiting, the ASN intends to take advantage of the results of on-going work to enhance its regulations and put other countries' "good ideas" to use in order to heighten nuclear safety in France. With regards to power reactors, the ASN has begun work revising general technical regulations and has already taken into account discussions within WENRA's "reactor" working group.

Finally, the direction taken by WENRA has already given rise to considerable work from organisations associated with it. It has made it possible to lay the foundations for future harmonisation work in Europe and could serve as an example in the radiation protection field.

8 Chernobyl – what has been achieved over the past 20 years

20 years of questions for a number of French people.

20 years of enhanced scientific knowledge.

20 years of heightened prevention of accidents and crisis management for public authorities.

What really happened in France in April and May 1986?

The accident happened in the middle of the night, on Saturday 26th April at 1:23 am, local time, but Soviet authorities did not issue any official information about an explosion concerning reactor no. 4 at the Chernobyl nuclear site until the evening of Monday 28th April. Meanwhile, on the morning of Monday 28th April, experts at Swedish nuclear sites noted a rise in ambient radioactivity concerning several sites and which therefore came from an external source. They rapidly informed their colleagues in other countries who, over the following days, confirmed similar observations. They quickly made the link with a fire at the Chernobyl site observed via satellites.

The national weather forecasting service indicated that an Azores anticyclone was forming and that air masses from eastern Europe would not affect France much. What no one had yet realized was that the initial explosion which had only lasted a few seconds had torn open the reactor core, thereby exposing it to the open air, and that the reactor fire, in particular the significant mass of graphite it contained, was continuing to release considerable quantities of radionuclides into the atmosphere. The fire finally lasted for ten days, with two peaks of radioactive emission on day 1 and day 9, during which significant variation in the weather took place.

During all these days between the end of April and the beginning of May 1986, radioactivity measurements in the environment carried out by the Ministry of Health's Central Department for Protection against Ionizing Radiation (SCPRI), the Ministry of Agriculture's National Centre for Veterinary and Food Studies (CNEVA) and the Treasury's Department for Consumption, Competition and Repression of Fraud (DGCCRF) were increased. Numerous other radioactivity measurements were also carried out by nuclear operators (CEA, EDF, COGEMA) on their respective sites.

The results of radioactivity measurements were communicated to the media (in particular press agencies) by the abovementioned bodies and especially by the SCPRI via daily telexes. The first increase in atmospheric radioactivity was slight and was only noted for the 30th April during the daytime by certain stations in the south-east of France. This increase concerned all the country's stations on the 1st May, with maximum recordings peaking on the 3rd May and decreasing tenfold the following day.

On the basis of data at their disposal, radiation protection specialists felt that there was no call to take specific protective measures for the public.

France and French media discovered the extent of the accident over its traditional long weekends of the 1st and 8th May, particularly long that year since the two public holidays fell on a Thursday. After the legislative elections of the 18th March 1986, France had a changeover in government which led to a cohabitation. The seriousness of the accident and the extent of the radioactive dispersion surprised the French authorities, as it did all other national authorities, and the response to such an event did not meet the challenges. Thus, some countries merely intensified their environmental radioactivity measurements, whereas others distributed stable iodine, issued warnings or imposed restrictions which, incidentally, differed depending on the country (putting livestock back into stables, restricting the use of rainwater, moderating or restricting the use of milk and/or leaf vegetables, reducing open-air activities). On the 6th May, the European Commission recommended maximum permissible levels of radioactive contamination for certain foodstuffs [Recommendation 86/156/EEC of the European Commission of the 6th May 1986 issued to Member States concerning the coordination of national measures taken with regards to agricultural produce following radioactive fallout from the Soviet Union].

In the spring of 1986, no one had the scientific knowledge they do today.

The first lessons learnt from the Chernobyl accident

A critical analysis of the Chernobyl accident was carried out by the ASN and its technical support, the IRSN, and this helped to draw important lessons for nuclear safety and radiation protection.

Nuclear reactors

The accident confirmed that safety depended on reactor design itself. The pressurized water reactors operating in France have 3 major advantages over their RBMK type counterparts in Chernobyl: their stability, the presence of a rapid automatic shutdown system and the existence of a thick concrete containment whose tightness and integrity are regularly checked and which constitutes a 3rd additional barrier between radioactive substances and the environment, whereas RBMK reactors only really have two.

