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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 material 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 problems of whatever nature, arising from the operation of nuclear or radiological facilities, the transport, use and transformation of radioactive or fissile materials, 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 individuals directly or indirectly exposed, including through environmental contamination.

The Nuclear Safety Authority (ASN), created by Act 2006-686 of 13 June 2006 on transparency and security in the nuclear field, is responsible for the regulation of nuclear safety and radiation protection in all fields using sources of ionising radiation or involving transport of radioactive materials. With regard to radiation protection, other organisations such as the labour inspectorate, the inspectorate for installations classified on environmental protection grounds and the medical devices inspectorate also have specific regulatory roles.

1 HAZARDS 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 damage, the most significant concerns the DNA of the cells and are not fundamentally different from those caused by certain toxic chemical materials.

When not repaired by the cells themselves, this damage 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 damage 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 metropolitan France is based on registers: 10 qualified departmental registers covering 11 *départements** or about 15% of the general population and 12 specialist registers, including 2 national registers of cancers in children aged under 15 (haematological malignancies and solid tumours in children).

Cover of a cancer register (InVS)

As with any monitoring system, the aim is to highlight spatial differences in incidence in the areas covered, to identify trends in terms of increased or reduced incidence in the various cancer locations over time, or to locate a cluster of cases in one of the areas covered. This intentionally descriptive monitoring method cannot identify radiation-induced cancers, as their form is not specific to ionising radiation.

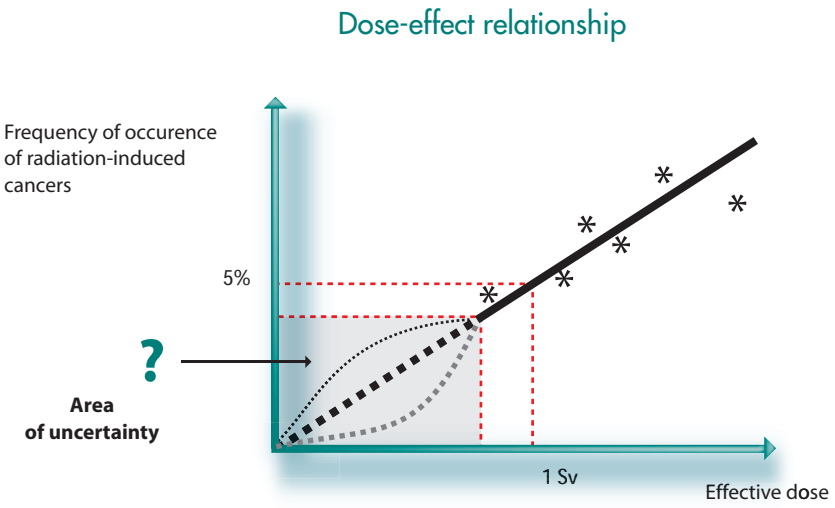
Epidemiological investigation supplements monitoring. The purpose of epidemiological surveys is to highlight an association between a risk factor and the occurrence of a disease, between a possible cause and an effect, or at least to enable such a causal relation to be postulated with a very high degree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

With a view to risk management, use is then made of the risk evaluation technique which uses calculations to extrapolate the risks observed at higher doses in order to estimate the risks incurred during exposure to low doses of ionising radiation. Internationally, this estimate uses the 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.

On the basis of the scientific work of UNSCEAR, the International Commission on Radiological Protection (see publication ICRP 103) published risk coefficients for death through cancer due to ionising radiation, showing a 4% excess risk per sievert for workers and 5% per sievert for the general population. Use of this model, for example, would lead to an estimate of about 7,000 deaths in France every year, as a result of cancer due to natural radiation.

*Administrative region headed by a *Préfet*.

Diagram of the linear relation without threshold



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 or zero impact, whether in terms of the doses received by medical or industrial workers, or those associated with discharges from BNIs. However, many uncertainties and unknown factors persist and require 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.

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.

UNSCEAR intends to publish 5 reports in 2008 concerning the epidemiology of cancers caused by radiation (A), cardiovascular diseases and diseases other than cancers caused by radiation (B), the biological effects of ionising radiation: non-targeted and delayed effects (C), effects on the immune system (D) and a study of source-effect relationships for radon in the home and radon in a professional setting (E). A number of other reports are also being prepared (effects of ionising radiation on plant and animal species, exposure due to radiological accidents, sources of exposure for workers and the public and medical exposure).

We could for instance mention several examples of areas of uncertainty concerning high dose radiation-induced pathologies, the effects of low doses and environmental protection:

High dose radiation-induced pathologies

• The treatment of serious damage due to over-exposure to ionising radiation - The treatment of these serious damage from over-exposure is extremely difficult and indeed disappointing, because they are persistent and evolve over a period of time. 2006 was marked by two exceptional success stories concerning two victims of an accident involving external irradiation from an industrial gamma radiography source on the one hand and an ionisation source on the other. The therapeutic innovations developed by IRSN (French Institute for Radiation Protection and Nuclear Safety) and the Percy armed forces hospital (HIA) in Clamart consist in using specific cytokines to stimulate targeted cell lines, as well as autologous mesenchymal stem cells cultivated in vitro and grafted to allow the renewal of the damaged tissue. These innovative treatments were in 2007 the subject of a clinical research protocol, headed by the Saint Antoine Hospital (Paris) for treating serious radiotherapy damage observed in the patients involved in the Epinal accident. The radiotherapy events notified to ASN in 2007 clearly raise the question of a scientific watching brief in the treatment of the secondary effects of irradiation, including non-accidental, in particular in radiotherapy where their frequency is about 5% (no doubt partly due to the high individual radio-sensitivity of the patients).

• Hyper-sensitivity to ionising radiation - The effects of ionising radiation on personal health vary 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?

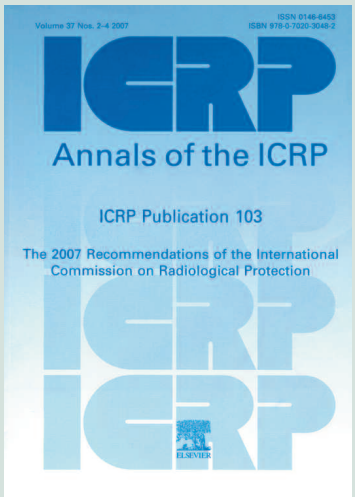
ICRP

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 IAEA) and European Community directives. New recommendations were published at the end of 2007, following consultation on an initial draft in 2004 on its website (www.icrp.org), followed by further proposals made in 2005. 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.

The optimisation principle is now situated at the heart of the proposed system, even though the principles of justification and limitation are maintained. Regardless of the type of exposure situation (planned, emergency or existing exposure), the ICRP recommends that a maximum dose value be set, known as the reference value, with individual doses then being reduced as low as reasonably achievable, down to an optimised level. The individual dose limits, applicable to exposure arising from all sources to which the individual is exposed, remain unchanged. Finally, the exposure categories (at work, the public and medical applications) are also maintained.

The ICRP thus simplified the existing system without radically altering it, in order to take account of the need for stability expressed by both professionals and regulatory authorities.

CIPR 103



Effects of low doses

• 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.

• Dose, dose rate and chronic contamination - The epidemiological surveys performed on individuals 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.

• 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.

• 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 alone, 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 an individual subject in the home to radon emissions from granite bedrock?

Environment

• Protection of non-human species - The purpose of radiation protection is to prevent or mitigate 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. ASN will therefore closely monitor the work being done on this subject by 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 material for civil use;
– production and use of ionising radiation;
– radioactive waste and contaminated sites;
– technologically enhanced naturally occurring radioactive materials (TENORM).

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 fixed nuclear installations, known as "basic nuclear installations" (BNIs), are defined in Article 28 of Act 2006-686 of 13 June 2006 on transparency and security in the nuclear field. Decree 2007-830 of 11 May 2007 concerning the list of basic nuclear installations, gives a more precise definition of BNI categories:
– nuclear reactors, with the exception of those equipping a means of transport;
– particle accelerators;
– plants for the separation, manufacture or transformation of radioactive materials, 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 materials, 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 materials 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 2007 is given in appendix A.

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 the licensee is responsible for safety. The public authorities ensure that this responsibility is fully assumed, in compliance with the regulatory requirements.

The respective roles of the public authorities and the licensee can be summarised as follows:
– the public authorities define the general safety objectives;
– the licensee proposes technical procedures for attaining them, and justifies them;
– the public authorities ensure that these procedures are consistent with the goals set;
– the licensee 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 the basic nuclear installations

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

The licensee 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

Inspection at the pumping station of the Cattenom nuclear power plant (Moselle)

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 licensee 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.

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

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

– the package, consisting of the container and its content, is the first line of defence. It plays a vital role and must be able to withstand all foreseeable transport conditions;
– the transport means 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 consignor is responsible for implementing these lines of defence.

Inspection of a radioactive materials transport at Roissy Charles-de-Gaulle airport (Val d'Oise)

2|3 Production and use of ionising radiation

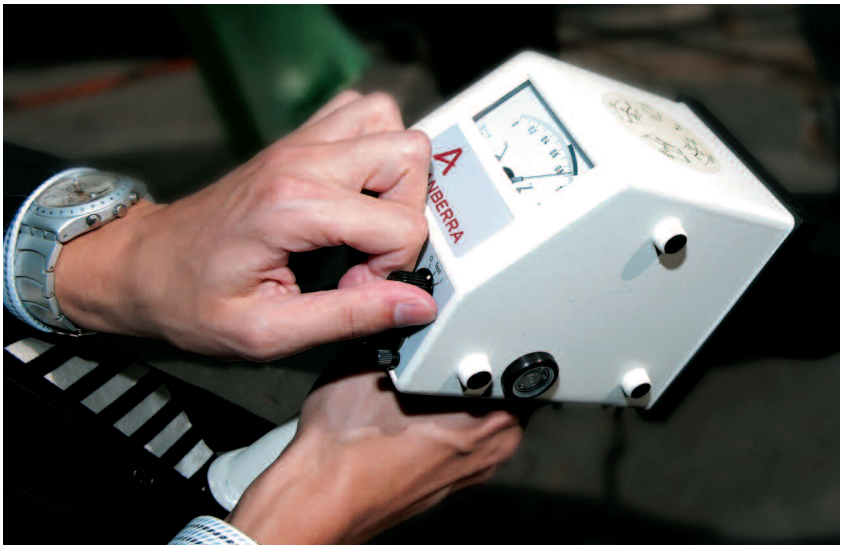
Ionising radiation, whether generated by radionuclides or by electrical equipment (X-rays), is used in very many areas of medicine (radiology, radiotherapy, nuclear medicine), human biology, research, industry, but also for veterinary and forensic applications as well as for conservation of foodstuffs.

In terms of radiation protection, most of these activities, which are also considered to be nuclear activities, are covered by the licensing or notification procedures stipulated in the Public Health Code or, as applicable, by particular procedures (case of BNIs and ICPEs) in which, on the basis of information forwarded by the licensee, the various aspects relating to radiation protection are examined, both with regard to the protection of workers and that of the population in general. Protection is also taken into account through the requirements applied to discharges of liquid and gaseous effluents. In the case of use for medical purposes, patient protection issues are also reviewed.

For activities other than those subject to the particular procedures mentioned above, the licences are issued to the individuals 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

Marking mud from the port of Zeebrugge – Inspection of the immersion device dilution chamber

Gammagraph inspection preparation



Start-up of a babyline for checking the dose rate

Examples of uses of ionising radiation in industry and research

relieved of his duty to provide the individual 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 and measuring instruments). Some activities (e.g.: medical or dental radiology facilities) are simply subject to notification.

2|4 Radioactive waste

Like all industrial activities, nuclear activities generate waste. Some of this waste is radioactive. The three fundamental principles on which strict management of radioactive waste is based, are the responsibility of the waste producer, the traceability of the waste and public information. For very low level waste (VLL), application of a management system based on these principles, if it is to be completely efficient, rules out setting a universal threshold below which regulation 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 disposal routes;
– ensure control 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 (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 radionuclides, 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.

Spectrometry measurement of medical waste at Nantes university hospital (Loire-Atlantique)

2 | 6 Activities enhancing naturally-occuring ionising radiation (TENORM)

TENORM activities justify regulation, 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 vicinity of the places where these activities are carried out. This is in particular the case with activities using raw materials, construction materials or industrial residues containing natural radionuclides which are not used for their fissile or fertile radioactive properties.

The natural families of uranium and thorium are the main radionuclides found. 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 precise identification of the activities, estimation of the impact of the exposure on the individuals concerned, taking 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 individuals 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 3.3 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: IRSN 2006). Depending on the location, the average individual effective dose can vary by a factor of 2 to 5. The following diagram represents an estimate of the respective contributions of the various sources of French population exposure to ionising radiation.

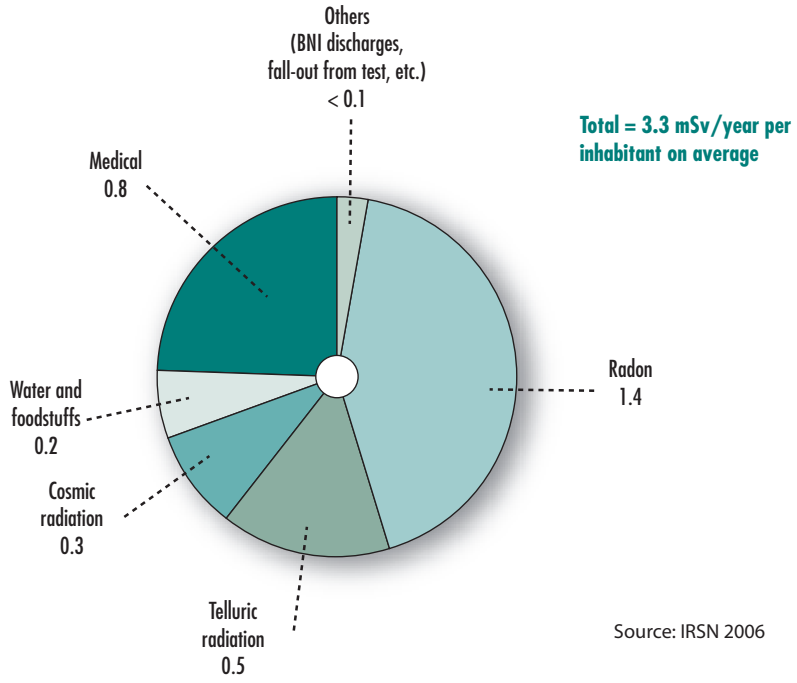
These data are however still too imprecise to allow identification of the most exposed categories or groups of individuals for each exposure source category.

3 | 1 Exposure of the population to NORM

Exposure of the population to naturally-occurring ionising 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



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

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 in France, depending on the regions, range between a few $nSv.h^{-1}$ and 100 $nSv.h^{-1}$.

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 (90% and 10% respectively), the average annual effective dose due to external exposure to gamma radiation of terrestrial origin is estimated at about 0.47 mSv (IRSN 2006), as compared with the worldwide average of 0.46 mSv, estimated by UNSCEAR (2000).

The internal exposure through inhalation, owing to air suspension of particles of soil, is estimated at 0.002 mSv per year, while that due to the long-lived descendents of radon is estimated at about 0.01 mSv 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 (2000), the average dose per individual is about 0.23 mSv 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 0.18 mSv/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 département 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.

Exposure to radon

Exposure to radon in the home was estimated by measurement campaigns, followed by statistical interpretations (see IRSN atlas). The average radon activity value measured in France is 63 Bq/m^3, with about half the results being below 50 Bq/m^3, 9% above 200 Bq/m^3 and 2.3% above 400 Bq/m^3.

Table 1: results of health checks on water for the years 2005 and 2006 (the four indicators of water radiological quality are presented in chapter – point 1 | 5).

	2005	2006	Total	% of noncoforming samples
Total alpha activity				
Number of samples analysed	17 837	19 271	37 108	–
Number of samples > 0,1 Bq.L^{-1}	713	931	1 644	4,43 %
Total beta activity				
Number of samples analysed	17 833	19 317	31 150	–
Number of samples > 1 Bq.L^{-1}	19	22	41	0,11 %
Tritium activity				
Number of samples analysed	10 732	11 352	22 084	–
Number of samples > 100 Bq.L^{-1}	0	0	0	0
Total indicative dose				
Number of samples analysed	5 430	6 241	11 671	–
Number of samples > 0,1 mSv.an^{-1}	26	52	78	0,67 %

Source: Ministry of Health/SISE-Eaux

Less than 1% of the samples analysed present a total indicative dose (TID) greater than 0.1 mSv.year^{-1} and 0.05% a TID greater than 0.3 mSv.year^{-1}, the value as of which exposure reduction solutions must be sought and water is considered to be unsuitable for drinking and for preparation of food for babies, children and pregnant women.

This 0.05% of non-conforming samples corresponds to about ten wells that need to be given priority monitoring with respect to the radiological quality of the water they produce.

These measurements led to a classification of the départements 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 to be made 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 results of these measurements, published by DGSNR in 2003, show that of about 13,000 establishments checked between 1999 and 2001, 12% showed concentrations of more than 400 Bq/m^3 and 4% more than 1,000 Bq/m^3.

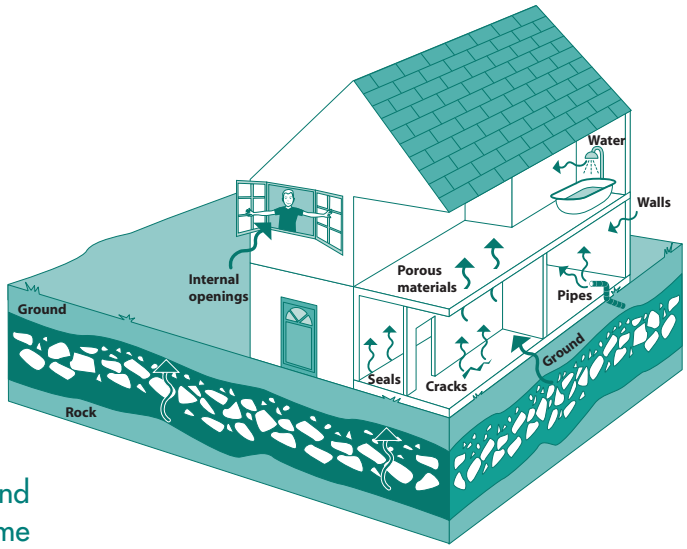
Results of the measurement campaigns conducted since 2005 by organisations approved by ASN are presented in table 2.

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.

Measurement of radon in the home

Improving knowledge and the dissemination of knowledge about radon exposure and the associated risk are closely linked to the creation of an appropriate information system. At the initiative of the General Directorate for Health, the "Appliradon" database is currently used for entry of data and will eventually be incorporated into the new database being set up for the main residential pollutants (Sise-Habitat). ASN is taking part in setting up Sise-Habitat and in 2007 and 2008 is financing the entry into the "Appliradon" base of the data currently available in the Departmental Health and Social Action Directorates (DDASS).



Channels for entry and transfer of radon in the home

If we take account of the average time spent inside the home (which itself attenuates the ionic component of the cosmic radiation), the average individual effective dose in a locality at sea level in France is 0.27 mSv per year, whereas it could exceed 1.1 mSv per year in a mountain locality such as Cervières at 2,836m altitude. The average annual effective dose per individual in France is 0.331 mSv per year. This is lower than the global average value of 380 Sv per year, as published by UNSCEAR.

3|2 Doses received by workers

3|2|1 Exposure of nuclear workers

The system of monitoring external exposure of individuals 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

Table 2: results of measurement campaigns since 2008

Measurements campaign	Number of facilities controlled	Classified facilities below 400 Bq/m³		Classified facilities between 400 Bq/m³ and 1000 Bq/m³		Classified facilities up to 1000 Bq/m³	
		number	%	number	%	number	%
2005/2006	2970	2570	87	314	10	82	3
2006/2007	3000	2560	85	315	11	125	4

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 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.

2006 statistics

The results of dosimetric monitoring of worker external exposure in 2006 on the whole show that the prevention system introduced 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 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 possible that some workers do occasionally fail to wear their dosimeters.

For each field of activity, tables 3 and 4 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 and veterinary sector, which comprises a large share of the populations monitored (nearly 58%), only represents about 22% of the collective dose. On the other hand, it accounts for 18 occasions (out of a total of 26) on which the annual limit was exceeded, of which 3 (of a total of 5) are above 50 mSv.

The latest statistics published by IRSN in December 2007 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 -55%) since 1996 at a time when the populations monitored have grown by about 20%. The optimisation approach implemented by the nuclear licensees during the 1990s is no doubt the explanation for this positive trend (see diagrams 2 and 3).

Table 3: BNI worker dosimetry (year 2006-source IRSN)

	Number of individuals monitored	Total dose (man.Sv)	Doses > 20 mSv
EDF	19 339	5,86	0
AREVA	7 751	2,07	0
CEA	6 469	0,39	0
IPN Orsay	2 804	0,08	0
Outside companies	18 959	12,46	0

Results of dosimetric monitoring of worker external exposure in 2006 (source: IRSN)

Total population monitored: 278,150 workers

Monitored population with a recorded dose below the detection threshold: 238,793, or about 88%

Monitored population with a recorded dose of between the detection threshold and 1 mSv: 21,434, or about 7.6%

Monitored population with a recorded dose of between 1 mSv and 20 mSv: 11,458, or about 4.1%

Monitored population which exceeded the annual dose of 20 mSv: 26 including 5 above 50 Sv

Collective dose (sum of individual doses): 52.07 Man.Sv

Annual average individual dose in the population which recorded a non-nil dose: 1.6 mSv

Table 4: dosimetry of workers in small-scale nuclear activities (year 2006 – source: IRSN)

	Number of individuals monitored	Total dose (man.Sv)	Doses > 20 mSv
Medicine	124,576	10.39	2
Dental	26,973	1.03	1
Veterinary	13,945	0.34	0
Conventional industries	33,165	17.52	2
Research	8,437	0.21	0
Miscellaneous	9,751	0.47	0

The number of monitored workers whose annual dose exceeded 20 mSv has also been falling significantly (see diagram 4). Each overdose has to be the subject of a significant event notification by the nuclear activity licensee to ASN and of an individual investigation, jointly with the occupational physician and if necessary with the labour inspectorate, in accordance with the circular of 16 November 2007 concerning coordination of the radiation protection inspectors and the labour inspectors for the prevention of risks associated with ionising radiation.

3 | 2 | 2 Worker exposure to technologically-enhanced naturally occuring ionising radiation (TENORM)

There is no system for monitoring exposure of individuals 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 occurring ionising radiation (TENORM) is the result

Diagram 1: evolution of the populations monitored, per field of activity, from 1996 to 2005

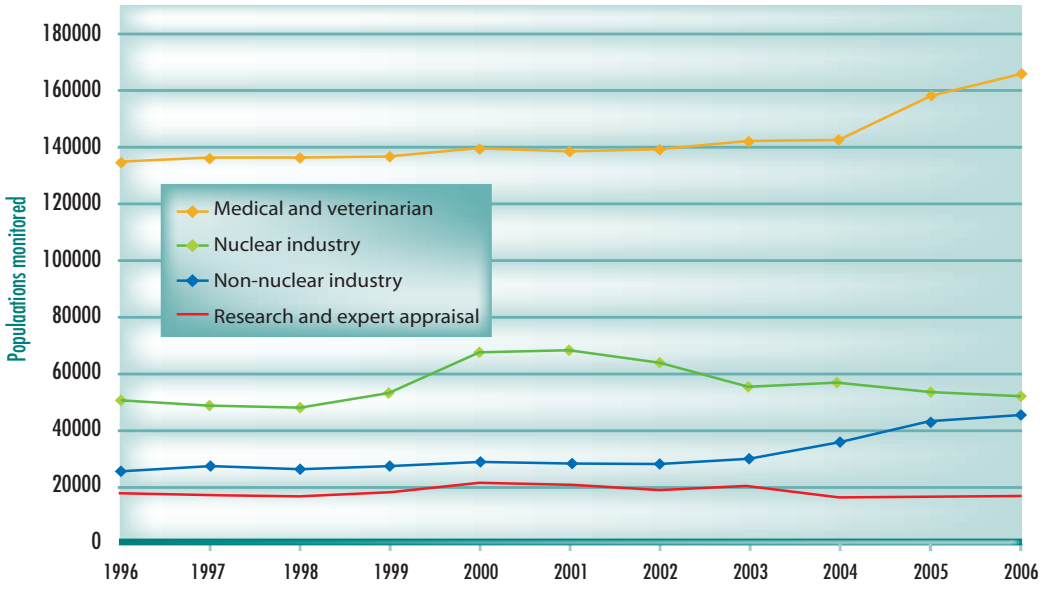


Diagram 2: evolution of the populaations monitored and of collective doses, from 1996 to 2005

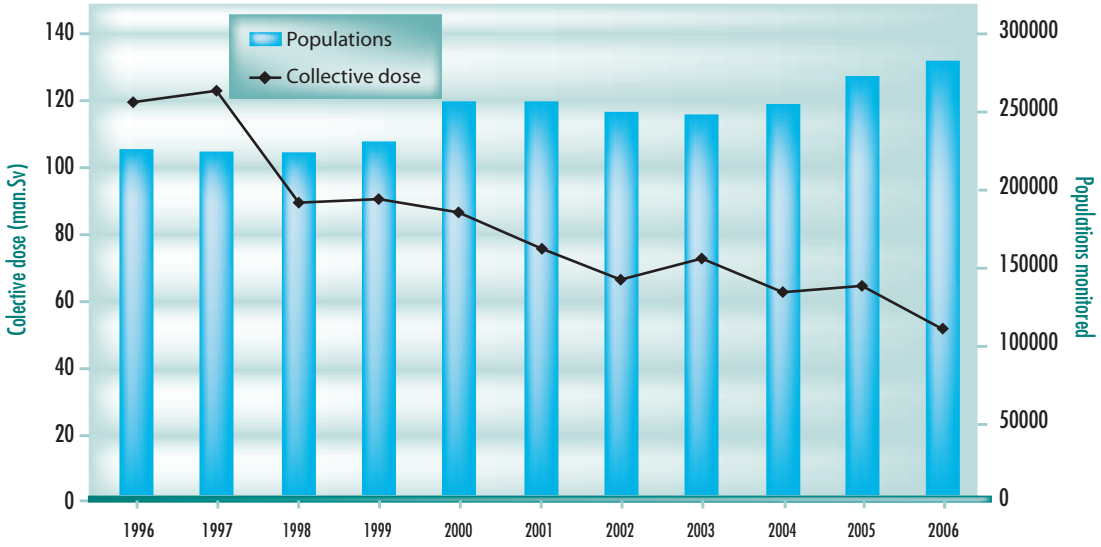
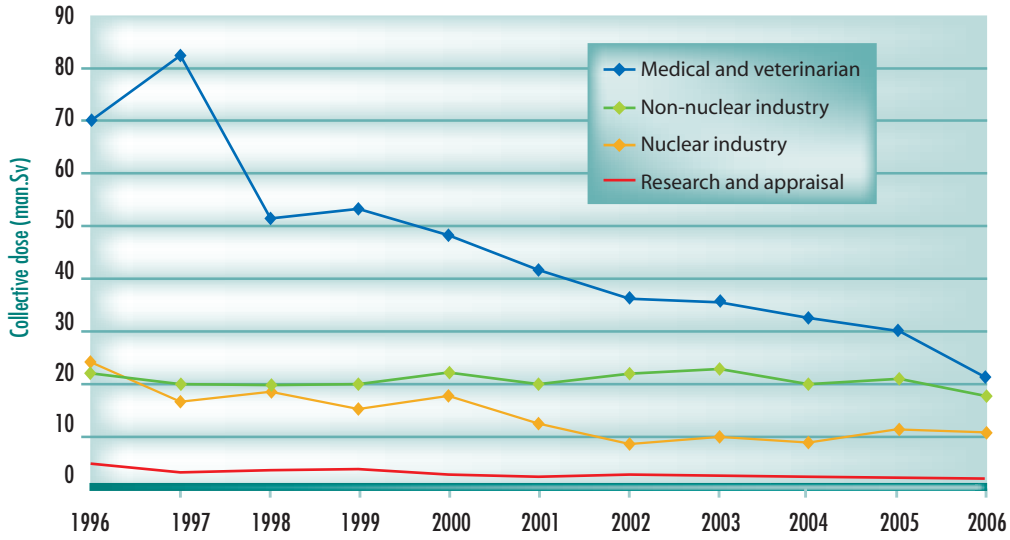
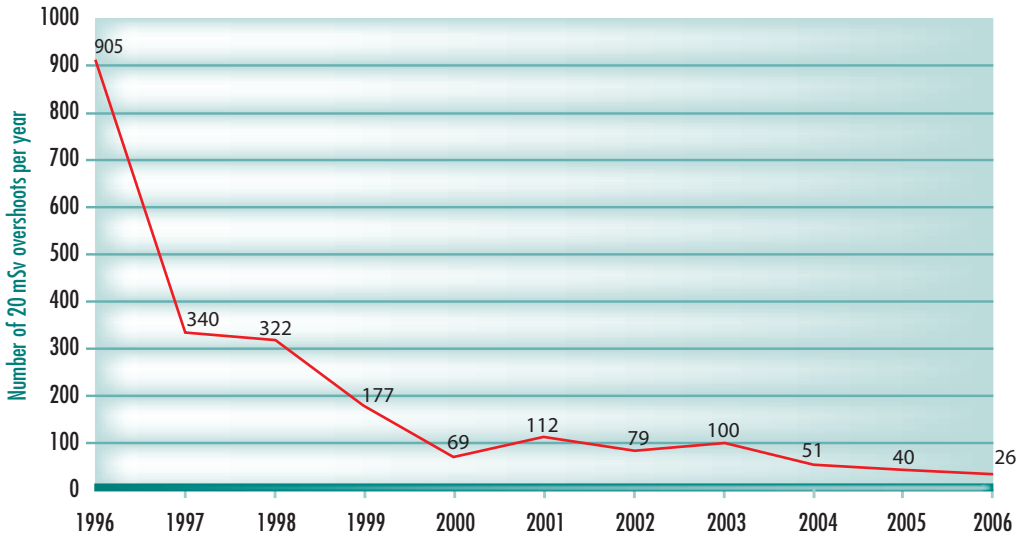


Diagram 3: evolution of collective doses, per field of activity, from 1996 to 2005



The regulations identify ten industrial categories requiring an evaluation of the doses received by both workers and the public. In 2007, about 50 dossiers were transmitted to ASN and IRSN. These dossiers are currently being evaluated. In France, the picture of the dose levels that can be found in these industries is becoming clearer: about forty studies evaluate a worker impact of less than 1 mSv per year, more than 40% of which concern industries using refractory ceramics. Other studies however show a non-negligible impact on workers, for whom protective action is necessary.

Diagram 4: evolution of number of workers monitored for whom the annual dose is higher than 20 mSv, from 1996 to 2005



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 radionuclide-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 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, 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 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 materials, 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

German study published in 2007

A German study published on 10 December 2007 reveals an excess risk of cancer and leukaemia in children from zero to five years old, living near German nuclear power plants, in particular those within a 5 km radius around these installations.

This study gives no explanation for the causes of this excess of cancers and leukaemia. Its results also differ from those of prior international studies. Accordingly, ASN decided that a fresh inventory of current knowledge on this subject was required. It therefore:

- *asked the French Health Watch Institute (InVS) and the Institute for Radiation Protection and Nuclear Safety (IRSN) to submit an opinion on the conclusions of the German study and to consider whether or not a similar study was needed in France;*
- *proposed that the European Commission convene the expert committee specified in Article 31 of the Euratom Treaty in order to review the state of knowledge in Europe on this subject.*

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. For example, the impact of hospital discharges leads to doses of a few microsieverts per year for the most exposed individuals, in particular sanitation workers operating in the sewerage networks (IRSN 2005 study).

Situations inherited from the past, such as atmospheric nuclear tests and the Chernobyl accident can make a small contribution to exposure of the population. The average individual effective dose currently being received as a result of fall-out from the Chernobyl accident is estimated at between 0.010 mSv and 0.030 mSv/year (IRSN 2001). That due to the fall-out from atmospheric testing was in 1980 estimated at about 0.020 mSv. Given a decay factor of about 2 in 10 years, current doses are estimated at well below 0.010 mSv per year (IRSN 2006).

3|4 Doses received by patient

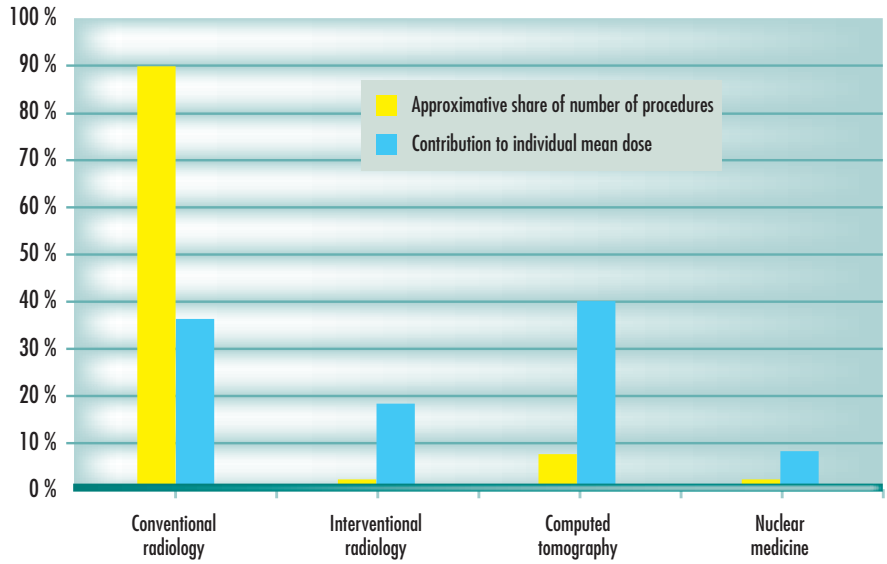
We have no system for monitoring patient exposure, in particular because this exposure is not subject to any strict limitation, owing to its medical benefits. It is hard to accurately identify the overall exposure of medical origin, as we do not know the numbers of each type of examination practice and 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

Table 5: number of procedures, per sector, using ionising radiation

Type of procedure	Health institution	Private practice
Conventional radiology (including dental)	14.5 to 25 million	40.9 million
Scanner	2 to 3.8 million	2.2 million
Nucleara medicine	850.000	n/a*
Interventional radiology	892.000	n/a
Total	61.3 to 73.6 million	

*n/a = not available

Diagram 5: breakdown of number of procedures and dose contribution



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.

An inventory of medical exposure sites was drawn up in 2005 by IRSN and InVS, as part of a national action plan coordinated by ASN. The data collected (2002) are presented in the following table.

The four most common conventional radiology 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, while scanner examination of the head and spine represent 38% and 26% respectively of the total number of examinations by scanner. Based on the estimated dose values per examination (national or, failing which, European data), the average annual effective dose per person is estimated at between 0.66 mSv and 0.83 mSv.

Diagram 5 presents the respective shares of the number of procedures and associated doses, for conventional radiology, scanners, nuclear medicine and interventional radiology.

4 OUTLOOK

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 threefold: 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. Thus:

– the results of the measurement of the doses received by workers in 2006, published by IRSN, confirm the drop in the number of monitored workers for whom the annual dose exceeded 20 mSv, as well as the drop in the collective dose, both of which began in 1996. However, these results do not take account of internal dosimetry and dosimetry of the extremities, which are not at present recorded by IRSN. As it is tasked with organising a permanent radiation protection watch, ASN remains particularly attentive to the correct working of the exposure monitoring system set up by IRSN (SISERI), in that the statistics provided constitute valuable national indicators of trends in worker exposure and are useful in assessing the effectiveness of the measures taken by the licensee to apply the optimisation principle;
– exposure of the French population to radon is at present inadequately documented, as the estimates produced by IRSN in 1997 have never been updated and fail to take account of the measurements taken since 1999 in premises open to the public. ASN considers that the future national database containing all available data, that is currently being set up under the supervision of the General Directorate for Health, is a vital step towards gaining a clearer understanding of the risk;
– finally, ASN hopes that the initial work carried out since 2003 to better understand the doses delivered to patients during medical examinations will be continued and intensified, in order to obtain relevant indicators for evaluating the efforts made by medical staff to optimise exposure in the field of medical imaging.

The radiotherapy accidents and incidents brought to the notice of ASN in 2006 and 2007 serve to underline the need for a clearer understanding of the possible side-effects of treatment, whether as a result of an incident or associated with the therapeutic strategy decided on by the practitioner. Introduction of the system for notifying serious undesirable events by InVS, interfaced with the radiation protection events notification system being piloted by ASN, will constitute very real progress once these effects can be analysed from the medical and scientific viewpoints. Similarly, the progress observed in the treatment of serious damage resulting from over-exposure to ionising radiation should also be underlined.

In addition to its regulatory duties, 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, ASN observes that even if the latest summaries of current scientific knowledge produced by UNSCEAR and the latest estimates of the risk linked to ionising radiation produced by ICRP contribute valuable data concerning some effects of ionising radiation (lung cancer linked to exposure to radon, cardiovascular diseases, hereditary effects, effects on the immune system, and so on), they do not change the current foundations of radiation protection.

At a national level, ASN will also be taking initiatives aimed at research organisations, to ensure that it is regularly informed of the progress and results of nuclear safety and radiation protection research, so that it can give its opinion on the objectives of public research programmes in this area. It will be particularly attentive to the creation of the research steering committee reporting to the IRSN board, as announced by the Government and which will be open to the "stakeholders": public authorities, companies and employees in the nuclear sector, elected officials and associations. ASN notes that this move is a logical continuation of the recommendations of the Vroussos Commission (March 2004) and the National Health and Environment Plan (June 2004) which underlined the need to organise a radiation protection science watch in France.

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

CHAPTER 2

1 **FUNDAMENTAL PRINCIPLES**

1 | 1 An international principle: the responsibility of the licensee

1 | 2 Constitutional principles

1 | 3 Principles enshrined in the Public Health Code

2 **REGULATION OF NUCLEAR SAFETY AND RADIATION PROTECTION**

2 | 1 Parliament

2 | 2 The Government

2 | 2 | 1 The Ministers responsible for nuclear safety and radiation protection

2 | 2 | 2 The nuclear safety and radiation protection unit

2 | 2 | 3 The *préfets*

2 | 2 | 4 Consultative bodies

2 | 3 The Nuclear Safety Authority (ASN)

2 | 3 | 1 Organisation

2 | 3 | 2 ASN operation

2 | 3 | 3 The ASN technical support organisations

2 | 3 | 4 Advisory Committees of experts

3 **OUTLOOK**

On behalf of the State, the Nuclear Safety Authority (ASN, www.asn.fr) regulates nuclear safety and radiation protection, in order to protect workers, patients, the public and the environment from the risks related to nuclear activities. It also contributes to informing the public.

The fundamental aim of nuclear safety and radiation protection is to protect individuals, society and the environment, by establishing and maintaining effective defences against radiological risks in nuclear installations ("Basics Safety Standards", International Atomic Energy Agency, Safety series N° 110, 1993, www.aiea.org).

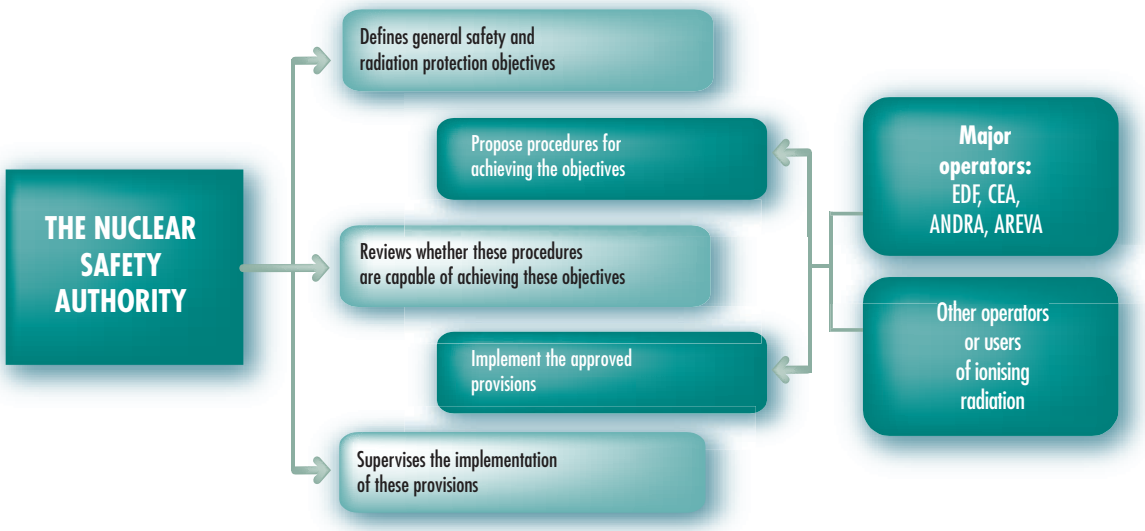
This aim takes the form of a number of operational objectives:
– in operating conditions, exposure to ionising radiation as a result of nuclear activities must be kept below the specified limits and at a level that is as low as reasonably achievable;
– preventive measures must be taken against accidents in nuclear installations;
– should an accident occur, steps must be taken to mitigate its consequences.

1 FUNDAMENTAL PRINCIPLES

Nuclear activities must be carried out in compliance with fundamental principles, some of which are contained in constitutional, legislative or regulatory texts.