Accident prevention

Systematic research into scenarios of reactivity accidents that were not envisaged at design stage and which might cause a very rapid rise in reactor power liable to lead to a major accident, is undertaken for French nuclear reactors. Study results enable specific responses to be defined.

Control of organisational and human factors

Analysis of the causes of the Chernobyl accident indicated the major role played by men and organisations at the source of the accident. An in-depth reflection on the role or organisational and human factors in reactor safety led to the notion of "safety culture", followed by the idea for safety management.

Communication with the public

The period immediately following the Chernobyl accident confirmed the great difficulty for public and media to have a clear idea of the severity of anomalies, incidents and accidents liable to affect a nuclear site. Consequently, the Higher Council for Nuclear Safety and Information (CSSIN) suggested that a scale of severity be determined that would be simple to understand and easy to use and which would enable incidents to be ranked by their level of severity.

International awareness

Given that the Chernobyl accident had repercussions in a certain number of neighbouring nations, the international community was led to negotiate several conventions aimed at preventing accidents and limiting their consequences.

Health repercussions

The unforeseen occurrence, as early as 1990, of thyroid cancers in children in Belarus, Ukraine and Russia (approximately 4,000 cases recorded today) led to formalisation of a specific approach aimed at providing preventive protection of the thyroid in the eventuality of radioactive iodine being given off as a result of an accident at a nuclear reactor: administration of stable iodine, prevention of inhalation and ingestion of radioactive iodines.

For over 20 years, France has endeavoured to perfect its nuclear safety and radiation protection system

For over 20 years, and on the basis of lessons learnt firstly following the 1979 Three Mile Island accident in the USA, then the Chernobyl accident, France has been constantly enhancing its system for managing nuclear safety and radiation protection at all levels.

Public authority organisation

In the area of public authority organisation, a central administrative board, the Nuclear Site Safety Board (DSIN) was set up in 1991 to replace the Central Department for Nuclear Site Safety (SCSIN). The DSIN initially reported to the Department of Trade and Industry, then to Ministries respectively in charge of industry and the environment. The SCPRI closed in 1994 and was replaced by the Office for Protection against Ionizing Radiation (OPRI). Following this, nuclear safety and radiation protection were brought closer together so as to optimise the system. Thus the DSIN and the main centre of the OPRI merged in 2002 to form the Nuclear Safety and Radiation Protection Board (DGSNR). From the point of view of expertise, the Radiation Protection and Nuclear Safety Institute (IRSN) was also set up in 2002 from the Protection and Nuclear Safety Institute (IPSN) and the OPRI expertise centre. This body may still develop alongside the transformation of the ASN into an independent administrative authority as announced by the French Republic President on 2006, January 5.

The ASN, made up of the DGSNR and the eleven regional DSNR, is today an organisation with 400 employees, as against just 170 in 1986 for controlling nuclear safety in France.

Operators

At operator level, which in particular means EDF, the safety culture is fostered and organisational and human factors taken into account. Each incident is precisely analysed so that incident feedback experience may be taken into account to improve organisations, work methods and sites. In this spirit, EDF has set up different tools for teams involved in the operational sector: risk analysis before action, self-assessment and self-diagnostics. In addition, the most difficult operations are specifically monitored. Operators are requested to provide more complete and more realistic assessments of the radiological repercussions of accidents and these assessments are appraised by the IRSN.

Monitoring operators

Operators are monitored rigorously by the ASN and control has been strengthened and diversified. The monitoring goes from the design stage to dismantling of sites and mainly consists of site inspections, inspections of worksites when power reactors are shut down for maintenance, on-site technical meetings with the operators of Basic Nuclear Facilities (BNFs) or manufacturers of materials used in the sites, and examination of supporting documentation issued by operators. Inspections include routine inspections, more in-depth inspections on issues with particular technical difficulties, review inspections over several days, inspections with sampling and measurements, inspections immediately following an incident or a significant event. Today, there are approximately 700 inspections annually covering all nuclear sites.