1 | 1 An international principle: the responsibility of the licensee

The responsibility principle states that the responsibility for activities entailing a risk lies with those who carry out these activities. This principle is commonly accepted internationally and is more specifically tailored to the various activities:
– licensees are responsible for the safety of basic nuclear installations (BNIs);
– consignors are responsible for the transport of radioactive materials;
– users of ionising radiation are responsible for the radiation protection of the public;
– suppliers are responsible for the recovery of radioactive sources;
– employers are responsible for the radiation protection of workers;
– the prescribing doctor and practitioner of the procedure are responsible for the radiation protection of patients;
– polluters are responsible for any harm they may cause to the environment;
– producers of radioactive materials are responsible for waste disposal.



Responsibility of licensees and responsibility of the Nuclear Safety Authority

1 | 2 Constitutional principles

The Environment Charter, which supplements the preamble to the Constitution by virtue of constitution act 2005-205 of 1 March 2005, in particular lays out the "polluter-pays", precaution and participation principles.

"Polluter-pays" (article 4):
"All persons must contribute to repairing the damage they cause to the environment." This polluter-pays principle introduced into the Environment Code is an application of the responsibility principle in that it ensures that the polluter responsible or potentially responsible for the environmental damage resulting from its activity bears the cost of pollution prevention and mitigation measures. This principle in particular entails the taxing of basic nuclear installations (BNIs) (the "BNI" tax), of radioactive waste producers (additional tax on radioactive waste) and of installations classified on environmental protection grounds (ICPE) (fraction of the general tax on polluting activities – TGAP).

Precaution (article 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."

With regard to the biological effects of ionising radiation at low doses and low dose rates, the precaution principle is implemented with adoption of a linear dose-effect relationship without threshold. This point is clarified in chapter 1 of this report.

Participation (article 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."

In the nuclear field, public debates and public inquiries, in particular those linked to decisions regarding the creation or decommissioning of nuclear installations, allow the participation of local residents in the drafting of decisions by the public authorities. The consultation of regional authorities with respect to certain decisions and the creation of local information committees (CLI) are further illustrations of this participation principle. The right to information concerns all the fields of activity of ASN, which saw the scope of its powers enhanced by the TSN act. It therefore contributes to informing the public about nuclear safety and radiation protection (role presented in chapter 6):
– informing the public about events occurring in BNIs or during the transport of radioactive materials, about discharges or releases from BNIs;
– informing workers about their individual radiological exposure;
– informing patients about the medical procedure, in particular its radiological aspect;
– providing public information.

1 | 3 Principles enshrined in the Public Health Code

Radiation protection follows the three principles specified in article L.1333-1 of the Public Health Code: justification, optimisation and limitation. These principles are developed further in chapter 3.

Justification
A nuclear activity can only be undertaken if its benefits, particularly 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 justification principle 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 ASN regulated areas: 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, effluents discharge, or the production of radioactive waste.

Optimisation
Exposure of persons 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 goal of the procedure.

This optimisation principle 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 regulated by ASN: nuclear safety, environmental protection, radioactive waste management.

The safety of nuclear facilities is to a large extent optimised by applying the concept of defence in depth. It is based on several levels of protection, whether technical or organisational, designed to maintain the effectiveness

of the physical barriers placed between the radioactive materials 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.

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 non-conformities (operation);
3. keeping accidents within the design basis 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).

Limitation
Exposure of a person to ionising radiation as a result of a nuclear activity, cannot raise the sum of the doses received beyond limits set by the regulations, unless this person is exposed for medical purposes or for biomedical research.

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 the non-radiological parameters of discharges from installations subject to licensing must remain below the values defined in the specific licences.

2 REGULATION OF NUCLEAR SAFETY AND RADIATION PROTECTION

The Convention on Nuclear Safety signed in Vienna (Austria) on 20 September 1994, to which France is a party, establishes the framework for regulating nuclear safety and radiation protection.

First of all, it stipulates that "Each Contracting Party shall establish and maintain a legislative and regulatory framework to govern the safety of nuclear installations" (article 7).

The principle of the responsibility of the licensees of activities involving a risk is recalled in these terms: "Each Contracting Party shall ensure that prime responsibility for the safety of a nuclear installation rests with the holder of the relevant licence and shall take the appropriate steps to ensure that each such licence holder meets its responsibility" (article 9).

Finally, each State that is a party to the Convention on Nuclear Safety shall "establish or designate a regulatory body entrusted with the implementation of the legislative and regulatory framework referred to in Article 7, and provided with adequate authority, competence and financial and human resources to fulfil its assigned responsibilities" (article 8).

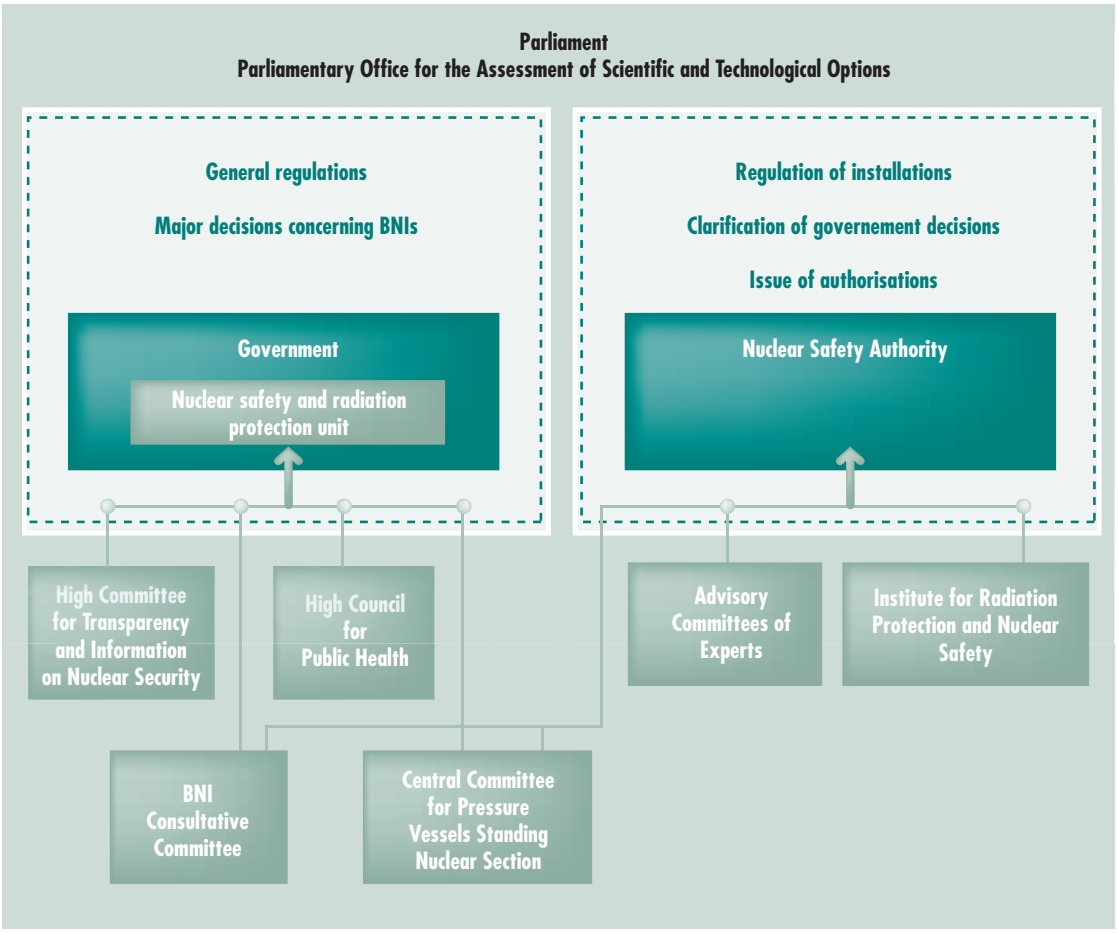
In France, the regulation of nuclear safety and radiation protection is primarily the responsibility of three parties: Parliament, the Government and ASN. Article 4 of Act 2006-686 of 13 June 2006 concerning transparency and security in the nuclear field (TSN Act) lists the respective duties of the Government and ASN.

2|1 Parliament

Parliament's role in the field of nuclear safety and radiation protection is in particular to pass Acts. Two major Acts were therefore voted in by Parliament in 2006 in the field of nuclear safety and radiation protection: the above-mentioned TSN Act and Programme Act 2006-739 of 28 June 2006 relative to the sustainable management of radioactive materials and waste. This latter act is in part codified in the Environment Code.

The TSN Act gives a legislative foundation for the BNIs licensing and regulation system, as well as the rules concerning transparency in the field of nuclear safety and radiation protection. It creates ASN, an independent administrative authority in charge of regulating these sectors. ASN is required to present its annual report to Parliament. At the latter's request, ASN reports on its activities and submits opinions or carries out studies on subjects within its field of competence.

The provisions of the programme Act of 28 June 2006 are detailed in chapter 16 of this report dealing with radioactive waste (chapter 16).



Regulating nuclear safety and radiation protection in France

In the same way as the other independent administrative authorities, as mentioned by the Parliamentary Office for Legislation Assessment in its report 404 filed on 15 June 2006, "Independent administrative authorities: assessment of an unidentified legal object", ASN wishes to report to Parliament on a regular basis concerning its activities.

2|2 The Government

The Government, headed by the Prime Minister, exercises regulatory powers. The Government is therefore in charge of laying down the general technical regulations concerning nuclear safety and radiation protection. The 13 June 2006 Act also gives it responsibility for taking major decisions concerning BNIs. In so doing, it may rely on proposals or opinions from ASN. It also has access to consultative bodies such as the High Committee for Transparency and Information on Nuclear Security, and the High Council for Public Health.

The Government is responsible for civil protection in the event of an emergency.

2|2|1 The Ministers responsible for nuclear safety and radiation protection

The ministers responsible for nuclear safety, as mentioned in the TSN Act of 13 June 2006, are the Minister for Ecology, Sustainable Spatial Planning and Development, and the Minister for the Economy, Finance and Employment. They define the general regulations applicable to basic nuclear installations, if necessary on the basis of a proposal from ASN. They take the few major individual decisions required concerning:
– the design, construction, operation, final shutdown and decommissioning of BNIs;
– the final shutdown, maintenance and surveillance of radioactive waste disposal facilities;
– the construction and operation of pressure vessels specifically designed for these installations.

The Parliamentary Office for Assessment of Scientific and Technical Options

Created by Act 83-609 of 8 July 1983, the Parliamentary office for the assessment of scientific and technological options (OPECST) is a parliamentary delegation consisting of eighteen Deputies and eighteen Senators, the composition of which is proportional to the political groups in each parliamentary house.

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 twenty-four members, with the composition of the Council reflecting the diversity of scientific and technical disciplines.

Since it was created, the Parliamentary Office has devoted a total of twenty four reports to nuclear issues. Eleven of these, all produced between 1990 and 2001 by Mr Claude Birraux, deputy for Haute-Savoie, more particularly concern the regulation of the safety and security of nuclear installations.

This commitment by the Parliamentary Office to the assessment nuclear safety was in response to an initial request from the highest authorities of the National Assembly and the Senate, that is their respective administrative Bureaux.

Mr. Henri Revol, Senator for the Côte-d'Or département *and Chairman of the Office, published a report jointly with Mr. Christian Bataille, member of the National Assembly 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 focused on the administrative organisation of safety and radiation protection, the arrangements made by the licensees in this field, the structures adopted in other countries and the adequacy of the resources given to ASN for the performance of its duties. Other studies concerned the management of radioactive waste and the lifetime of nuclear reactors, or socio-political issues such as the dissemination and perception of information about nuclear matters.

The Office's reports are produced ahead of an Act being voted, in order to prepare the legislative decision, or subsequently, to monitor implementation of the voted text. The Office's first report on radioactive waste, prepared by Mr. Christian Bataille and adopted in December 1990, was drawn on extensively by the 30 December 1991 Act on research into radioactive waste management. Similarly, the report by Mr. Christian Bataille and Mr. Claude Birraux entitled "Looking after the long term, an act in 2006 on the sustainable management of radioactive waste", adopted by the Parliamentary Office on 15 March 2005, was also a significant source of inspiration for the 28 June 2006 programme Act on the sustainable management of radioactive materials and waste.

The members of the Parliamentary Office for the assessment of scientific and technological options also played a major role in drafting the 13 June 2006 Act on transparency and security in the nuclear field, on the basis of eleven reports published on this subject and the work done in the first half of 1998 for the Government by Mr. Jean-Yves Le Déaut, deputy for the Meurthe-et-Moselle département, *then Chairman of the Office and acting as the parliamentary delegate. In particular, the rapporteurs for the bill in the Senate, Messrs Henri Revol and Bruno Sido, were also members of the Parliamentary Office for the Assessment of Scientific and Technological Options. Other deputies, who were members, such as Messrs Christian Bataille, Claude Birraux, Jean Dionis du Séjour, Claude Gatignol, Jean-Yves Le Déaut, played a significant part in the debate on the bill in the National Assembly, with several of their amendments being adopted.*

In 2007, the Parliamentary Office monitored the implementation of these two Acts in various ways.

In accordance with the duty entrusted to the Parliamentary Office by the 28 June 2006 Act, Messrs Christian Bataille and Claude Birraux published a report on 6 March 2007 assessing the first "national radioactive materials and waste management plan". After checking that its content did indeed correspond to the legislative requirements, they made a number of recommendations concerning both the plan itself and the implementation of the front and back ends of the nuclear fuel cycle.

On 24 July 2007, the Parliamentary Office gave a hearing to the members of the National Commission for the assessment of research and studies into the management of radioactive materials and waste, following its reorganisation as a result of the 28 June 2006 Act. The interviews confirmed that the research organisations involved, ANDRA, CEA, CNRS, need to comply with the schedule set by this same Act for developing operational solutions for disposal and transmutation. They also led to an agreement being reached on the importance of research into the social sciences in order to improve how consultation of the public is incorporated into the decision-making process regarding the management of nuclear waste. In this respect, the Swedish experience was put forward as an example.

In November 2007, Mr Christian Bataille agreed to take part in the work of the Bure local information and supervisory committee, in order to monitor in the field the experimental work being done in the underground laboratory.

Finally, Mr Claude Birraux presented France's radioactive waste management strategy as a result of the two Acts of 13 and 28 June 2006, to several foreign delegations.

During a visit to the United States from 29 January to 2 February 2007, he held conferences in the main national laboratories of the Department of Energy (Argonne and Idaho), as well as in American universities working on the issues of nuclear waste management (MIT and Berkeley). These conferences each brought together between 50 and 100 researchers and managers and offered an opportunity to analyse the French approach in the light of the obstacles encountered in the United States with the Yucca Mountain disposal project, and to examine the compatibility of the solutions chosen in France, through the new avenues opened up by the GNEP (Global Nuclear Energy Partnership) initiative concerning the fuel cycle.

In London on 29 March, Mr Claude Birraux presented the role played by Parliament in the French nuclear waste management strategy, to the heads of the Franco-British nuclear forum, including Lord Truscott, Under-Secretary to the Minister of Trade and Industry.

On 5 July and 27 November, he welcomed to the National Assembly two delegations of correspondents from the NEI (Nuclear Energy Institute), an association of nuclear electricity generators in the United States, and on 8 November, he received a delegation from the JAIF (Japan Atomic Industrial Forum), the counterpart organisation in Japan, which came specifically to examine the conditions concerning the finalisation of the programme for the disposal of nuclear waste in France. In the meantime, on 15 October, Mr Claude Birraux opened the international conference at Bern in Switzerland, with a presentation on the geological disposal of radioactive waste, France's strategy for dealing with this issue.

After its recommendations were transcribed into the 2006 Acts on the sustainable management of radioactive materials and waste and transparency and security in the nuclear field, the Parliamentary Office in 2007 focused its attention on supervising the implementation of these two Acts.

On the advice of ASN, if an installation presents serious risks, the above-mentioned ministers may pronounce suspension of its operation.

Furthermore, the Minister in charge of Health (the Minister for Health, Youth and Sports) is responsible for radiation protection. He or she determines the general regulations, based on proposals from ASN when applicable, concerning radiation protection. The regulations covering the radiation protection of workers are the responsibility of the Minister in charge of Labour (Minister for Labour, Labour Relations and Solidarity).

Finally, the ministers responsible for nuclear safety and radiation protection jointly approve the ASN internal rules. They also each approve ASN regulatory decisions of a technical nature within their respective spheres of competence.

2 | 2 | 2 The nuclear safety and radiation protection unit

To assist the Ministers responsible for nuclear safety and for radiation protection, a unit under their joint authority was created within the Directorate for Regional Action, Quality and Industrial Security at the General Business Directorate in the Ministry for the Economy, Finance and Employment. This unit will in particular be responsible for monitoring public inquiry procedures, approving ASN technical decisions and taking decisions specifying the general regulations passed by decree.

2 | 2 | 3 The *Préfets**

The *préfets* are the guarantors of public order in the *département*** under their responsibility. They in particular have a major role to play in the event of an emergency, as they are responsible for preventive measures to

*In a *département*, representative of the State appointed by the President.
**Administrative region headed by a Prefect

be taken with respect to the population. These measures are proposed by ASN. For the procedures described in chapter 3, and after obtaining the opinions of his departments and that of one or more inquiry commissioners, following a public inquiry, the *préfet* also submits his standpoint to the authority in charge of reviewing the licensing request. At the request of ASN, he refers to the departmental council for the environment and for health and technological risks, which submits its opinion concerning water intake, discharges and other detrimental effects from basic nuclear installations, as well as the addition, within the perimeter of a basic nuclear installation, of equipment requiring licensing under the regulations concerning installations classified on environmental protection grounds or water protection regulations.

ASN regional delegates, who are also regional directors of industry, research and the environment, under the authority of the region *préfets*, are independent of the latter with regard to nuclear safety and radiation protection.

2|2|4 Consultative bodies

a) The BNI Consultative Committee (CCINB)

The BNI Consultative Committee (CCINB), set up by decree 2007-1557 of 2 November 2007 concerning basic nuclear installations and the regulation of the nuclear safety aspects of radioactive material transports, must be consulted by the ministers responsible for nuclear safety whenever an application is made for the creation, modification or final shutdown of a BNI and with regard to the general regulations applicable to each of these installations.

Until such time as it is finally set up, the Interministerial Commission for Basic Nuclear Installations, the composition of which was renewed by order of the Prime Minister on 6 September 2006, stands in for the CCINB. It is chaired by Mrs Marie-Eve Aubin, Chair of the honorary section of the *Conseil d'État**.

The Commission, which is required to meet at least once a year, held four sessions in 2007, with Mrs Marie-Eve Aubin as chair, during which eleven draft texts were reviewed.

ASN provided secretarial services for the CIINB until the end of 2007. Secretarial services for the CCINB will be provided by the MSNR, jointly with ASN.

b) The High Council for Public Health

The French High Public Health Council (CSHPF), a scientific and technical consultative body, under the authority of the Minister for Health, was replaced in the first quarter of 2007, by the High Council for Public Health (HCSP), created by Act 2004-806 of 9 August 2004 concerning public health policy. The ASN

*France's highest administrative court.

CIINB meetings in 2007

7 March	• Draft decree authorising *Électricité de France* to create a basic nuclear installation, called ICEDA, in the commune* of Saint-Vulbas (AIN *département*). • Draft order modifying the order of 26 February 1974 concerning the construction of the main primary system for nuclear steam supply systems. • Draft decree authorising *Électricité de France* to introduce and use MOX fuel in reactors 5 and 6 of the Gravelines nuclear power plant (BNI 122), in the Nord *département*, modifying the decree of 18 December 1981 authorising *Électricité de France* to create two units at the Gravelines nuclear power plant, modified by decree 85-1331 of 10 December 1985 modifying the perimeter of this basic nuclear installation. *Smallest administrative subdivision administered by a mayor and a municipal council
14 June	• Draft decree authorising CEA (French atomic energy commission) to proceed with final shutdown and decommissioning of basic nuclear installation 36 known as the radioactive waste treatment plant, in the *commune* of Grenoble (Isère). • Draft decree authorising CEA to proceed with final shutdown and decommissioning of basic nuclear installation 79 known as the storage facility for the decay of radioactive waste, in the *commune* of Grenoble (Isère). • Draft decree authorising CEA to proceed with final shutdown and decommissioning of basic nuclear installation 61 known as the nuclear materials analysis and control laboratory, in the *commune* of Grenoble (Isère).
18 October	• Draft decree authorising CEA to create a basic nuclear installation called Magenta on the Cadarache site in Saint-Paul-Lez-Durance (Bouches-du-Rhône). • Draft decree authorising CEA to proceed with final shutdown and decommissioning of basic nuclear installation 49 known as the High Activity Laboratory, located in the French atomic energy agency's Saclay centre in the *communes* of Saint-Aubin, Saclay and Villiers-le-Bâcle (Essonne).
14 December	• 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, called Centraco, in the commune of Codolet (Gard). • Draft decree authorising CEA to create a basic nuclear installation called Agate on the Cadarache site in Saint-Paul-lez-Durance (Bouches-du-Rhône).

Chairman is represented on the board of experts (10 qualified persons and de jure members including the ASN Chairman) which governs this new assembly, consisting of four specialised commissions:
– the "health safety" specialised commission (30 qualified persons);
– the "chronic diseases and incapacity" specialised commission (20 qualified persons);
– the "prevention and determining factors in health" specialised commission (30 qualified persons);
– the "assessment, strategy and outlook" specialised commission (15 qualified persons).

As applicable, some of the opinions and recommendations issued by the new advisory committees for radiation protection (section 2|3|4 of this chapter) could be presented to the HCSP.

c) The High Committee for Transparency and Information on Nuclear Security

The TSN act of 13 June 2006 created a High Committee for Transparency and Information on Nuclear Security, an information, discussion and debating body dealing with the risks inherent in nuclear activities and the impact of these activities on human health, the environment and nuclear safety.

The High Committee can issue an opinion on any question in these fields, as well as on controls and the relevant information. It can also deal with any issue concerning the accessibility of nuclear safety information and propose any measures such as to guarantee or improve nuclear transparency.

The High Committee can be called on by the Ministers in charge of nuclear safety, by the chairmen of the competent commissions of the National Assembly and the Senate, by the Chairman of the Parliamentary Office for the assessment of scientific and technological options, by the chairmen of the local information committees or by the licensees of BNIs, on all questions concerning information about nuclear safety and its regulation.

The High Committee consists of thirty-four members appointed for a period of six years, including members of Parliament and representatives of the local information committees, associations, persons responsible for nuclear activities, employee trade union organisations, ASN and the Government, as well as personalities chosen for their particular expertise. The members were appointed by decree of the Prime Minister dated 28 February 2008.

It replaced the High Council for Nuclear Safety and Information (CSSIN) which had been created in 1973 with similar duties. The CSSIN's activities in 2007 are described in chapter 6.

2|3 The Nuclear Safety Authority (ASN)

The TSN Act created an independent administrative authority, ASN, responsible for regulating nuclear safety and radiation protection. ASN prepares draft regulatory texts on behalf of the Government and clarifies the regulations through technical decisions. It issues certain individual authorisations and proposes others to the Government. The nuclear safety and radiation protection

The other stakeholders

High Health Authority (HAS)
www.has.fr

Health Monitoring Institute (InVS)
www.invs.sante.fr

French Health Products Safety Agency (AFSSAPS)
www.afssaps.sante.fr

National Cancer Institute (INCA)
www.inca.fr

French Food Products Safety Agency (AFSSA)
www.afssa.fr

French Environmental Health Safety and Working Conditions Agency (AFSSET)
www.afsset.fr

inspectors at ASN carry out regulation and monitoring of nuclear activities. Finally, ASN contributes to public information. From a technical viewpoint, ASN relies on the expertise provided by the Institute for Radiation Protection and Nuclear Safety (IRSN) and Advisory Committees of experts.

In more detail:

1. ASN is consulted on draft decrees and ministerial orders of a regulatory nature and dealing with nuclear safety.

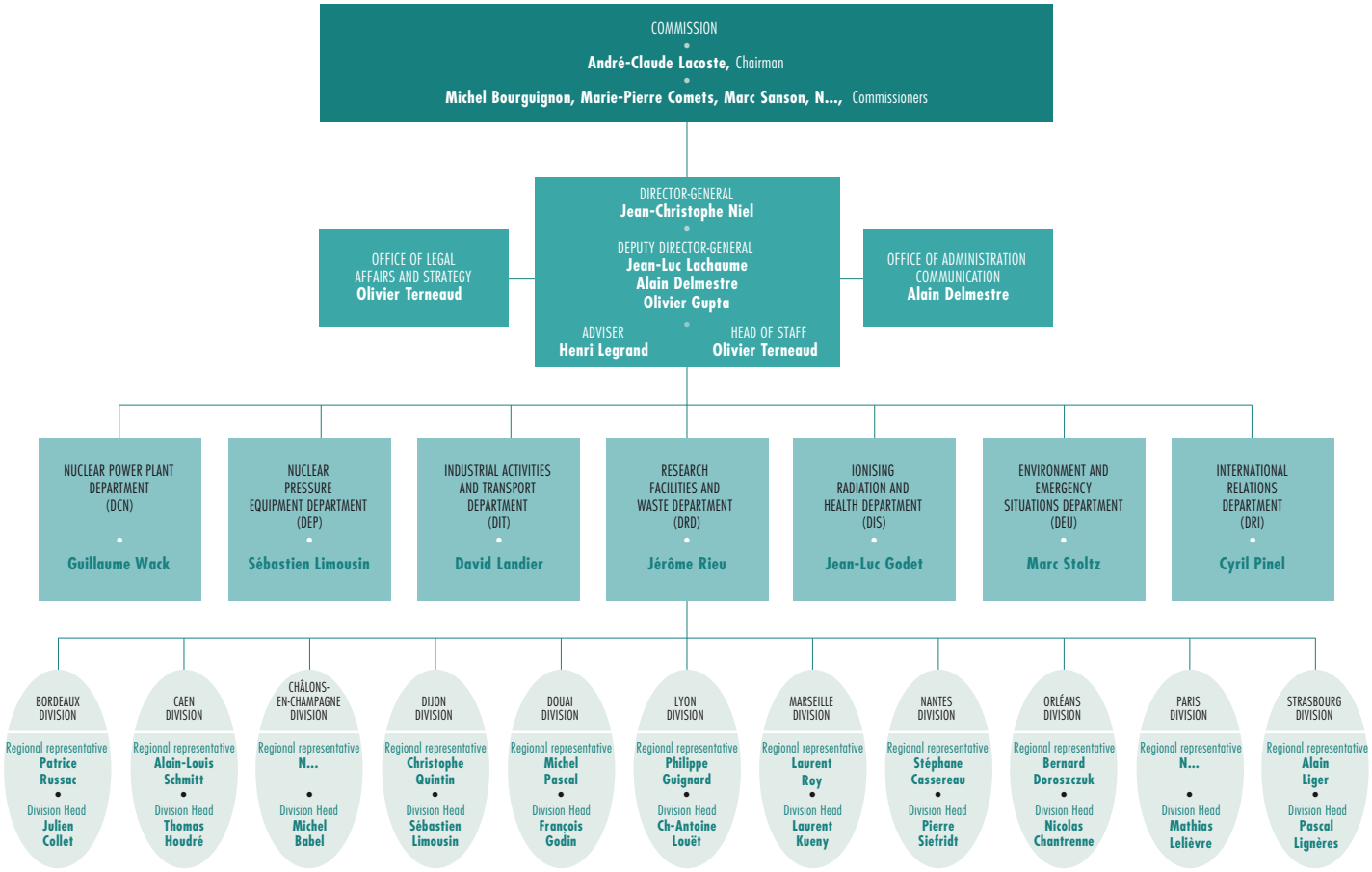
It can take regulatory decisions of a technical nature to complete the implementing procedures for decrees and orders adopted in the nuclear safety or radiation protection field, except for those relating to occupational medicine. Decisions relative to nuclear safety are subject to the approval of the ministers tasked with nuclear safety and decisions relative to radiation protection are subject to the approval of the ministers tasked with radiation protection. Approval orders and approved decisions are published in the Official Gazette (*Journal officiel*).

2. ASN reviews BNI authorisation or decommissioning decree applications and makes proposals to the Government concerning the decrees to be issued in these fields. It defines the requirements applicable to these installations with regard to the prevention of risks, pollution and detrimental effects. It authorises commissioning of these installations and pronounces delicensing following decommissioning.

Some of these ASN decisions require approval by the Ministers responsible for nuclear safety.

ASN also issues the licences for small-scale nuclear facilities, provided for by the Public Health Code.

3. ASN checks compliance with the nuclear safety and radiation protection general rules and special requirements applicable to BNIs, the construction and use of pressure vessels specifically designed for these installations, transports of radioactive materials and the activities mentioned in article L. 1333-1 of the Public Health Code and the persons mentioned in article L. 1333-10 of the same code.



ASN organisation chart on 15 February 2008

The members of the ASN executive committee (from left to right: O. Terneaud, A. Delmestre, J.-C. Niel, J.-L. Lachaume, O. Gupta, H. Legrand)

ASN organises a permanent radiation protection watch throughout the national territory.

From among its own staff, it appoints nuclear safety inspectors, radiation protection inspectors and officers in charge of verifying compliance with pressure vessel requirements. It issues the required approvals to the organisations participating in the verifications and nuclear safety or radiation protection watch.

4. ASN participates in informing the public in its areas of competence.

5. ASN is associated with the management of radiological emergencies resulting from events liable to compromise human health and the environment by exposure to ionising radiation and occurring in France or liable to affect the French territory. It provides the competent authorities with its technical assistance in drawing up measures within the emergency response plans, which take account of the risks arising from nuclear activities.

When such an emergency situation occurs, it assists the Government for all matters within its competence. It sends the competent authorities its recommendations on the measures to be taken at the medical and health levels or regarding civil security. It informs the public of the safety state of the installation that caused the emergency situation, when the latter is subject to its surveillance, and of the possible releases into the environment and their risks for personal health and the environment.

6. In the event of an incident or accident involving a nuclear activity, ASN may conduct a technical inquiry along similar lines to those applicable to "accident and investigation" boards called on to deal with transport accidents.

2|3|1 Organisation

ASN is run by a Commission of five commissioners. It consists of central services, regional delegates and local divisions, placed under the authority of the Director General, himself assisted by three deputies, an adviser and a Head of Staff.

a) ASN Commission

ASN is run by a Commission of five commissioners working on a full-time basis. These appointments are

permanent and have a non-renewable mandate of 6 years.

The Commission defines ASN strategy and is more particularly involved in setting up regulatory policies and external relations both nationally and internationally. It thus adopted a multi-year strategic plan for 2007-2009 along with general policy memoranda.

Pursuant to the TSN Act, the Commission submits ASN's opinions to the Government and takes the main ASN decisions, which are published on its website, www.asn.fr.

ASN must in particular be consulted with regard to:
– draft decrees or ministerial orders dealing with the regulation of nuclear safety;
– draft BNI authorisation, final shutdown and decommissioning decrees;
– draft decrees modifying the nuclear safety aspects of the Public Health Code and the Labour Code.

It may be consulted at the request of the Government or Parliament with respect to draft texts or particular questions.

The TSN Act lists the various categories of regulatory or individual decisions taken by ASN, for example:
– technical regulatory decisions implementing decrees or orders adopted concerning nuclear safety and radiation protection;
– BNI authorisation decrees;
– authorisations or approvals concerning the transport of radioactive materials or medical installations and equipment using ionising radiation.

Some of these decisions need to be approved by the Ministers responsible for nuclear safety or radiation protection.

The Commission adopts the ASN internal rules which lay down its organisation and working rules, as well as its ethical guidelines. The internal rules lay down the conditions and limits concerning the delegation of powers to the Chairman by the commissioners, and those concerning delegation by the Chairman of his power of signature to the officers in the various ASN departments.

In 2007, the ASN Commission met 54 times. It issued 42 opinions and took 87 decisions. They are listed in appendix C. The complete text, along with that of the

ASN directors on 1 January 2008 (from left to right: C. Pinel, S. Limousin, J. Rieu, M. Stoltz, D. Landier, J.-L. Godet and G. Wack)

ASN regional delegates and Division heads (from left to right:
C.-A. Louët, P. Guignard, M. Babel, F. Godin, A.-L. Schmitt, M. Lelièvre, B. Doroszczuk, T. Houdré, N. Chantrenne,
M. Lignères, A. Liger, P. Siefridt, S. Limousin, L. Kueny and J. Collet)

internal rules, can be consulted on the website, www.asn.fr.

b) ASN central services

The ASN central services comprise an Office of Administration, which is also responsible for Communication, an Office of Legal Affairs and Organisation and various Departments. The seven departments are organised according to various themes:

– two functional departments: the international relations department (DRI), and the environment and emergency situations department (DEU);

– five operational departments: the nuclear power plants department (DCN), the industrial activities and transports department (DIT), the research facilities, decommissioning and waste department (DRD), the nuclear pressure equipment department (DEP) and the ionising radiation and health department (DIS).

The role of the departments is the national management of the activities for which they are responsible. They take part in drafting the general regulations and coordinate the actions of the ASN divisions.

c) The regional delegates and ASN divisions

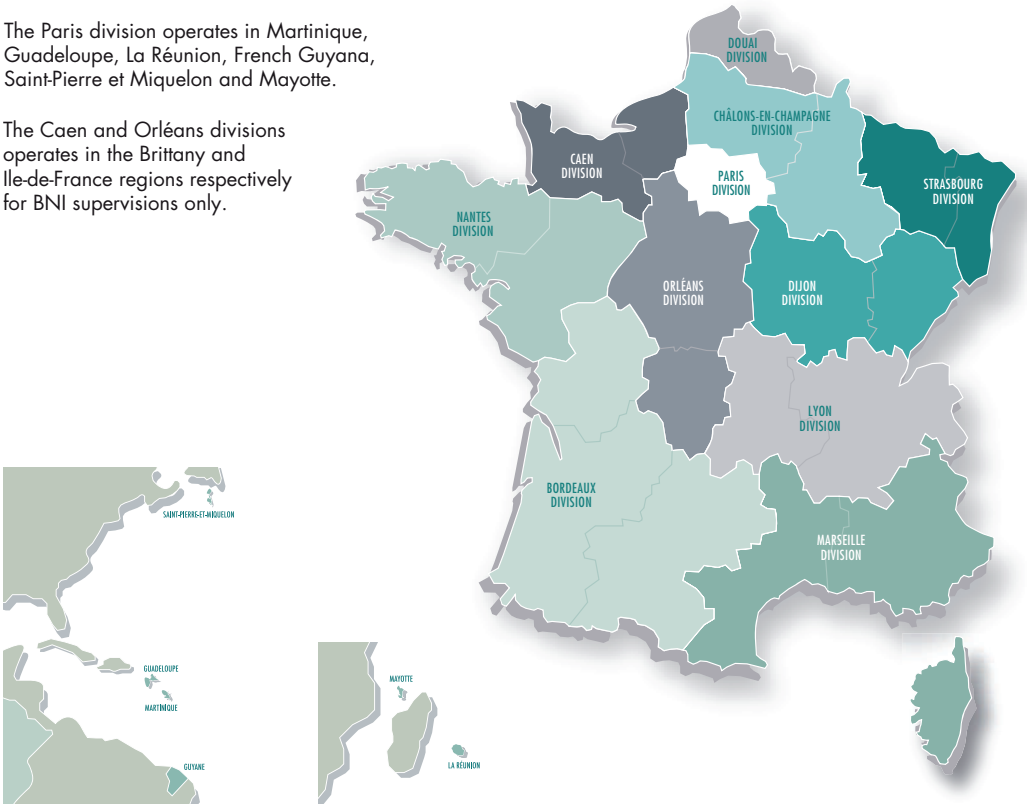
The ASN regional divisions operate under the authority of the regional delegates, appointed by the ASN Chairman. The Director of the local DRIRE for the area in which the division concerned is located acts as the regional delegate. He is seconded to the ASN for the performance of this duty. This secondment process was made possible by a decree of 21 September 2007 and a secondment agreement with the Ministry for the Economy, Finance and Employment, signed on 28 November 2007. Delegation of the power of signature by the Director General gives them the authority to take decisions at a local level.

The divisions carry out most of the direct regulation of the BNIs, radioactive material transports and small-scale nuclear activities, through:

– field inspections and checks on nuclear safety, radiation protection, environmental protection around the nuclear installations, pressure vessels and the Labour Code as applicable to nuclear power plants;
– review of incidents and accidents which occur in their regions;
– regulation of nuclear power plant unit outages in their regions.

The Paris division operates in Martinique, Guadeloupe, La Réunion, French Guyana, Saint-Pierre et Miquelon and Mayotte.

The Caen and Orléans divisions operates in the Brittany and Ile-de-France regions respectively for BNI supervisions only.



Geographical competence of the regional divisions

The divisions review most authorisation applications submitted to ASN by those responsible for the nuclear activities located in their regions (BNI licensees, industrial users of ionising radiation, researchers, physicians, etc.):
– creation, operation, major or minor modification, or final shutdown of BNIs;
– licensing of activities using ionising radiation.

Certain major decisions are reviewed by ASN headquarters with the support of the divisions.

In emergency situations, the divisions assist the *préfet* of the *département*, who is in charge of protecting the population, and oversee the operations carried out to safeguard the installation on the site, if it is accessible or does not entail a hazard. To ensure preparedness for these situations, they take part in drawing up the emergency plans drafted by the *préfets* and in periodic emergency exercises.

Finally, the regional delegates are ASN's representatives in the regions. With the support of the divisions, they contribute to the ASN's public information duty. They also take part in meetings of the local information committees and maintain regular contacts with local media, elected officials, environmental protection associations, licensees and the local administrative partners (*préfets*, ARH, DRASS, and so on).

2|3|2 ASN operation

a) Human resources

Workforce

As at 31 December 2007, the ASN total workforce stood at 426 people.

This workforce can be broken down as follows:
– 322 civil servants or contractual agents;
– 104 agents seconded from public establishments (Assistance publique – Hôpitaux de Paris, CEA, IRSN).

On 31 December 2007, the average age of the ASN officers was 40 years and 7 months, and 62% (265) of these agents are younger than 45. This well-balanced age

Workforce as at 31 December 2007

Central services	206
Regional divisions	220
TOTAL	426

pyramid enables ASN to carry out active regulation 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.

b) Financial resources

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

The ASN budget amounts in 2007 to 37.3 million, including 32.4 million for personnel costs. ASN also receives services from the Ministry of the Economy, Finance and Employment (MINEFE) and from the DRIRE network under the terms of special agreements. The ASN regional divisions are located in the premises of the DRIREs. For 2007, the ASN's total budget was about 54 million euros.

In 2008, the ASN's budget is included in action 3 "Regulation of nuclear safety and radiation protection" of programme 181 "Prevention of risks and mitigation of pollution" of the "Ecology and sustainable development" mission.

As stipulated in the TSN Act, ASN also relies on IRSN for technical expertise, backed up whenever necessary by research. In its article 16, the Act states that ASN is consulted by the Government on the corresponding share of the State subsidy to IRSN. This share of the IRSN subsidy, which amounts to 72 million in 2007, is included in programme 189 "Research in the field of risks and pollution" of the "Research and higher education" mission.

Basic Nuclear Installation tax

Article 16 of the TSN Act also states that the ASN Chairman is responsible, on behalf of the State, for issuing payment authorisation for and settling the tax on BNIs created by article 43 of the 2000 Finance act (act 99-1172 of 30 December 1999). The revenue from this tax amounts to 365.8 million in 2007. It is paid into the State's general budget.

In order to encourage rapid decommissioning of nuclear installations, article 77 of the supplementary budget act for 2005 reduced this tax by 50% for installations shut down and undergoing decommissioning. The tax ceases to be due once installation delicensing has been pronounced.

The revenue from the tax amounted to 213 million euros in 2003, 346 million euros in 2004, 347 million euros in 2005, 358.7 million euros in 2006 and 365 million euros in 2007.

Additional tax on radioactive waste

Programme Act 2006-739 of 28 June 2006 concerning the sustainable management of radioactive materials and waste, in addition to the BNI tax, created three additional taxes for nuclear reactors and spent nuclear fuel reprocessing plants, known as the "research", "support" and "technological dissemination" taxes respectively. They are allocated to financing economic growth, on the one hand, and to financing ANDRA research into underground disposal and interim storage, on the other.

Table 1: summary of ASN's 2007 budget

Programme	Action	Amount	Purpose
Programme 127: Regulation and prevention of technological risks and industrial development	Action 3 "Regulation of nuclear safety and radiation protection"	M€ 37 (2007 Constitutional bylaw and budget act)	ASN staff and operation
	Action 5 "Support for the DRIRE network"	M€ 17 (amount paid calculated at end of 2006	Secondment of staff from the regional offices
Programme 218: Control and oversight of economic, financial and industrial policies	Action 5 "Support services and assistance"		Secondment of staff from the Paris offices
Programme 189: Research into the field of risks and pollution	Sub-action 3-2 "Technical support for ASN" of the IRSN budget	M€ 72 (budget presented to the IRSN board under the terms of the 2007 Constitutional bylaw and budget act)	Share of IRSN budget devoted to financing ASN technical support

Table 2: breakdown of contributions

Licensee	Amount for 2007 in millions of euros	
	BNI Tax	Additional taxes
EDF	326	102
AREVA	20	6
CEA	8	20
ANDRA	6	
OTHERS	5	3
TOTAL	365	131

For 2007, the revenue from these new taxes amounts to 132 million euros.

The breakdown of contributions is shown in table 2.

c) Skills management

Competence is one of the four key values of ASN. The mentoring system, along with initial and continuous training, whether general, linked to nuclear techniques or communication, are key elements in professionalism.

Management of ASN personnel skills is in particular based on a formalised curriculum of technical training. For each member of staff, this curriculum is a means of implementing a detailed and regularly updated training reference system. For example, an inspector must follow a series of predetermined training modules before being qualified to carry out inspections. This involves technical training, but also training in legal aspects and communication. In 2007, 2787 days of technical training were given to ASN staff during 60 different training courses. The financial cost of the courses, provided by organisations other than ASN, amounted to 394 k€.