Managing accident situations

The regulatory system for preventing and restricting repercussions of a nuclear accident was enhanced in 1990, thereby providing action plans with a regulatory basis. Internal emergency plans (PUIs) were set up by operators to meet with accident situations on a nuclear site. Specific action plans (PPIs) were set up in 1988 by department prefectures concerned by the presence of a basic nuclear facility (BNF) should the consequences of the event outstrip the capacity of the site to limit the radiological repercussions for civilian populations in the case of significant discharge. PPIs were improved in 2000 so as to take a reflection phase into account. An inter-ministerial directive of the 7th April 2005 covers the actions to be taken by public authorities in the case of an event which gives rise to a radiological emergency situation (informing civilian populations, managing the alert, organising the crisis at national, local and central levels). So as to optimise management of nuclear events, the ASN and IRSN have each set up an emergency centre with powerful communication means. These centres have been activated in real situations and proved to be highly efficient during the flooding of the Blayais facility during the December 1999 storm and the Rhone floods in December 2003.

Exercises and drills

So as to be fully operational, the whole system and organisation is tested on a regular basis by nuclear emergency drills as set out in an annual circular. These exercises are managed from the emergency centres and bring together the operator, local and national public authorities, in particular prefectures, the DGSNR and IRSN. In practice, carrying out an emergency drill every three years on each nuclear site seems to be a reasonable compromise between training people and the time needed for organisations to evolve. Thus, since the 1980s, the number of exercises has been significantly increased to reach ten or so per year by 2005. The exercises make it possible to test emergency plans, organisation and procedures and contribute to training participating staff. The main objectives of the exercises are determined at the beginning of the drill. They mainly aim at correctly assessing the situation, bringing the site where the accident has occurred to a safe status, taking suitable measures to protect civilian populations and ensuring good communication to media and the populations in question. At the same time, the exercises enable the alert system of national and international authorities to be tested. They also enable the provisions to be tested for administering stable iodine to prevent thyroid contamination in an accident where radioactive iodine is dispersed, in cases where a projected dose to the thyroid of 100 mSv might be exceeded.

Monitoring the environment

So as to supply public authorities without delay with information which will help them to make decisions, the networks for monitoring radioactivity in the environment have been developed and modernised; they are today managed by the IRSN. The number of stations which carry out daily collection of atmospheric particles (aerosols) has been increased. The other systems have been automated and can automatically give an alert if the threshold is exceeded. From 1991 onwards, the Teleray network has been developed for continuously measuring the dose rate linked to ambient gamma radiation (181 detectors spread throughout the country). The six automatic Hydroteleray stations continuously monitor gamma radioactivity in major French rivers downstream of nuclear sites. As for the thirteen Telehydro stations, these enable continuous monitoring of water in major metropolitan areas' water-treatment plants.

In addition to IRSN laboratories, 38 laboratories from various origins are approved by the ASN and are able to analyze radioactivity in the environment. Moreover, should a radiological emergency situation arise public authorities must have information available on the state of environmental radioactivity, and measurement figures constitute a decision-making tool. With this objective in mind, the inter-ministerial directive of the 29th November 2005 details the organisation set up to ensure such measurements and interpret the results.

Distributing stable iodine

As early as 1987, recommendations for administering stable iodine as an immediate preventive measure for the intervention levels then in force were drawn up within the framework of organising medical care on the first day of any radiological or nuclear accident. In 1990, France included taking iodine tablets as counter-measures into the PPIs. Stocks were then built up in the plants and at national level. In 1996, public authorities decided to go on to the preventive distribution phase. In 2001, against the backdrop of terrorist attacks, local stocks were made up and the possibility to meet any demand from the civilian population via back-up stocks. In all, the whole of the French population was now concerned by the distribution of stable iodine (60 million tablets have been manufactured by the central armed forces pharmacy and distributed throughout the country). Finally, in 2005, the third distribution campaign was carried out together with finalisation of local and back-up stocking that had been begun four years previously.

Medical action

As early as 1996, a manual entitled “medical action in response radiological or nuclear events”, was drawn up for healthcare professionals. The document was revised after September 2001 and has been regularly updated since. In addition, orders and circulars have been issued with a view to optimising medical action (so-called Red Plan) and dealing with victims, including situations which might involve a great number of victims (so-called White Plan) in hospital infrastructures. Regional organisation in defence zones has been set up by the Ministry of Health. Specific training for health professionals and in particular medical emergency treatment in cases of nuclear and radiological risk have been set up and are currently being continued.

Informing the public and communicating

In 1987, the telematic magazine on French Minitel, MAGNUC, was created by the ASN. Since then, ASN opened its Internet website on www.asn.gouv.fr in May 2000. Updated in real time, the site makes all current news available on topics concerning nuclear safety and radiation protection.

A scale of seriousness for incidents and accidents in electronuclear reactors which have a bearing on nuclear safety and enable classification on the basis of factual criteria was initially drawn up in France, then taken up and modified by the OECD and the IAEA leading to the current INES scale applicable to nuclear sites and transport of radioactive substances. This scale was extended to radiation protection in 2004.

Orders of the 21st February 2002 and the 4th November 2005 complete the systems for alerting and informing civilian populations in the eventuality of a radiological emergency situation.

International actions

The previously mentioned actions were taken against a backdrop of exchanges with the international community, in particular with international bodies such as the IAEA and the NEA.

France is contracting party to four conventions: two conventions deal with prevention of nuclear accidents (convention on nuclear safety of the 17th June 1994 to which France has been a party since the 24th October 1996, joint convention on the safety of spent fuel management and on the safety of radioactive waste management of the 29th September 1997 to which France has been a party since the 18th June 2001) and two others concerning repercussion management (convention on the rapid notification of a nuclear accident and convention on assistance in the eventuality of a nuclear accident or emergency radiological situation of the 26th September 1986 to which France has been a party since the 6th April 1989). France also applies European regulations on the importing or on the contamination of foodstuffs (Euratom Regulation no. 3954/87 of the Council of the 22nd December 1987 determining maximum permissible levels of radioactive contamination for foodstuffs and fodder for livestock in the wake of a nuclear accident or in any other emergency radiological situation; EEC Regulation no. 3955/87 of the Council of the 22nd December 1987 concerning the conditions for importing agricultural produce from third countries in the wake of the accident that occurred at the Chernobyl nuclear plant).

Over and beyond rapidly informing European Union Member States in the eventuality of a radiological or nuclear alert, databases have been set up to pool results of environmental monitoring measurements (DATAREM for sampling and EURDEP for telemetry).

In addition, France takes part in working groups of the OECD Nuclear Energy Agency (NEA) on post-accident management and organises international nuclear emergency exercises called INEX, the analysis of which is taken into account when optimising the French approach to post-accident management.

Finally, in 1999, the ASN took the initiative of creating the WENRA association which brings together the seventeen Safety Authority heads of the European Union's "nuclear" countries and Switzerland. WENRA's target is to foster a joint approach in the field of nuclear safety and associated regulations, by sharing respective experiences, exchanging staff and defining common reference levels.

Nuclear safety in Eastern European countries

The international community has made the safety of Eastern European reactors one of its priorities. France has played an important role in the efforts towards cooperation which are currently continuing: closure of the oldest reactors and in particular closure of RBMK reactors (the last one at the Chernobyl plant was closed in 2000), improvement of operational safety of existing nuclear plants and modernisation of their technical systems, and overall modernisation of nuclear plants whose construction has to be finished. In addition, the promotion of a real safety policy is ensured with regards to these countries, in particular via the strengthening of safety authorities and separating nuclear control and operation.

Health repercussions in France

Approximately 500 French people with thyroid ailments have registered complaints since 1999 since they feel that their pathology is linked to the radioactivity dispersed at the time of the Chernobyl accident and that the preventive measures which should have been taken at the time were not. The doctors from the thyroid research group of the French Society of Endocrinology (see Reference) are of the opinion that the thyroid pathologies are not linked to the Chernobyl accident. Since the matter has been referred to the courts which have begun to examine the complaints, the final conclusions must be awaited.

* * *
*

Over the past 20 years, the considerable efforts deployed in France have completely transformed the nuclear control system and the organisation of the response to nuclear accident situations. For its part, the ASN is unrelentingly continuing its approach to optimise nuclear safety and radiation protection supervision in France, rigorously and with a concern for seamless transparency.

Reference

JL.Wémeau, P.Caron, B.Hélal, N.Balarac, L.Leenhardt, Y.Malthiéry, M.Misrahi, P.Niccoli-Sire, J.Orgiazzi, B.Rousset, JL.Sadoul, ME.Toubert. Thyroïde et Tchernobyl. Position du groupe de recherche sur la thyroïde. [Thyroid and Chernobyl. Position of the thyroid research group]. Annales d'Endocrinologie, 2002, 62(5) : 435-436.

9 Informing the Public

Informing the public about nuclear safety has always been one of the Nuclear Safety Authority's (ASN) missions. Since 2002 and the institutional reform in civilian nuclear control in France, this mission has been confirmed and extended to the field of radiation protection.