Since 1997, ASN has followed a programme of qualification of its inspectors, based on recognition of their technical competence. An accreditation committee was set up in 1997 to advise the Director General on the entire qualification system. It in particular reviews the training curriculum and the qualification reference systems applicable to the various ASN departments, and interviews inspectors as part of the confirmation process.

Chaired by Mr. Yves Lecointe, the Accreditation Committee is made up half of senior inspectors belonging to ASN and half of persons with competence in the field of nuclear safety regulation, assessment and teaching, and regulation of classified installations. Its scope of competence will be extended to radiation protection.

The Accreditation Committee met twice in 2007 and proposed the confirmation of fourteen BNI inspectors.

On 31 December 2007, 44 ASN nuclear safety inspectors were senior inspectors, or about 25% of all the nuclear safety inspectors.

d) Internal communication and information systems

The ASN Intranet, Oasis, is the main source of ASN internal information, carrying all the documents and information needed by the staff on a day to day basis, plus news and the daily press review. The action taken in recent years for internal communication also continued in 2007:

– presentation of each *Contrôle* magazine topic to the staff in the ASN departments and exchanges with the executive committee, prior to presentation of the magazine to the media;
– organisation of introductory sessions for new ASN recruits in January, May and October;
– regular visits by the management committee to each of the entities making up ASN (Office of Administration, departments, divisions).

Oasis is also the interface for the ASN information system: about ten professional sector applications accessible to all ASN staff organise, harmonise and capitalise on information concerning the main processes within ASN.

e) Quality management system

To guarantee and improve the quality and effectiveness of its actions, ASN defined and implemented a quality management system inspired by the ISO and IAEA international standards and based on:

Follow up to the IRRS review hosted by ASN in 2006

The International Atomic Energy Agency (IAEA) drafts and publishes international safety standards for nuclear installations, the transport of radioactive materials, the management of radioactive waste and protection against ionising radiation. IAEA also handles their distribution and implementation. In so doing, it offers regulatory bodies a service to assess implementation of its standards, taking the form of IRRS (Integrated Regulatory Review Service) reviews. These reviews aim to audit the regulatory bodies with regard to nuclear safety, radiation protection and the safe transport of radioactive materials.

At its request and in order to ensure continuous improvement, ASN hosted an IRRS review team from 5 to 17 November 2006. This was the first ever "full scope" review undertaken by IRRS to cover all nuclear safety and radiation protection fields. It also concerned a nuclear safety authority that regulates one of the world's largest and most diverse inventories of nuclear activities and installations. In asking for this first IRRS full-scope review, ASN had three objectives in mind.
1. To submit to an external peer review to ensure that its organisation and practices are in conformity with international standards and improve the pertinence of its actions and effectiveness.
2. To present a certain number of its practices to its peers, in particular those practices that it considers go further than IAEA's recommendations.
3. To encourage the larger regulatory bodies also to ask for an IRRS review. In 2007, several IRRS reviews were carried out, including one led by the ASN Chairman. Others are scheduled for 2008 and 2009. This approach should lead to a cross-comparison of benefits to the regulatory bodies and an "upwards" harmonisation of regulatory organisations and practices with a view to ensuring progress in nuclear safety and radiation protection.

The IRRS review was conducted by a team of sixteen peer reviewers from regulatory bodies of other countries, coordinated by 6 IAEA experts. It assessed ASN's organisation and practices both nationally and regionally, in an open and frank context. Auditors accompanied ASN inspectors in their field visits, whether inspections, technical meetings or emergency management exercises.

The IRRS review was the subject of a report published in full on the website www.asn.fr. It identified 40 good practices, 49 suggestions (deviations from the IAEA guidelines) and 35 recommendations (deviations from IAEA standards).

In a large number of areas such as inspection, preparedness for emergencies, provision of public information, or its international role, ASN ranks among the best international practices. ASN will aim to perpetuate all the good practices identified by this review.

On the basis of the areas for improvement identified by the review, ASN is implementing an action plan in order to guarantee full conformity of its practices and its organisation with the best international standards. Most of the actions stipulated in this plan have been or will have been carried out by the end of 2008. Some illustrations:
– ASN's role in overseeing management of the fund dedicated to the decommissioning of nuclear installations and to radioactive waste was clarified and reinforced in 2007;
– the practical measures for implementing new enforcement tools specified by the 13 June 2006 Act on transparency and security in the nuclear field (installation final shutdown decisions, formal notices, fines, etc.) are currently being finalised;
– the creation of a single national regulatory text for the management of radioactive waste, regardless of the producer, is being worked on jointly with the administrations concerned and should be completed in 2008.

An IAEA mission will be organised early in 2009 to assess the progress made with implementation of this action plan.

– 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 ASN;
– listening to the needs of all parties involved (the public, elected officials, 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.).

2|3|3 The ASN technical support organisations

ASN relies on the expertise of technical support organisations when preparing its decisions. The Institute for Radiation Protection and Nuclear Safety (IRSN, www.irsn.fr) is the main one. For a number of years now, ASN has also been following a policy of technical support diversification, both nationally and internationally.

a) Institute For Radiation Protection And Nuclear Safety

IRSN, created by Act 2001-398 and by decree 2002-254, was set up as an independent public industrial and commercial establishment, as part of the national reorganisation of nuclear safety and radiation protection regulation, in order to bring together public expertise and research resources in these fields. IRSN reports to the Ministers for the Environment, Health, Research, Industry and Defence.

The Institute conducts and implements research programmes in order to build its public expertise on the very latest national and international scientific knowledge in the fields of nuclear and radiological risks. It is tasked with providing technical support for the public authorities with competence for safety, radiation protection and security, in both the civil and defence sectors. Finally, the decree that created it gives it certain public service duties, in particular monitoring of the environment and of populations exposed to ionising radiation. To enable it to perform these duties, IRSN manages national databases (national nuclear material accounting, national inventory of radioactive sources, file of worker exposure to ionising radiation, etc.), and contributes to public information concerning the risks linked to ionising radiation.

IRSN budget

In accordance with the Constitutional bylaw and budget act, the State's general budget subsidy granted to IRSN is consolidated in action 3, "Evaluation and prevention of nuclear risks" of programme 189 "Research in the field of risks and pollution" of the "Research and higher education" interministerial mission. In 2007, this was supplemented by 10 million euros taken from BNI tax revenue.

The State subsidy to IRSN in 2007 voted under the finance Act amounts to 236 million euros. The share of this budget corresponding to ASN support work amounts to € 72 million.

In accordance with article 16 of the 13 June 2006 Act on transparency and security in the nuclear field, ASN was consulted by the Government on the share of the State subsidy to IRSN corresponding to the technical support provided to ASN by the Institute for the year 2008. The opinion was issued on 13 November 2007. It notes that the State's subsidy to IRSN for ASN support work is less than the amount jointly requested with IRSN. It asked that ASN be more closely involved in the budget procedure. Finally, it announced the implementation of more precise budgetary monitoring of IRSN actions on behalf of ASN.

Pursuant to the same article, an agreement was signed by ASN and IRSN to define the working methods and principles governing the technical support provided to ASN by the Institute. This agreement is clarified on a yearly basis by a protocol identifying the actions to be performed by IRSN to support ASN.

b) The ASN's other technical support organisations

To diversify its sources of expertise and take advantage of other specific skills, ASN also has its own credit allocation, amounting to 888,000 euros in 2007.

A significant part of the budget is devoted to producing an inventory of exposure of the population to radon in the home.

ASN continued its cooperation with:
– the *Robin des bois* association: study of phosphogypsum deposits and ashes from coal-fired power plants;
– APAVE: drafting of a strategy for revision of the industrial/ASME codes and prevention of the criticality risk at CEA;
– CEPN: Core health project.

2|3|4 Advisory Committees of experts

When preparing its decisions, ASN relies on opinions and recommendations from Advisory Committees of

experts and the standing nuclear section of the Central Committee for Pressure Vessels.

In accordance with the internal rules, four Advisory Committees of experts (GPE) were created by the 9 March 2007 decision of the ASN Chairman to work with the ASN Director General. 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.

The GPEs are consulted by the ASN Director General concerning the safety and radiation protection of installations and activities within their particular field of competence. They in particular review the preliminary, provisional and final safety cases for each of the BNIs. They are in possession of reports presenting the results of the analyses conducted by IRSN and issue an opinion plus recommendations.

Each GPE may call on any person recognised for his or her particular competence. It may hold a hearing of licensee representatives. Participation by foreign experts can help diversify the approach to problems and take greater advantage of experience acquired internationally.

Finally, together with IRSN, ASN is examining how it could effectively and efficiently distribute the opinions issued by the Advisory Committees of experts.

The Advisory Committees of experts comprise experts nominated for their individual competence. They come from university and associative backgrounds, as well as from the licensees concerned by the subjects being dealt with.

a) The Advisory Committee for reactors

The Advisory Committee for reactors is chaired by Mr Pierre Govaerts. It consists of experts nominated for their competence in the field of nuclear reactors.

In 2007, the Advisory Committee for reactors held 11 meetings.

b) Advisory Committee for laboratories and plants

The Advisory Committee for laboratories and plants is chaired by Mr Pierre Chevalier. It comprises experts nominated for their competence in the field of laboratories and plants in which radioactive materials are used. In 2007, the Advisory Committee for laboratories and plants held 7 meetings.

c) The Advisory Committee for waste

The Advisory Committee for waste is chaired by Mr Pierre Bérest. It comprises experts nominated for their competence in the nuclear, geological and mining fields.

In 2007, the Advisory Committee for waste held 5 meetings.

d) The Advisory Committee for transport

The Advisory Committee for Transport is chaired by Mr Jacques Aguilar. It comprises experts nominated for their competence in the field of transport, in particular

Meetings of the "Advisory Committee for Nuclear Reactors" in 2007

Topic	Date
In-house meeting	8 March
Review of site protection against off-site flooding Joint meeting with the Advisory Committee for laboratories and plants	21 March 22 March
Review of the preliminary safety case for the Jules Horowithz reactor (RJH)	20 June 21 June 28 June
Review of the "safety cost-benefits" method	5 July
Preparation of the 1st meeting of the four-party working group: sump clogging	20 September
High flux reactor (RHF) – Earthquake analysis and visit of the installation Information meeting dealing with licensee follow-up to ASN requests following the opinion expressed by the Advisory Committee fo reactors in 2002 Meeting in Grenoble	11 October
Second review of preliminary safety case for the Jules Horowitz reactor (RJH)	29 November
Review of operational experience of French and foreign PWR reactors during the period from 2003 to 2005	20 December

Meetings of the "Advisory Committee for laboratories and plants" in 2007

Topic	Date
Review of site protection against off-site flooding (joint meeting with the Advisory Committee for reactors)	21 March
MAGENTA Installation – Review of preliminary safety case	28 March
ATALANTE (Marcoule) – Commissioning	23 May
CERN- LHC – Safety review of CERN's Large Hadron Collider project and its injectors	27 June
BUGEY 1 – Review of decommissioning conditions (joint meeting with the Advisory Committees for reactors and for waste	24 October
SACLAY BNI 35 and STELLA – Periodic safety review of the liquid effluents management zone	28 November
INB 118 (La Hague COGEMA) – Periodic safety review of BNI 118 (STE 3, MDSB shops, discharge duct)	19 December

Meetings of the "Advisory Committee for waste" in 2007

Topic	Date
Meeting of Advisory Committee for waste – RSK	5 June 6 June
Review of the revision of the RFS III.2.f fundamental safety rule concerning final disposal of radioactive waste in deep geological formations	19 June 26 June
Presentation of the ANDRA Development Plan (PDD)	4 December

representatives from the French committee for certification of companies in training and monitoring of personnel working with ionising radiation.

The Advisory Committee for transport did not meet in 2007.

e) The Standing Nuclear Section of the CCAP

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

Meeting of the Advisory Committee for reactors on 29 November 2007

Meetings of the CCAP Standing Nuclear Section in 2007

Topic	Date
Application of article 13 of the order of 10.11.1999 to steam generator tube bundles	17 January
Request for waiver to the requirements of articles 13 and 16 of the order of 23 July 1943 concerning renewal of periodic testing and inspection	17 January
Modification of the order of 26 February 1974	Consultation by letter
Chemical cleaning of steam generators in Cruas reactor 4	6 March
Repair of the weld on the final joint of replacement steam generator 1 in Bugey reactor 4	11 May
Application of article 13 of the order of 10.11.99 to steam generator tubes Operating experience feedback from chemical washing operations Decree 1557-2007 of 02.11.07 modifying the decree of 13.12.99	5 December

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 called on by the Director for Regional Action, Quality and Industrial Safety (DARQSI) and by ASN for all questions concerning application of laws and regulations to pressure vessels. Accident reports are also forwarded to it.

For particular regulation of the more important pressure vessels in nuclear installations, it has a Standing Nuclear Section (SPN), the role of which is to issue recommendations on application of pressure vessel regulations to the main nuclear pressure vessels. This Standing Nuclear Section works as an Advisory Committee of experts in dealing with nuclear pressure vessel issues.

In 2007, it held four meetings and sent out a letter to consult its members.

f) The Advisory Committees for radiation protection

The dissolution and replacement of the French High Public Health Council in April 2007 and consequently the closure of the radiation protection section and commission for the use of ionising radiation sources associated with it, led ASN to create two new Advisory Committees of experts to deal with radiation protection issues. The first deals with radiation protection in the medical field and the second with radiation protection in other fields (small-scale non-medical nuclear installations and exposure to naturally occurring radioactive materials – NORM). Through an integrated approach, the particular issues concerning radiation protection in BNIs are still dealt with by the corresponding Advisory Committees.

The role of these new Advisory Committees of experts, which should be set up at the beginning of 2008, will be to issue opinions and recommendations:
– on the state of radiation protection in the various places in which sources of ionising radiation are used, particularly in small-scale nuclear installations;
– on enforcement of the justification principle for new uses of sources of ionising radiation and, as necessary, for existing activities when the technical context so requires;
– on new materials emitting ionising radiation, before they are released to the market;
– on policy concerning radiological emergencies;
– on protection of persons against Naturally Occurring Radioactive Materials (NORM).

The Advisory Committees for radiation protection could also be called on for changes to regulations, in particular when preparing new international, European Community and national guidelines. More generally, they can issue recommendations on desirable changes to the organisation and rules governing radiation protection in France.

3 OUTLOOK

The regulation of nuclear safety and radiation protection concerns all State structures:
– Parliament, in particular the OPECST, for definition of the main long-term options;
– the Government, in particular the Ministers responsible for nuclear safety and radiation protection, who are given general regulatory powers and deal with individual questions concerning the creation of a BNI;
– ASN, which contributes to drafting technical regulations and the monitoring and regulation of activities;
– the consultative bodies, which provide an outside view of the important decisions concerning nuclear safety and radiation protection;
– the *préfets*, who are in charge of protecting the population.

2007 saw the creation of various bodies provided for in the 13 June 2006 Act concerning transparency and security in the nuclear field. 2007 was the first full year of operation for ASN as an independent administrative authority. This year was an opportunity to adopt positions on important subjects concerning the organisation of the Authority and the regulation of nuclear activities. These positions are an intermediate stage ensuring continuity with the previous system, while providing a foretaste of changes to come.

While ensuring continuity, and with a view to achieving constant progress, ASN is taking action to improve the quality of its decision-making processes:
– in order to respond to the various comments made by the IAEA auditors after the IRRS review in November 2006, a plan of action was defined. It is being closely monitored to ensure that the IAEA follow-up review, which will take place in 2009, will be able to confirm that account has been taken of all the recommendations and suggestions made;
– in addition to the Advisory Committees of experts in the field of nuclear installations, ASN has set up two additional Advisory Committees to deal with opinions in the field of radiation protection. The first opinions could be issued in 2008;
– to clarify the 2007-2009 strategic plan, ASN has defined technical subjects it considers to be priorities for 2008. These will be closely monitored.

While retaining its independence, ASN's actions involve close ties with Government entities in charge of subjects linked to nuclear safety and radiation protection. The continued construction of ASN's independence involves greater links with Parliament and greater budgetary autonomy. With this in mind, this report will be presented to the Parliamentary Office for the Assessment of Scientific and Technological Options. Ties have also been forged with other Parliamentary organisations.

Further to the ministerial changes of 2007, ASN's 2008 credits will be included under action 9 "regulation of nuclear safety and radiation protection" of programme 181 "Prevention of risks and mitigation of pollution" run by the Ministry for Ecology and for Sustainable Development and Planning. At present, ASN's resources are more or less adequate for its duties. However, it considers that a system could be put into place giving greater visibility and flexibility in financing the regulation of nuclear safety and radiation protection.

CHAPTER 3

1 THE REGULATION OF RADIATION PROTECTION

1 | 1 The regulatory basis
1 | 1 | 1 The international reference framework (ICRP, IAEA, Euratom)
1 | 1 | 2 The Public Health Code and the Labour Code

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

1 | 3 Protection of individuals exposed for medical and forensic purposes
1 | 3 | 1 Justification of procedures
1 | 3 | 2 Optimisation of exposure
1 | 3 | 3 Forensic applications of ionising radiation

1 | 4 Protection of individuals exposed to technologically enhanced naturally occurring radioactive materials (TENORM)
1 | 4 | 1 Protection of individuals 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 Authorisations and licences
2 | 1 | 1 Siting
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2 | 2 | 1 Ministerial and government orders
2 | 2 | 2 Documents produced by ASN
2 | 2 | 3 French nuclear industry codes and standards

3 REGULATIONS FOR THE TRANSPORT OF RADIOACTIVE MATERIALS

3 | 1 International regulations

3 | 2 National regulations

4 OUTLOOK

APPENDIX 1 – VALUES AND UNITS USED IN RADIATION PROTECTION

APPENDIX 2 – REGULATION LIMITS AND DOSE LEVELS

2007 was marked by important decrees implementing the 2006-686 Act of 13 June 2006 concerning transparency and security in the nuclear field, known as the "TSN Act".

Of the 15 decrees implementing the TSN Act, 9 were published during the course of 2007.

The BNI regime, dating from 1963, was thus completely overhauled with the entry into force of decree 2007-1557 of 2 November 2007 concerning basic nuclear installations and the regulation of the nuclear safety aspects of the radioactive material transports.

As a result of this decree, ASN now has the legal tools it needs to play its full role as a regulatory body.

Apart from the complete overhaul of the BNI regime, the Public Health Code and the Labour Code also underwent significant changes, to take account of the requirements of European Council Directive 96/29/Euratom of 13 May 1996 setting basic standards for the health protection of the population and workers against the risks of ionising radiation.

Two important small-scale nuclear activity and radiation protection decrees were adopted in 2007:
– decree 2007-1582 of 7 November 2007 concerning the protection of individuals against the risks of ionising radiation and modifying the Public Health Code, extensively revised Part III of Book III of the first part of the Public Health Code;
– decree 2007-1570 of 5 November 2007 concerning worker protection against ionising radiation and modifying the Labour Code.

This legislation is based on internationally adopted rules, whether regulations or community directives such as Council directive 96/29/Euratom dated 13 May 1996 and setting basic standards for health protection of the population and workers against the risks of ionising radiation. It is also based on a variety of norms, standards and recommendations, such as the recommendations from the International Commission on Radiation Protection (ICRP) or the standards issued by the International Atomic Energy Agency (IAEA), in particular the International Basic Safety Standards for Protection against Ionising Radiation and for the Safety of Radiation Sources (Safety Series n° 115).

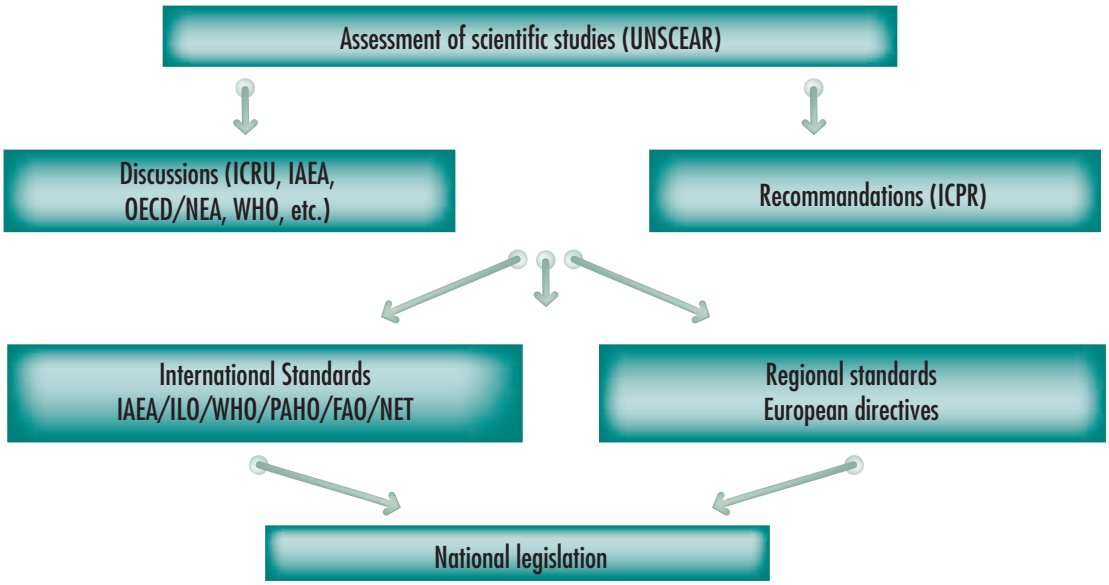
This chapter presents the current regulations applicable to radiation protection, nuclear safety and the transport of radioactive materials.

1 THE REGULATION OF RADIATION PROTECTION

1 | 1 The regulatory basis

1 | 1 | 1 The international reference framework (ICRP, IAEA, Euratom)

The specific regulations for radiation protection are based on various norms, standards and recommendations issued internationally by various organisations. The following in particular should be mentioned:
– the International Commission on Radiation Protection (ICRP), a non-governmental organisation comprising experts in various fields from around the world. It publishes recommendations concerning the protection of workers, the population and patients against ionising radiation, based on an analysis of the available scientific and technical knowledge. The latest recommendations from the ICRP are to be found in ICRP Publication 60, which came out in 1991. The ICRP has completed revision of this work and this in 2007 led to a new publication taking account of changing professional knowledge and experience;
– the International Atomic Energy Agency (IAEA) which regularly publishes and revises standards in the fields of nuclear safety and radiation protection. The International Basic Safety Standards for Protection against Ionising Radiation and for the Safety of Radiation Sources (Safety Series n° 115), based on the ICRP recommendations, were published in 1996, in partnership with the United Nations Food and Agriculture Organisation (FAO), the International Labour Organisation (ILO), the OECD Nuclear Energy Agency



Drafting of radiation protection policy

(NEA), the Pan-American Health Organisation (PAHO) and the World Health Organisation (WHO). IAEA has begun a process to revise the International Basic Standards for Protection against Radiation, while a new standard concerning the basic safety principles was published at the end of 2006;

– the International Standards Organisation (ISO) which publishes international technical standards. These are a key element in the radiation protection of individuals and are the cornerstone between the principles, concepts and units, and the body of regulatory texts for which they guarantee harmonised implementation.

At a European level, the Euratom Treaty, and more particularly articles 30 to 33, specifies how the standards for protection against radiation are drafted and defines the powers and obligations of the European Commission with respect to how they are applied. The corresponding directives are binding on the various countries, such as directive 96/29/Euratom of 13 May 1996 setting basic standards for health protection of the population and workers against the risks of ionising radiation, directive 97/43/Euratom of 30 June 1997 concerning the health protection of individuals against the risks of ionising radiation during exposure for medical purposes, and directive 2003/122/Euratom of 22 December 2003 concerning supervision of high-level sources and orphan sources. The European Commission has initiated a revision of these directives in order to take account of the experience acquired by the member States and the changes made to international texts.

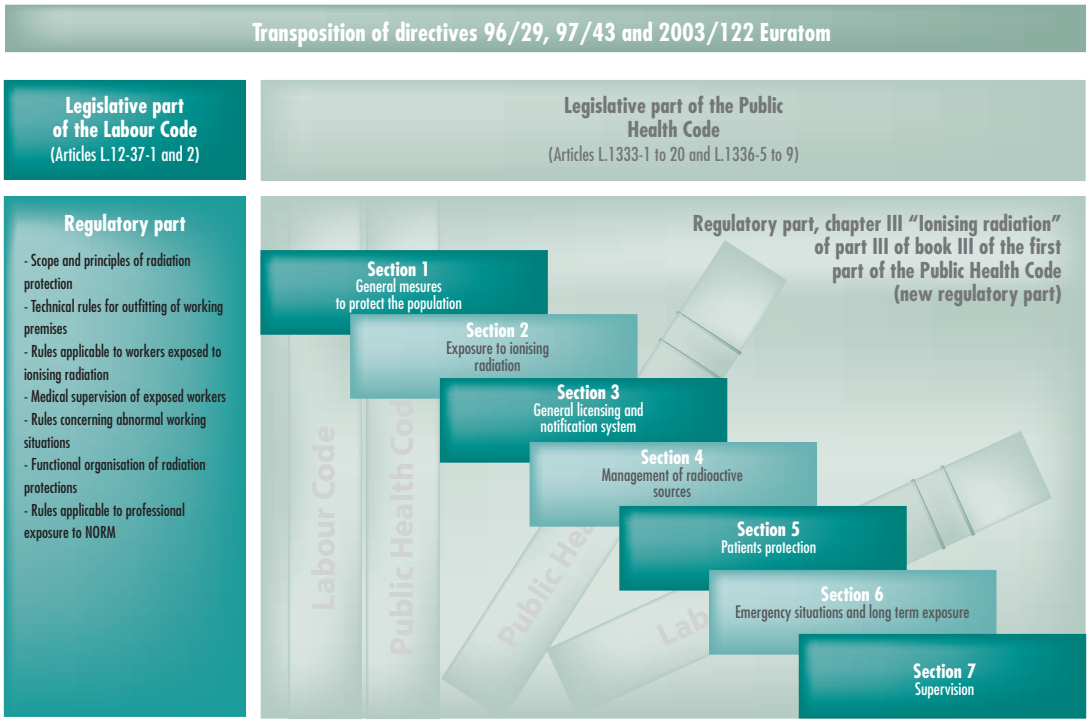
1|1|2 The Public Health Code and the Labour Code

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 risks arising from ionising radiation and Council directive 97/43/Euratom dated 30 June of 1997 on health protection of individuals against the risks 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.

The update of the legislative part was completed with publication of the above-mentioned ordinance of 28 March 2001 and Act 2004-806 of 9 August 2004 concerning public health policy, with the introduction of new articles concerning the radiation protection inspectorate and an update to take account of the creation of ASN (Act of 13 June 2006).

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 risks arising from ionising radiation;
– decree 2003-270 of 24 March 2003 concerning the protection of individuals exposed to ionising radiation for medical and forensic purposes (including forensic



Legislative and regulatory architecture of radiation protection

science, screening technologies, insurance and other related applications);
– 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 risks of ionising radiation.
– decree 2006-694 of 13 June 2006 setting the procedures for designating, approving and swearing-in radiation protection inspectors and modifying the Public Health Code.

The decrees of 4 April 2002, 24 March 2003, 2003-295 of 31 March and 2006-294 of 13 June 2006, mentioned above, are codified in chapter 3 "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.

An initial update of chapter 3 "Ionising Radiation" of the Public Health Code, was carried out in 2005, with additions to section 7 "Emergency situations and long-term exposure" by decree 2005-1179 of 13 September 2005 concerning radiological emergencies, in order to complete the transposition of Council directive 89/618/Euratom of 27 November 1989 concerning public information about applicable heath protection measures and what to do in the event of a radiological emergency.

A second update was carried out in 2007 (decree 2007-1582 of 7 November 2007 concerning protection of individuals against the risks arising from ionising radiation and modifying the Public Health Code and decree 2007-1570 of 5 November 2007 concerning worker protection against the risks arising from ionising radiation and modifying the Labour Code) in order to meet the following objectives:
– to transpose Council directive 2003/122/Euratom of 22 December 2003 on the control of high-level 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 regulation of radiation protection;
– to take account of the prerogatives granted to ASN by the Act of 13 June 2006.

The actual implementation of the new regulatory requirements was dependent on the publication of a number of orders (27 were published between July 2003 and

September 2006, 8 are still to be published) and a large number of ASN technical decisions (42 decisions are mentioned in the Public Health Code and the Labour Code). However, transposition of the above-mentioned directives 96/29/Euratom, 97/43/Euratom and 89/618/Euratom is considered to be complete.

The Public Health Code

The principles of radiation protection

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 material 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 ASN is responsible.

1. The principle of justification

"A nuclear activity or intervention may only be undertaken or carried out if justified by the advantages it procures, particularly in health, social, economic or scientific terms, with respect to the risks inherent in the exposure to ionising radiation to which the individuals are likely to be subjected."

Depending on the type of activity, the justification decision lies with various levels of authority: it lies with the Government for issues of general interest, as in the case of whether or not to resort to nuclear energy; it lies with ASN in the case of sources used for medical, industrial and research purposes; it lies with the AFSSAPS for release to the market of a new irradiating medical device and with the physicians for prescribing and carrying out a diagnostic or therapeutic procedure. 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 materials 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 as the ALARA principle, for example leads to a reduction in the discharge licences of the quantities of radionuclides present in the radioactive effluents from nuclear installations, to surveillance of exposure at the workstation in order to reduce it to the strict minimum, and to ensure that medical exposure as a result of diagnostic procedures remains close to the predetermined reference levels.

3. The principle of limitation

"Exposure of a person to ionising radiation as a result of a nuclear activity, cannot raise the sum of the doses received beyond limits set by the regulations, unless this person is exposed for medical purposes or for biomedical research."

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 of the *Conseil d'Etat** can be used to lay down general rules concerning the conditions for prohibition, licensing and notification of uses 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.

Exposure to Technologically Enhanced Naturally Occurring Radioactive Materials (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 radioactive materials (NORM), in particular exposure to radon,

*France's highest administrative court.

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 ASN. The implementing decree of 13 June 2006 set the procedures for designating, approving and swearing-in the radiation protection inspectors. The law of 13 June 2006 now gives the ASN Chairman the powers to designate radiation protection inspectors, chosen mainly from among ASN personnel. 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).

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 ionising radiation during their activities in controlled areas and the above-mentioned Council directive 96/29/Euratom. They also 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 risks of ionising radiation from nuclear activities

1 | 2 | 1 General protection of workers

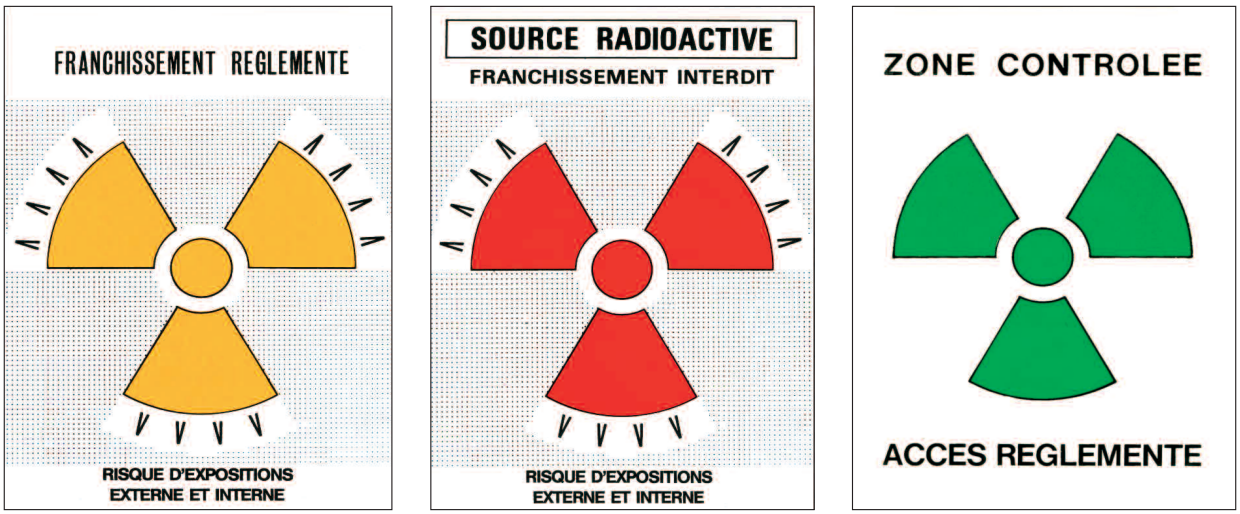
Articles R. 231-71 to R. 231-116 of the Labour Code, introduced by above-mentioned decree 2003-296 of 31 March 2003, create a single radiation protection system for all workers (whether or not salaried) likely to be exposed to ionising radiation during their professional activities. Of these requirements, 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;
– 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 implementing orders offers the clarification necessary for these new measures to be put into place.

Zoning

New provisions concerning the boundaries of monitored zones, controlled zones and specially regulated zones (subject to special checks) were issued, regardless of the activity sector, by the order of 15 May 2006 (O.G. of 15 June 2006). This order also defines the health, safety and maintenance



Signs marking out areas in which work with ionising radiation is carried out

rules to be observed in these zones. When marking out the regulated zones, three levels of protection are now taken into account. They are the effective dose for external and, as applicable, internal exposure of the whole organism, the equivalent doses for external exposure of the extremities and, as applicable, the dose rates for the whole organism. The order thus sets reference values that the head of the establishment is required to compare with the external and internal exposure levels encountered at the workstations, when determining the zones. A DGT/ASN circular of 18 January 2008 specifies the implementation procedures.

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 assessing 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 and active dosimetry data (art. R. 231-106). The PCR must receive their training from instructors accredited by the COFRAC.

The 26 October 2005 order concerning training of the person with competence for radiation protection and certification of the instructor, distinguishes between three different activity sectors:

– the "medical" sector, comprising nuclear and radiological activities intended for preventive and curative medicine - including forensic examinations - dentistry, medical biology and biomedical research, as well as veterinary medicine;
– 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;
– 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 arrangements for accreditation of organisations responsible for worker dosimetry have also been published (order of 6 December 2003); the arrangements for worker medical surveillance and transmission of information on individual dosimetry were published in the order of 30 December 2004. ASN is now in charge of examining the accreditation applications submitted by the dosimetry organisations and laboratories.

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 the French Institute for Radiation Protection and Radiation Safety (IRSN), to the department with competence for radiation protection or to organisations approved under application of article R. 1333-44 62 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 effluents produced. This supervision is partly carried out as part of the licensee's in-house inspection processes and partly by outside organisations (the outside checks must be performed by 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.

The list of accredited organisations is available from the ASN website, www.asn.fr.

Radon in the workplace (see point 1|4|1).

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 risks 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 to manufacture 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 IRSN, with guidelines being defined by ASN (order of 27 June 2005 organising the national network for environmental radioactivity measurements and setting the procedures for laboratory accreditation).

Old advertising poster for agricultural fertiliser containing radium

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 benchmarking tests. The list of accredited organisations is available from the ASN website, www.asn.fr.

Old advertising poster for the now prohibited uses of radionuclides in consumer goods

Management of waste and effluents 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 effluents from other facilities, including hospitals (art R. 1333-12 of the Public Health Code), general rules will be specified by an ASN decision. This waste and effluents must be disposed of in duly authorised facilities, unless there are special provisions for on-site organisation and monitoring of their radioactive decay (this concerns radionuclides with a radioactive half-life of less than 100 days).

Although 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 effluents and waste from a nuclear activity can be disposed of without supervision. In practice, waste and effluents 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 microsievert/year).

1 | 2 | 3 The licensing and declaration procedures for sources of ionising radiation

The system of licensing or notification, which covers all sources of ionising radiation, is described in full in section 3 of chapter III of part III of book III of the Public Health Code. This section was updated in 2007 to take account of the experience acquired by ASN since 2002 and the new prerogatives granted to it by the 13 June 2006 Act.

All licences will from now on be issued by ASN and notifications will be filed with ASN regional departments.

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 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 the prevention of accidents as a result of orphan sources.

In accordance with article L.1333-4 of the Public Health Code, the licences concerning industries covered by the Mining Code, BNIs and ICPEs, constitute radiation protection authorisations. The list of installations classified on environmental protection grounds concerning certain nuclear installations was modified by decree 2006-1454 of 24 November 2006. Facilities other than industrial and commercial facilities (health institutions for example) are no longer included on this list and that for industrial activities, the classification as an ICPE only becomes mandatory if the facility which uses the radioactive source is subject to licensing under one of the headings of the list.

The procedures for submitting licensing applications or notifications, specified by the order of 14 May 2004, will need to be updated by ASN in order to introduce the content of the files enclosed with the licensing application and the submission of notification, along with the content of the licences.

The medical, biomedical research and forensic fields

For medical and biomedical research applications, the licensing system contains no exemptions:
– the licences required for the use manufacture of radionuclides, or products and devices containing them, as well as for their distribution, import or export, are issued by ASN and no longer 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 ASN;
– ASN must be notified of X-ray generators if they are of low-intensity (radiology or dental surgery). Larger scale equipment (scanners) requires a licence issued by ASN.

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

Furthermore, in order to be able to carry out biomedical research, the "researcher" must have prior authorisation from the place of research (L.1121-13) in the following highly particular cases:
– when this is not a place of health care;
– when this is a place of health care but:
  • the research involves the performance of procedures not usual in this place,
  • the person being treated has a clinical condition other than that for which the department is competent.

Chapter III "Ionising radiation" (part III, book III) of the Public Health Code was modified in order to transpose Council directive 2003/122/Euratom of 22 December 2003 concerning the supervision of high-level sealed

radioactive sources and orphan sources, which are defined in appendix 13-7.

The industrial and non-medical research fields
ASN is also in charge of issuing licences for non-medical industrial and research applications, and for receiving the notifications. For these areas, 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.

The criteria for licensing exemption adopted by directive 96/29/Euratom (Appendix 1, table A) have been introduced into and appended to the Public Health Code (table A, appendix 13-8) and values for supplementary radionuclides introduced by the order of 2 December 2003 have been added to it.

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, a mass limitation was introduced (the mass of material used must be less than 1 ton), which is the reference criterion used when preparing the scenarios on which the exemption values were based. 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.

Transport of radioactive materials
Without prejudice to the regulations concerning the transport of dangerous goods, companies that transport radioactive materials must now submit a notification to or request a licence from ASN for all transports within the national territory.

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 list of approved organisations is available from the ASN website, www.asn.fr. 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 the CIREA (Interministerial commission on artificial radioelements) and their supervision is now the responsibility of ASN. However, the CIREA 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 notified;
– validity of the formalities required for the import and export of radioactive sources, products or devices, defined by the CIREA and the customs services, is renewed.

The system for disposal and recovery of sealed sources which have either expired or reached the end of their operational life, is taken from the CIREA special licensing conditions (decision of the 150th CIREA meeting of 23 October 1989):

An ASN decision will define the procedures for implementation of the measures concerning the identification and marking of high-level sealed sources, as well as the type of information concerning these sources that the person in possession will be required to provide.
A new requirement is introduced for the control of orpphan radioactive sources: the préfet is asked to determine how they are to be dealt with as well as the steps to be taken in the event of such a source being discovered.*

**In a département, representative of the State appointed by the President.*

– 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 gamma radiography devices were updated by the order of 2 March 2004, thereby abrogating the special conditions which had been stipulated by CIREA.

The methods for calculating the financial guarantees required from source suppliers will shortly be introduced into the Public Health Code. The national table of charges, established for each family of sources, will be specified by order of the ministers responsible for health and finance, on recommendations from ASN, IRSN and ANDRA, along with the procedures for implementaion and payment of this guarantee.

1 | 2 | 5 Protection of individuals during a radiological emergency

The population is protected against the risks of ionising radiation in the event 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 government 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. These levels constitute reference points for the public authorities (*préfets*) who have to decide locally, on a case by case basis, on what action is to be taken. 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 thyroid dose is liable to exceed 100 mSv.

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 individuals 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:
– 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;
– the second group comprises personnel who are not members of the special response teams but who are called in on the basis of their expertise. They are given appropriate information.

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

Section 3 of chapter III (part III, book III) of the Public Health Code concerning the general system of licensing and notification has been completely reorganised and supplemented, in order to simplify the licensing and notification system set up in 2002 and include ASN's new prerogatives with regard to individual decisions.

The main changes made involve many sources being transferred from the licensing to the notification category, cancellation of the 5-year licence validity period, it now being possible for ASN to set such a limit on a case by case basis if necessary, but with a maximum of 10 years, and the possibility of issuing the individual licence to a corporate body rather than an individual person. For implementation of this section, several ASN decisions will be required, in particular to:
– exempt certain electrical devices from licensing or notification, as their design confers effective protection;
– draw up the list of installations subject to notification;
– clarify the list of the information to be included with the notification and the licensing application;
– indicate the elements which can be covered by the licence issued by ASN;
– set the particular conditions for use of certain ionising radiation sources;
– lay down minimum technical rules for the design, operation and maintenance of the installations.

– 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;
– 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.

Public information in a radiological emergency

The ways in which the population is informed in a radiological emergency situation are covered by a specific directive (directive 89/618/Euratom of 27 November 1989 concerning public information about health protection measures and how to act in the event of a radiological emergency). This directive was transposed into French law by:
– decree 2001-470 of 28 May 2001 concerning public information and modifying decree 88-622 of 6 May 1988 dealing with 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 its own off-site emergency plan (PPI) and the order of 21 February 2002 concerning information of the populations);
– decree 2005-1179 of 13 September 2005 concerning radiological emergency situations.