Targets and supports

In order to fulfil this mission, the ASN develops dedicated supports and actions which enable it to make information available to the public, expressed in simple terms and able to be accessed by as many people as possible. The www.asn.gouv.fr website whose audience is constantly growing, the annual report on Nuclear Safety and Radiation Protection in France, the *Contrôle* review and the topics it deals with, public information sheets or the ASN's public information centre constitute the ASN's main information tools.

Also encompassed within this mission are ASN attendance at conferences or seminars in France or abroad, in partnership with the Radiation Protection and Nuclear Safety Institute (IRSN), and participation in the "Nuclear under close surveillance" travelling exhibition.

Committed to be closer to citizens, in 2005 the ASN published a brochure on the organisation, at local level, of nuclear safety and radiation protection supervision of each of the nineteen EDF-run nuclear plants. The brochure was distributed to over 500,000 households in the vicinity of the sites.

The ASN also informs various opinion relays. It contributes towards regularly informing media by organising theme-focused press conferences. It is also dedicated to fostering the action of Local Information Commissions (CLIs). The ASN also runs the secretariat of the Higher Council for Nuclear Safety and Information (CSSIN) to which it regularly sets forth its actions. The ASN also has regular relations with elected representatives and environmental protection associations.

Seamless transparency

Technology has accelerated the circulation of information. Citizens express increasingly precise needs at information level. For its part, the ASN wishes to give ever-enhanced account of its actions. This naturally leads it to continue its commitment with a concern for transparency, while at the same time avoiding saturating information channels and implementing approaches which accompany, enhance awareness or even have an educational purpose that will enable citizens and elected officials to have easier access to information.

Informing the public and ensuring transparency with regards to nuclear activities should, moreover, be reinforced with the proposed bill on transparency and safety in the nuclear field. This text, which should soon be brought before Parliament by the Minister for Ecology and Sustainable Development, recognizes a right for public access to information held by nuclear plant operators and those in charge of transporting radioactive substances.

Stakeholders involvement and public consultation

The ASN wishes to promote stakeholder participation (representatives of environmental protection associations, industrialists or administrations, elected representatives etc.) in drafting regulatory texts of general scope. It also wishes to foster information to the public about the drafting thereof and enable it to give its opinion on contents.

The proposed National Plan for Management of Radioactive Waste and Reusable Material (PNGDR-MV) fulfils this dual target. Drafted by an ASN-steered working group and extended to different stakeholders, it went on-line in the summer of 2005 to collect opinions on the ASN's website www.asn.gouv.fr. All comments received have also been put on-line, thereby fuelling the debate on an important current, social topic.

Public awareness and ASN's image

In 2005, in partnership with the TNS SOFRES Institute, the ASN instigated an opinion study aimed at quantifying how well aware the public was of the ASN and how satisfied different types of public were with the information it delivers.

The first part of this opinion study was carried out at the end of 2005 with a representative sample of

Information and documentation center of ASN at 6, place du Colonel Bourgoin à Paris 12e

the general public and a sample called "informed public" made up in particular of journalists, elected representatives, heads of associations, administrative heads, CLI chairpersons, healthcare professionals and teachers representing an informed public. It emerges that, although a large majority of interviewees were aware of the existence of a control organisation, few were able to cite the ASN spontaneously or recognize its name (16% of those interviewed in the general public sector).

Overall awareness of the ASN was, however, greater with informed public and reached 61%. This public had a better perception of the regulatory mission (30% as against 8% with the general public), but relatively few were aware of the informative mission (13% as against 4% among general public interviewees that said they know of the ASN).

Challenges

The ASN aims to ensure a nuclear control that is efficient, legitimate, credible and recognized by citizens and one which constitutes an international reference. For a large part, this is based on its capacity for informing, associating and accounting to people.

This objective covers all current or future ASN actions for informing the public and ensuring transparency.

The first results from the opinion and ASN awareness study will also have to be taken into account by the Authority within the scope of its policy for informing general and professional publics, in particular to heighten its institutional image, enhance awareness as well as the way its missions are perceived.

10 Internal authorisations

Internal authorisations: strengthening efficiency of control and responsibility of nuclear facility operators

The ASN must focus its efforts on areas that help ensure that nuclear safety and radiation protection control is as efficient as possible.