Two implementing orders were published:
– the order of 4 November 2005 concerning public information 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-out thresholds for sites contaminated by radioactive materials. 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 materials, version 0, December 2000), produced at the request of the ministries for Health and the Environment, and distributed to the *préfets* (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.

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 materials;

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 as defined by international conventions or agreements, or decisions taken by the European Community on the subject of information in the event of a radiological emergency."

1 | 3 Protection of individuals exposed for medical and forensic purposes

The new regulations, implemented in March 2003, transposing above-mentioned directive 97/43/Euratom, were 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 individuals 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 forensic setting.

1 | 3 | 1 Justification of procedures

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. 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 being finalised by the various learned societies.

Prescription and performance guides for medical procedures involving 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 Nuclear Medicine and Molecular Imaging Society (SFMN), the French medical Radio-physics Society (SFPM), and various organisations representing dental practitioners, have set up the necessary working frameworks for drafting these guides.

IRSN, the High Health Authority (HAS) and the National Cancer Institute (INCa) are also involved in this approach. As applicable, ASN coordinates or supports this work, or is simply kept informed. The progress of the various guides is presented in the following table.

1 | 3 | 2 Optimisation of exposure

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 prepared by health professionals to make optimisation easier in practice (table 1).

Diagnostic reference levels

New statutory concepts specific to radiation protection 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 centralising them at 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 is of no direct benefit to the individuals exposed, dose constraints designed to limit the doses delivered must be established by the physician.

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 (PSRPM), 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 such degrees was published in the order of 7 February 2005), followed by specialist training including clinical work placements.

Table 1: Progress in the production of prescription and performance guides for medical procedures involving exposure to ionising radiation

Speciality	Medical radiology		Nuclear medicine	Radiotherapy	Dental radiology
Documents	Procedure guide	Indication guide	Procedure guide	External radiotherapy procedure guide	Indication and procedure guide
Start	09.1999	06.2001	09.1999	04.2004	01.2004
Interim reports	07.2000	03.2004	06.2004	10.2006	08.2005
Finalisation	10.2001* (JFR 2001)	10.2004 (JFR 2004)		11.2007	05.2006
Availability	www.sfrnet.org www.irsn.org	www.sfrnet.org www.irsn.org	www.sfmn.org	–	www.adf.asso.fr www.has.sante.fr

*Currently being updated

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 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.

The following decisions were published:
- decision of 2 March 2004 concerning external quality control of external radiotherapy installations, modified by a decision of 27 July 2007;
- 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 quality control procedures for analogue mammography installations, amended by a decision of 16 December 2005;
- decision of 30 January 2006 concerning quality control procedures for digital mammography installations;
- decision of 27 July 2007 setting the external quality control procedures for external radiotherapy installations;
- decision of 27 July 2007 setting the internal quality control procedures for external radiotherapy installations abrogating the decision of 2 March 2004 concerning electron accelerators used for medical applications and tele-cobalt therapy devices;
- decision of 24 September 2007 setting the quality control procedures for certain radiodiagnosis installations, abrogating the decision of 20 November 2006;
- decision of 22 November 2007 setting the quality control procedures for computed tomography scanners.

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 the justification and optimisation principles, the report on the procedure, written by the medical practitioner carrying out the examination, must provide information justifying the procedures and the operations carried out and the data used to estimate the dose received by the patient (order of 22 September 2006).

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 the patient 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 (French High Public Health Council, learned societies) were distributed by ASN (January 2007) to enable the content of the information already sent out to be harmonised.

1 | 3 | 3 Forensic applications of ionising radiation

In the forensic 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 apply both to the person requesting the examinations and the person who carries them out.

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 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 first half of 2008.

Approval criteria for the practice of external radiotherapy activities

Decree 2007-388 of 21 March 2007 defines the layout conditions for "cancer treatment" health care activities. The licence issued by the Regional Hospitalisation Agency is granted for one or more therapies: surgery, external radiotherapy and brachytherapy, therapeutic use of unsealed source radionuclides and chemotherapy.

In the field of external radiotherapy, this licence takes the place of the previous high-risk equipment licence. The conditions for issue of the licence include:

- *the presence of a technical area which on the same site comprises at least two particle accelerators, one of which has an energy level in excess of 15 MeV;*
- *compliance with the approval criteria defined by the National Cancer Institute (deliberations of the board of the INCa of 20 December 2007). These criteria were defined with the participation of ASN and representatives of professional organisations as well as the regional hospitalisation agencies. The criteria defined in particular include:*
  - *the use of 3-dimensional imaging on a scanner dedicated to treatment preparation;*
  - *the recording and verification of the treatment parameters by means of a dedicated IT system;*
  - *the use of in-vivo dosimetry;*
  - *periodic verification of the position of the patients and the geometrical properties of the beams;*
  - *the presence of a radiation therapist and a radiological physicist for the duration of patient treatment.*

Radiotherapy quality assurance

After publication of the report from the inquiry carried out jointly by ASN and IGAS into the radiotherapy incident in Épinal, ASN was given responsibility for developing a radiotherapy quality assurance system designed to prevent patient exposure errors and significantly improve the safety of radiotherapy treatment.

The quality management system, based on ISO 9000, was prepared by ASN with the contribution of HAS, INCa, MeaH, SFRO, SFPM and AFSSAPS. It should become enforceable on the basis of a technical decision from ASN. ASN considers that 4 main points of interest must be underlined:
1. creation of a quality management system including a pertinent documentary system,
2. management of human resources and, to a lesser extent, of material resources,
3. management of performance of radiotherapy treatment, from the first patient consultation to post-treatment follow-up,
4. finally, continuous quality improvement through supervision and the implementation of monitored corrective measures.

This quality management system is accompanied by a guide which aims to provide clarifications and recommendations to make it easier to apply, along with technical data sheets offering examples or proposing practical support tools.

1 | 4 Protection of individuals exposed to technologically enhanced naturally occurring radioactive materials (TENORM)

1 | 4 | 1 Protection of individuals exposed to radon

The regulations applicable to management of the radon-related risk in premises open to the public (article R. 1333-15 of the Public Health Code) introduce 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 ASN, these measurements being repeated every 10 years and whenever work is carried out to modify the ventilation or the radon tightness of the building.

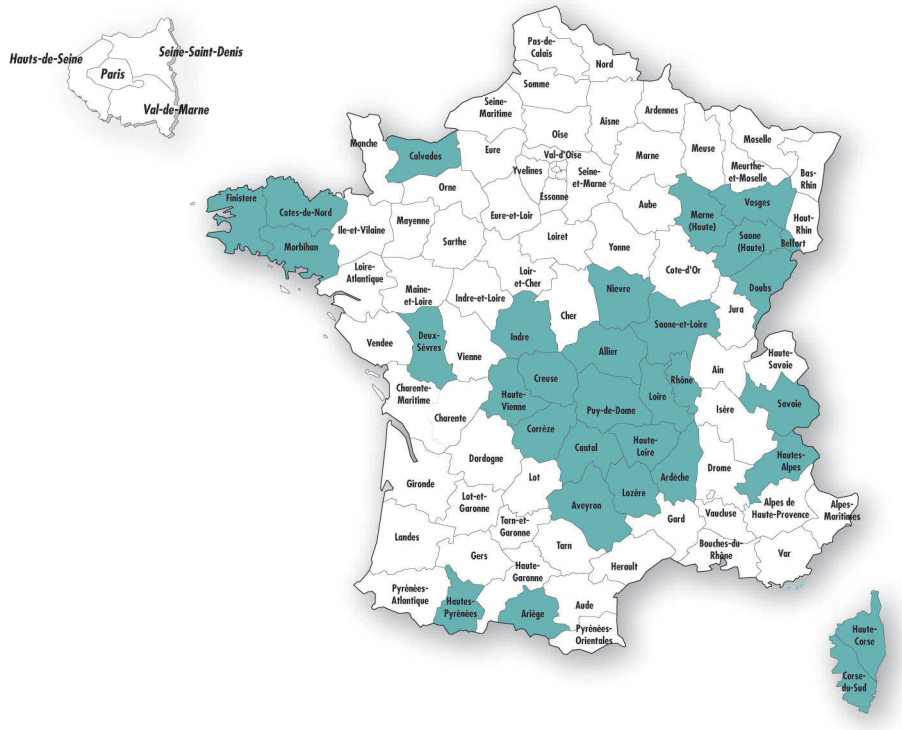
In addition to introducing action trigger levels of 400 and 1000 Bq/m^3, the implementing order of 22 July 2004 concerning management of the radon risk in premises open to the public defined geographical areas and premises open to the public for which radon measurements are now mandatory: the geographical areas correspond to the 31 *départements** 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 14 July 2006 concerning the accreditation of organisations responsible for measuring radon. The list of approved organisations was updated in the order of 25 July 2006, after obtaining the opinion of the accreditation commission consisting of representatives of the Ministries concerned, technical organisations (IRSN, Scientific and Technical Centre for the Building Industries, French High Public Health Council), building professionals and professionals involved in radon measurements. The list of approved organisations is available on the ASN website, www.asn.fr.

The order of 22 July 2004 was accompanied by the publication in the Official Gazette of an opinion defining the applicable standards for radon measurement (O.G. of 12 August 2004) and an opinion concerning the definition of the action and work to be done if the action trigger levels of 400 and 1000 Bq/m^3 (O.G. of 22 February 2005) were to be exceeded.

*Administrative region headed by a *préfet*.



Map of the 31 priority *départements* for radon measurement

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

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

Finally, in the working environment, the new article R. 231-115 of the Labour Code requires the head of the facility to take radon activity measurements and take the steps needed to reduce exposure when the measurement results reveal an average radon concentration of more than 400 Bq/m3. An order defining the workplaces in which these measurements are required should be published in 2008.

1 | 4 | 2 Other sources of exposure to TENORM

Professional activities which use materials which naturally contain radionuclides not used for their intrinsic radioactive properties but which are likely to create exposure such as to harm the health of workers and the public ("enhanced" natural exposure) are subject to the provisions of the Labour Code (art. R. 231-114) and the Public Health Code (art. R. 1333-13).

The order of 25 May 2005 defines the list of occupations 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:

– coal combustion in thermal power plants;
– processing of tin, aluminium, copper, titanium, niobium, bismuth and thorium ores;
– the production of refractory ceramics as well as glass-making, foundry, steelmaking and metallurgical activities employing them;
– the production or use of compounds comprising thorium;
– the production of zircon and baddeleyite, and foundry and metallurgical activities employing them;
– the production of phosphated fertilisers and the manufacture of phosphoric acid;
– processing of titanium dioxide;
– processing of rare earths and production of pigments containing them;

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

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 materials 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 above-mentioned 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.

On this basis, the 12 May 2004 order setting out the procedures for control of the radiological quality of water intended for human consumption, implementing the above-mentioned decree of 20 December 2001, defined new radiological inspection programmes for public mains water and non-mineral bottled waters, as well as two guideline values: the total alpha activity, set at 0.1 Bq/L and the total beta activity, set at 1 Bq/L. Since 1 January 2005, health checks on the radiological quality of water intended for human consumption have been mandatory and have been carried out by the Departmental Health and Social Action Directorates (DDASS). A circular from the General Directorate for Health (DGS) dated 13 June 2007, accompanied by

Implementation of the regulations to professional activities which use naturally occurring radioactive materials (NORM) not specifically used for their radioactive properties, has led the industries concerned to submit the studies requested by the Public Health Code and the Labour Code. These studies, of which there are fifty to date, allow an assessment of the radiological risk to the workers and to the population, and can be broken down according to the sectors concerned in the following way:
– coal combustion in thermal power plants: 10
– the production of refractory ceramics as well as glassmaking, foundry, steelmaking and metallurgical activities employing them: 25
– the production of zircon and baddeleyite, glassmaking and metallurgical activities employing them: 5
– the production of phosphated fertilisers and the manufacture of phosphoric acid: 1
– processing of titanium dioxide: 3
– processing of rare earths and production of pigments containing them: 1
– treatment of underground water by filtration: 1
– spas: 1
– others: 3

recommendations from ASN, specifies the policy underpinning this new regulation.

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, Council Regulation 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, revised in 2007, are appended to this chapter.

2 BNI REGULATORY PROVISIONS

The BNI regulations are to a large extent based on international conventions and on standards issued by the International Atomic Energy Agency (IAEA), under the aegis of the United Nations.

The Nuclear Safety Convention, in force since 1996, concerns civil nuclear power generating reactors. It defines a certain number of safety objectives and appropriate measures. Its counterpart in the field of spent fuel and radioactive waste management is the Joint Convention on the Safety of Spent Fuel Management and the Safety of Radioactive Waste Management, in force since 2001.

IAEA publishes reference texts, called "Basic Safety Standards", describing the safety principles and practices that can be used by States as the foundation for their own national regulations. These documents are not binding. They concern installation safety and radiation protection, the safety of waste management and the safe transport of radioactive materials.

At a Community level, the only two texts dealing with nuclear safety are Council resolutions of 22 July 1975 and 18 June 1992 concerning technological nuclear safety problems and asking the member States and the Commission to reinforce cooperation through significant joint actions to tackle fundamental safety issues. For their part, the members of WENRA (association created at the initiative of ASN in 1999), which brings together the 17 heads of the regulatory bodies in the "nuclear" countries of the European Union plus Switzerland, have for the past few years being working on a programme to harmonise technical rules in the two areas of nuclear installation safety and the management of spent fuel and radioactive waste.

At a national level, BNI regulations are now covered by the "BNI procedures" decree (2007-1557 of 2 November 2007), implementing article 36 of the TSN Act.

The "BNI procedures" decree abrogated decree 63-1228 of 11 December 1963 concerning nuclear installations and decree 95-540 of 4 May 1995 concerning BNI discharges of liquid and gaseous effluents and water intake. It defines the new framework henceforth applicable to BNI procedures and deals with the entire lifecycle of a BNI: from its authorisation decree to commissioning, to final shutdown and decommissioning. Finally, it explains the relations between the ministers responsible for nuclear safety and ASN in the field of BNI safety.

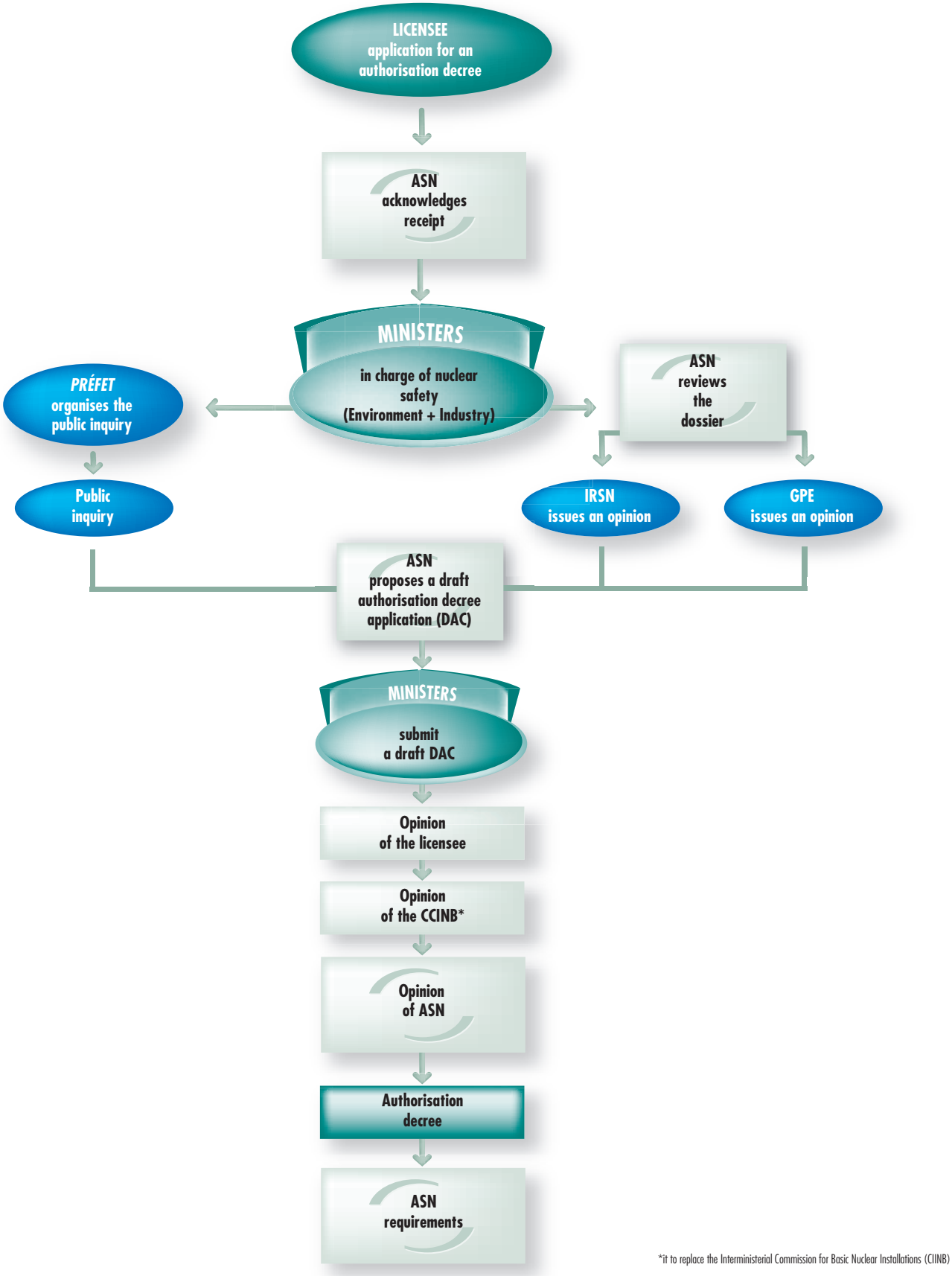
It creates the BNI Consultative Committee (CCINB), a new body for consultation concerning the regulatory texts and the main individual decisions affecting BNIs. It specifies the applicable procedures for adoption of the general regulations and for individual decisions concerning BNIs. It defines the procedures for implementation of the law concerning inspection and the administrative or legal penalties. Finally, it defines the particular conditions for implementation of certain regimes within the perimeter of basic nuclear installations.

2|1 Authorisations and licences

Part IV of the "TSN Act" contains an authorisation decree procedure followed by a series of licences issued throughout the life of a BNI: creation, commissioning, possible modification of the installation, final shutdown and decommissioning.

2|1|1 Siting

Construction of a BNI requires issue of a building permit by the préfet, according to procedures specified in articles R. 421-1 and following of the Town Planning Code.



Basic nuclear installations authorisation decree procedure under the law of 13 June 2006

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

This analysis deals with socio-economic aspects and safety. For its part, ASN analyses the safety-related characteristics of the sites: seismicity, hydrogeology, industrial environment, cold water sources, etc.

Furthermore, pursuant to articles L.121-1 and following of the Environment Code, BNI creation entails the holding of a public debate:
– systematically, in all cases when dealing with a new electricity generating site or a new site not generating electricity and costing more than € 300 million;
– possibly, when dealing with a new site not generating electricity from nuclear power and costing between € 150 million and € 300 million.

Public debates were held in 2006 to discuss the building of an EPR type nuclear reactor at Flamanville and the location of the ITER research reactor in Cadarache.

2 | 1 | 2 Safety options

Anyone intending to operate a BNI may, even before starting the licensing procedure, ask ASN for an opinion on all or part of the safety options of its installation. The applicant is notified of the ASN opinion and will produce any additional studies and justifications as necessary for a possible authorisation decree application.

The safety options will then be presented in the authorisation application file, in the form of a preliminary safety case.

ASN generally asks a competent Advisory Committee of experts (GPE) to review the project. Their report is then sent to the licensee so that it can familiarise itself with the issues which will need to be addressed 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

A BNI authorisation decree application is submitted by the person in charge of operating the installation, who thus acquires the status of licensee, to the ministers responsible for nuclear safety. The application is accompanied by a file comprising several items, including the detailed drawing of the installation, the impact assessment, the preliminary safety case, the risk management study and the decommissioning plan

ASN is responsible for reviewing the file, jointly with the ministers responsible for nuclear safety. This is followed by a period of parallel consultation of the public and technical experts.

The public inquiry

The authorisation decree can only be issued after a public inquiry as provided for in I of article 29 of the TSN Act.

The authorisation decree application and its corresponding file are submitted to a public inquiry by the *préfet*.

The public inquiry is opened at least in each of the *communes** which is situated, at least in part, less than five kilometres from the perimeter proposed by the licensee. The file submitted to the public 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.

A copy of the file submitted to the public inquiry is sent for information to the mayor of each of those *communes* in the area in which the operation is to be carried out, but the town hall of which is not selected for holding the inquiry.

In addition to the *préfecture* concerned, a descriptive file and an inquiry register are made available in all communes completely or partially within a 5 km radius around the planned installation. If this radius encompasses the territory of several *départements*, a joint order of the *préfets* concerned organises the inquiry in each *département*, with the *préfet* of the main site of the operation co-ordinating the procedure.

In accordance with general provisions in this respect, the public inquiry shall proceed for a minimum period of one month and a maximum period of two months, with the possibility of a two week extension in the event of a well-founded decision in this matter on the part of the Inquiry Commissioner.