The broadening of the ASN's scope of control over the last few years, particularly its responsibility in the field of radiation protection, carries a certain risk, in that the ASN can subject all nuclear activity to its own issuance of authorisations, without any overall oversight.

This natural "sociological tendency" is a question of habit or novelty. If the ASN is not careful, its effectiveness may be significantly weakened by this natural tendency which may lead it to spread its resources too thin and not focus its efforts on matters carrying the greatest risk to nuclear safety or radiation protection.

Moreover, the existence of a controller influences the behaviour of the party being controlled. One of the fundamental principles regarding the safety of high-risk activities is that the operator of these activities is the responsible party. If the ASN intervenes too zealously, it risks taking on the role of internal controller, which should be performed by the operator on its own activities or decisions. Indeed, the controller may be wrongly perceived as being the final safety net, for example by closely monitoring safety issues.

ASN is encouraging operators to develop a system of internal authorisations to boost the efficiency of its own action and the responsibility of operators. The system aims to make operators responsible for certain decisions formerly subject to ASN authorisation.

For certain operations not involving the fundamental safety of facilities, operators may, subject to a report by an internal commission independent of the teams operating the facilities, issue their own authorisations for implementation of these operations, instead of the ASN.

This policy was initially developed for the CEA nuclear research laboratories where, by definition, the people in charge of the facilities make numerous minor changes to them in the context of their research. A commission which is independent of the operators of the facilities in question, comprising mainly CEA agents from other fields and specialists outside the CEA, issues a report to the operator – the site manager – on the acceptability of small-scale operations planned by its teams. The site manager, after consultation of this report, may then decide to issue the authorisation, within certain limits. In October 2005, the manager of the Valrhô centre authorised the introduction of new equipment to measure the thermal stability and the flash point of organic liquids and contaminated solvents with a view to their destruction in the future DELOS plant.

This strategy was also quickly applied in CEA facilities that are being dismantled and for which numerous minor operations are required within the overall dismantling process. For example, while awaiting the evacuation of the low-level waste produced by the dismantling of the enriched uranium treatment workshops, the manager of the Cadarache centre authorised the head of this plant to build a temporary storage area for this waste.

The process also applies to EDF reactors being dismantled. In order to issue authorisations, the manager of the plant in question uses the report from the deconstruction safety committee of the CIDEN (Deconstruction-Environment Engineering Centre). For example, the samples taken from the disassembled heat exchangers from the CHINON A3 plant being dismantled in view of their elimination in the waste reactor system were authorised by the manager of the CHINON plan in April 2005.

The process also applies to certain phases of operation of EDF production plants, particularly to changes in the level of water in the primary cooling system during maintenance operations.

Deployment to the COGEMA plant in La Hague is under consideration.

The ASN has set out a strict framework for the internal authorisations system.

Internal authorisations must first be scheduled. The schedule is conveyed to the ASN as early as possible so that it may check that the authorisations in question are de facto internal authorisations, i.e. authorisations for minor operations. If necessary, the ASN may decide to submit a particular project for fast-track authorisation.

Then, if issued by the operator, the internal authorisations and the limits within which the operations have been authorised are declared to the ASN, which may then decide to monitor their correct implementation.

Lastly, the ASN uses specific inspections to ensure the quality of the reports given internally and evaluates the independence of the commission.

If there is doubt as to the quality of the process for a particular operator or facility, the ASN may, at any time, decide to re-establish a system whereby its own authorisation is required for all operations.

The internal authorisation system allows the ASN to focus its efforts on issues with the greatest impact on safety, all the while making the operators responsible for their own choices.

The internal authorisation system meets the needs for efficiency mentioned above. It values the inspections made by the ASN since an authorisation request evaluated by the ASN in advance becomes an internal authorisation controlled subsequently by the ASN. The responsibility for undertaking operations thus falls entirely on the operators and the control performed by the ASN is not hindered by the framework that it would itself have determined if it had authorised the operation.

The introduction of this system means that the ASN and its technical advisor, the IRSN, play the role of quality controllers of the scheduling, preparation and internal control of nuclear operators, thus boosting their legitimacy as controllers.

The inspections made by the ASN over the past two years on the quality of the internal authorisation requests submitted by operators tend to confirm an improvement in the quality of the justifications presented in them, in comparison with the same type of requests submitted previously. This is a good indicator of the positive nature of the system.