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

*Smallest administrative subdivision administered by a mayor an a municipal council

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 *préfet*.

In each *département* concerned by the public enquiry, the *préfet* also consults the General Council and the Local Councils in those *communes* where the public enquiry is taking place, as well as the State regional offices he feels to be concerned by the application.

No later than fifteen days following receipt of the report and the conclusions of the enquiry commissioner, the *préfet* forwards them to the Ministers responsible for nuclear safety and to ASN, with his opinion, along with the results of all the consultations carried out.

The creation of a local information committee (CLI)

By giving them a legislative basis, the TSN Act has strengthened the role of the CLIs (see chapter 6 point 3).

A CLI is set up for all sites comprising one or more BNIs.

Its role is a general one of supervision, information and consultation concerning nuclear safety, radiation protection and the impact of nuclear activities on people and the environment. It comprises representatives from the general councils, local councils or joint council assemblies and the regional councils concerned, elected members of Parliament from the region, representatives of environmental protection associations, economic interests and pertinent employee trade unions and the medical professions, as well as qualified personalities. ASN representatives and other State departments concerned, as well as representatives of the licensee, may attend the sessions of the local information committee on a consultative basis.

The CLI may forward to ASN and the ministers responsible for nuclear safety or radiation protection all questions concerning nuclear safety and radiation protection as related to the site.

It can obtain from the licensee, ASN and other State departments all documents and information it may need to perform its duties.

Consultation of technical organisations

The preliminary safety case appended to the authorisation decree application is transmitted to ASN, which submits it for review to one of the Advisory Committees of Experts reporting to it, following a report from IRSN.

Further to its investigation and the results of the consultations, ASN sends the Ministers responsible for nuclear safety a proposal for drafting of a decree either authorising or rejecting creation of the installation.

Authorisation decree

The Ministers responsible for nuclear safety send the licensee a draft decree granting or rejecting authorisation. The licensee has a period of two months in which to present its observations.

After consulting the licensee, the ministers responsible for nuclear safety finalise the draft decree and forward this draft and the file submitted to the public inquiry to the CCINB for its opinion.

The CCINB is required to submit its opinion within two months. The Ministers responsible for nuclear safety ask ASN for its opinion concerning the draft authorisation or rejection decree, possibly as amended to take account of the opinion of the CIINB.

ASN's opinion is deemed to be favourable if not returned within two months.

The authorisation decree for a BNI is issued by the Prime Minister, countersigned by the ministers responsible for nuclear safety.

The authorisation decree sets the perimeter and characteristics of the installation and the particular rules by which the licensee is bound.

The authorisation decree also sets the duration of the licence and the time by which the installation must be commissioned. It also specifies the essential elements required to protect public health and safety and to protect nature and the environment.

The requirements defined by ASN for application of the authorisation decree

For application of the authorisation decree, the ASN uses its technical regulatory powers to define requirements concerning the design, construction and operation of the BNI that it considers to be necessary to protect public health and safety and to protect nature and the environment.

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 materials, installation modifications, final shutdown and decommissioning.

As and when necessary, ASN in particular specifies the requirements concerning BNI water intake and the radioactive materials discharged from the BNI. The specific requirements setting limits on the discharges from the BNI into the environment must be approved by the Ministers responsible for nuclear safety.

Installation modifications

The licensee advises ASN of any modifications to the installation entailing an updating of the general operating rules or the on-site emergency plan.

A new authorisation decree, examined as previously described for the authorisation decree, must be obtained if there is a change in licensee, a modification of the perimeter or a significant change to the installation.

A modification is considered to be significant if:
– there is a change in the nature of the installation or an increase in its maximum capacity;
– there is a change in the key elements regarding protection of the interests mentioned in I of article 28 of the 13 June 2006 Act, mentioned in the authorisation decree;
– a new BNI mentioned in III of article 28 of the above-mentioned law of 13 June 2006 is added within the perimeter of the installation and its operation is linked to that of the installation in question.

The other installations located within a BNI perimeter

Two types of installation exist side by side within a BNI perimeter:
– equipment and installations which are part of a BNI: these are elements of this installation which are 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 the procedure applicable to BNIs;
– classified equipment and installations which are not necessarily linked to the BNI: this equipment and these installations are subject to the legislation applicable to installations classified on environmental protection grounds (ICPE) as specified in part I of Book V of the Environment Code.

The equipment necessary for BNI operation is fully covered by the BNI regime specified in the "BNI procedures" decree. The other equipment subject to another regime (water or ICPE) but located within the perimeter of the BNI remains subject to this regime, but with a change in competent party, as individual measures are no longer taken by the *préfet*, but by ASN.

2|1|4 Operating licences

Commissioning corresponds to first use of radioactive materials in the installation or the first operation of a particle beam.

Prior to commissioning, the licensee sends ASN a file comprising the safety case, the general operating rules, a waste management study, the on-site emergency plan and the decommissioning plan.

After checking that the installation complies with the objectives and rules defined by the TSN Act and its implementing texts, ASN authorises commissioning of the installation.

ASN's authorisation decision is mentioned in its Official Bulletin. ASN notifies the licensee of its decision and communicates it to the ministers responsible for nuclear safety and to the *préfet*. It may also forward it to the local information committee.

Prior to or on completion of the authorisation procedure, partial commissioning may however be authorised by decision of ASN, published in its Official Bulletin, for a limited period and with regard to one of the following categories:
– performance of particular installation operating tests requiring that radioactive materials be brought into it;
– arrival of nuclear fuel within the perimeter of a reactor, prior to first loading of fuel into this reactor.

2|1|5 Final shutdown and decommissioning licences

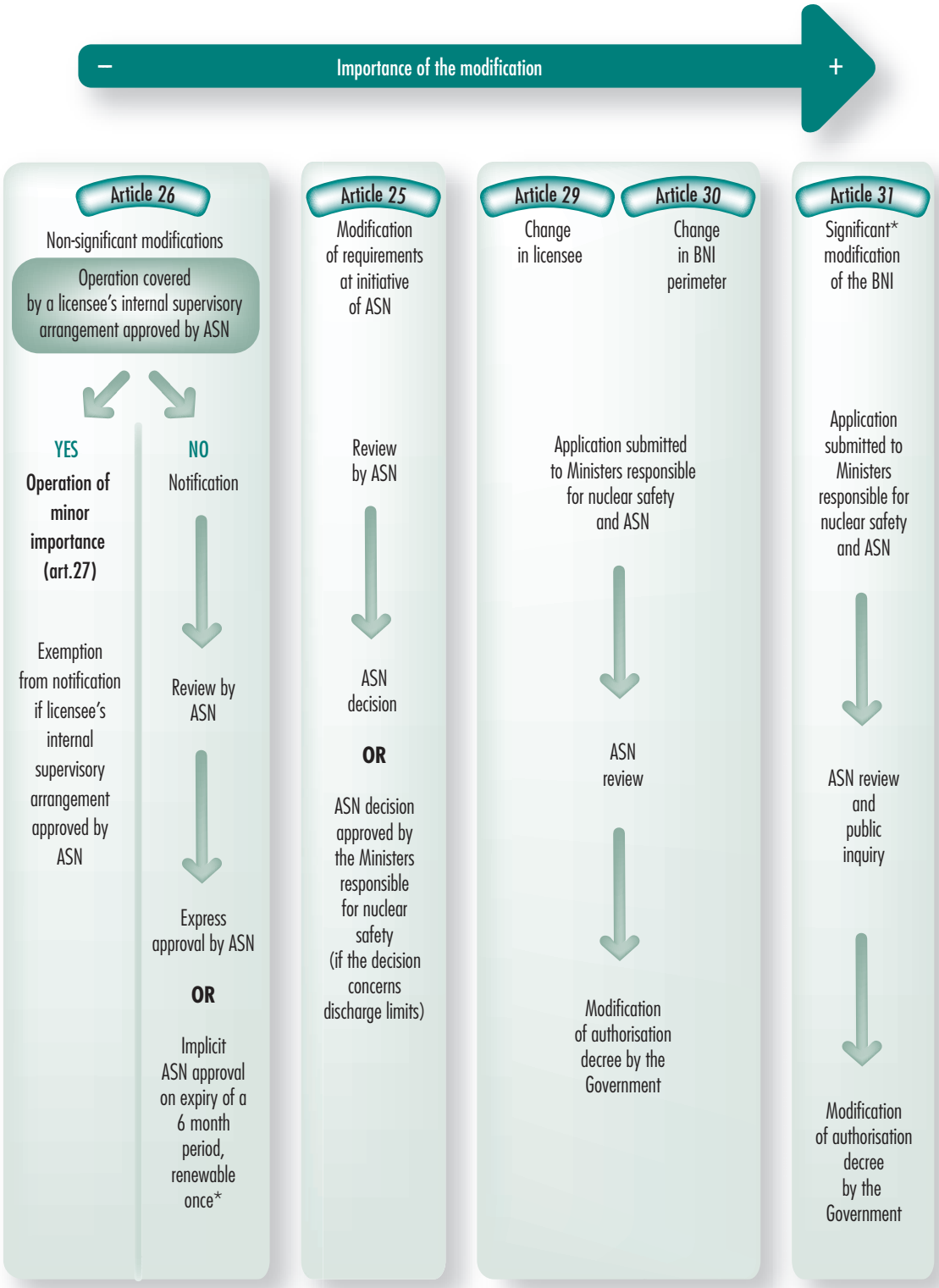
The final shutdown and decommissioning licensing procedure

At least one year before the date scheduled for final shutdown, the licensee submits the authorisation request to the ministers responsible for nuclear safety.

The licensee sends ASN a copy of its application along with the file necessary for its examination.

The final shutdown and decommissioning authorisation application is in the same way subject to the consultations and inquiries applicable to the BNI authorisation decree applications.

Types of BNI modifications covered by the "BNI procedures" decree



* Definition of significant modification of a BNI: a change in its nature or rise in its capacity, a change in the key aspects regarding the protection of public health and safety, nature and the environment, the addition of a new BNI within the perimeter of the initial BNI.
** This time allows ASN to proceed with a new review or issue additional requirements.

Two licensing systems coexist, one for general cases and one for radioactive waste disposal facilities:

General case:
– the licence application contains requirements concerning the shutdown conditions, the decommissioning and fuel management procedures, and the surveillance and subsequent maintenance of the installation site;
– the licence is granted by decree, subject to the opinion of ASN, setting the dismantling characteristics, the time allotted for decommissioning and the types of operations for which the licensee is responsible after decommissioning.

Radioactive waste disposal facilities:
– the licence application contains requirements concerning final shutdown and subsequent maintenance and surveillance of the site;
– the licence is issued by decree, subject to the opinion of ASN, setting the types of operations for which the licensee is responsible after final shutdown.

Performance of final shutdown and decommissioning operations

For installations other than radioactive waste disposal facilities, the final shutdown and decommissioning operations comprise two successive phases of work:
– 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;
– decommissioning work on the nuclear part of the plant. This work can start as soon as the decommissioning 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-out operations can be performed under the provisions of the authorisation decree for the plant considered. To do so, these operations must ensure compliance both with previously imposed requirements and with the safety case and general operating rules currently in force, albeit with minor modifications if necessary. In all other cases, such operations come under the provisions of the final shutdown and decommissioning decree.

Installation delicensing and public protection restrictions

If decommissioning work is taken as far as the final target state, as validated by ASN, the installation can be delicensed and removed from the BNI list in accordance with the procedure specified in its final shutdown and decommissioning licence.

The delicensing application in particular contains a presentation of the site after decommissioning, giving an analysis of the state of the soil and a description of any remaining installation constructions and their state.

In order to keep a trace of the past existence of a BNI on a site and make provision for any limitations on the future use of the installation, public protection restrictions may be implemented after delicensing or disappearance of the installation and concern the use of the soil in and around the installation. These protection restrictions are created in accordance with article 31 of the above-mentioned law of 13 June 2006, further to the opinion of ASN, in the conditions laid down in articles L. 515-8 to L. 515-12 of the Environment Code.

Public protection restrictions concerning the use of the soil and performance of work subject to notification or administrative authorisation may also be implemented, pursuant to article 31 of the law of 13 June 2006, on existing installations, including installations in service.

2 | 2 General technical regulations

The general technical regulations comprise all general texts laying down technical rules for nuclear safety, whether regulatory (orders) as specified in article 30 of the above-mentioned law of 13 June 2006 or related (circulars, basic safety rules, guides).

2 | 2 | 1 Ministerial and government orders

Pressure vessels

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

The applicable regulations are detailed in table 1.

Quality organisation

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

It thus stipulates that the licensee must define quality requirements for each activity concerned, employ the appropriate skills and methods for meeting these quality

Table 1: regulation of pressure vessels

	Nuclear			Conventional
	Main primary system of pressurised water reactors	Main secondary systems of pressurised water reactors	Other equipment	
Construction	• Decree of 2 April 1926 • Order of 26 February 1974(1)	• Decree of 2 April 1926 • RFS II.3.8 of 8 June 1990(1)	• Decree of 2 April 1926 • Decree of 18 January 1943 or • Decree 99-1046 of 13 December 1999	• Decree 99-1046 of 13 December 1999
	or Order of 12 December 2005			
Operation	• Order of 10 November 1999		• Decree of 2 April 1926 • Decree of 18 January 1943(1)	• Decree 99-1046 of 13 December 1999 • Order of 15 March 2000

(1) As of 2011, the order of 12 December 2005 will apply to the construction and operation of nuclear pressure vessels, except for the operational aspects of the main primary and main secondary systems of pressurised water reactors.

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 licensee supervise the service companies used and check compliance with procedures adopted to guarantee quality.

Operating experience feedback from incidents and accidents occurring in BNIs and the findings of the inspections conducted, enable ASN to analyse the various problems in order to assess the implementation of the abovementioned order of 10 August 1984.

A draft revision of the quality order has been produced, aiming to bring it into line with the WENRA reference levels. This order should be replaced by one dealing with BNI safety policy and management. As part of the WENRA reference levels transcription process, five working groups have been drafting texts (order and guides) since the beginning of 2006 in the following areas: safety policy and management (all BNIs); safety approach; pressurised water reactor (PWR) design; PWR operations and emergency situations.

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 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 order of 31 December 1999 stipulating the general technical regulations designed to prevent and mitigate the harmful effects and external hazards resulting from operation of basic nuclear installations;
– ICPE legislation for installations of this type within the BNI perimeter.

The order by the ministers for the Environment and Industry of 31 December 1999, as amended by the abovementioned order of 31 January 2006, 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 effluents. 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. Implementation of this text ensures that environmental protection concerns are taken into account by the licensees at a level comparable with that required for non-nuclear industrial installations.

2 | 2 | 2 Documents produced by ASN

Technical regulatory decisions

Pursuant to article 4 of the TSN Act, ASN issues decisions to supplement the implementation procedures for

the decrees and orders issued concerning nuclear safety or radiation protection, except for those dealing with occupational medicine.

They require approval by the Ministers responsible for nuclear safety when they concern nuclear safety, or by the Ministers responsible for radiation protection when they concern radiation protection.

These ASN decisions, as well as the mandatory opinions it is required to issue concerning draft decrees, are published in its Official Bulletin, available on-line from its website.

Basic safety rules and ASN guides

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

They are not, strictly speaking, regulatory documents. A Licensee 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.

In the light of the overhaul of the general technical regulations described in point 2|2, the RFS will be transformed into guides.

There are currently about forty RFS and other technical rules issued by ASN, which can be consulted on the ASN website (www.asn.fr).

2|2|3 French nuclear industry codes and standards

The nuclear industry produces detailed rules dealing with the state of the art and industrial practices. It groups these rules in "Industrial codes". These rules allow effective 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 licensees 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 Areva NP 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 rather than 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 ASN in 2003. 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.

In the field of nuclear pressure vessels, these requirements changed with the publication of the 12 December 2005 order implementing the 13 December 1999 decree on pressure vessels. The use of a code is now dependent on a demonstration of its conformity with the essential safety requirements defined in these texts. This arrangement thus enables the use of other construction codes to be envisaged.

With regard to the RCC-M code, the AFCEN has undertaken a number of changes aimed at bringing it into line with the previously mentioned requirements. ASN will examine these changes.

The RSE-M code changed in October 2005, in particular to ensure conformity with the 10 November 1999 order concerning supervision of the operation of PWR reactor main primary system and main secondary systems. ASN carried out an overall analysis of these changes. With regard to the most important changes, this analysis concluded that the 2005 version of this code can today be applied. However, this analysis will continue in 2008 in order to reach an exhaustive ruling on all the modifications presented.

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

3 REGULATIONS FOR THE TRANSPORT OF RADIOACTIVE MATERIALS

Unlike the technical safety regulations for installations, which are specific to each State, the International Atomic Energy Agency (IAEA) has laid down an international basis for transport safety and this constitutes the regulations for the transport of radioactive materials, known as TS-R-1.

3|1 International regulations

This basis is used in the drafting of the transport safety regulations in force: the ADR agreement (European agreement on the international transport of dangerous goods by road) for road transport, the regulations concerning international rail transport of dangerous goods (RID) for rail transport, the regulations for the transport of dangerous goods on the Rhine (ADNR) for river transport, the international maritime dangerous goods code (IMDG) for maritime transport and the technical instructions of the ICAO (International Civil Aviation Organisation) for air transport. These transport regulations have been fully transposed into French law and have been implemented by government orders. ASN is for this reason in contact with the administrations responsible for the various modes of transport (General Directorate for the Sea and Transports – DGMT and General Directorate for Civil Aviation – DGAC) and has a representative on the Interministerial Commission for the Transport of Dangerous Goods - CITMD).

Transport safety is based on three main factors:
– first and foremost, on the engineered robustness 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 commensurate with the potential harmfulness of the material transported. For each type of package, the regulations define associated safety requirements and testing criteria (see chapter 11, point 1|1).

ASN aims to intervene as early as possible in the drafting of the regulations, jointly with 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, ASN is a member of the IAEA TRANSSC Committee (Transport Safety Standards Committee) and is represented as an expert in many working groups, organised according to transport mode, in cases where radioactive material transport is at issue. An ASN representative thus took part in the meetings of the TRANSSC group held from 12 to 15 March and from 1 to 5 October 2007 in Vienna. It also takes part in the "Regulatory transport safety group (RTSG)" which brings together the authorities of several countries and in

IAEA TS-R-1 regulations and maritime (IMDG) and air transport (IT ICAO) regulations

ADR and RID regulations

principle meets every two years. The last meeting took place in Vienna in January 2006.

ASN is also a member of the safety of radioactive material transports standing working group of the DG Energy and Transport of the European Commission. In this respect, it took part in the meetings of this group on 12 and 13 June and 11 and 12 December 2007.

3|2 National regulations

The orders applicable to each mode of radioactive material transport are as follows:
– the order of 1 June 2001 as modified concerning the transport of dangerous goods by road (known as the "ADR order");
– the order of 5 June 2001 as modified, concerning the transport of dangerous goods by rail (known as the "RID order");
– the order of 5 December 2002 as modified, concerning the transport 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.

4 OUTLOOK

Radiation protection

The revision of the Public Health Code and the Labour Code now requires the updating of certain orders and the publication of numerous decisions by ASN, by virtue of its regulatory powers.

As a priority, ASN will publish decisions concerning the updating of the licensing and notification systems applicable to small-scale nuclear activities, the methods for calculating the financial guarantees required of the radioactive source suppliers, management of the radon risk in the workplace and definition of the radiotherapy quality control system.

In the field of radiation protection, a number of orders for implementation of the Public Health Code and the Labour Code are currently being drafted and should be released in 2008.

ASN is also actively participating in the work being done to revise the basic radiation protection standards initiated by IAEA and the European Commission, which is preparing a revision of the Euratom directives. These revisions will take account of the recommendations of the International Commission on Radiological Protection (ICRP) published at the end of 2007.

BNI

The 13 June 2006 Act concerning transparency and security in the nuclear field brought about an in-depth overhaul of the regulations concerning BNI safety. Pursuant to this Act, a number of decrees were adopted to determine the new regime applicable to BNIs. These decrees abrogated the decree of 11 December 1963 concerning nuclear installations and the decree of 4 May 1995 concerning BNI liquid and gaseous effluents discharges and water intake.

An order from the Ministers responsible for nuclear safety and a regulatory decision from ASN should be published in 2008 in order to complete the overhaul of the BNI procedures.

The implementation of this new framework, plus the process of European harmonisation, will lead to a major revision and development of the general technical regulations applicable to BNIs. Work is proceeding on several government orders and regulatory decisions along these lines and drafting will continue during the course of 2008.

With regard to individual decisions, if the main authorisations concerning the life of a BNI (creation, final shutdown and decommissioning) remain within the remit of the Government, it is up to ASN to authorise BNI commissioning and define the requirements regarding its design, construction and operation pursuant to the decrees. It is in this respect that ASN defines the requirements concerning water intake into and liquid and gaseous discharge of materials from the installation, whether or not radioactive.

Transports

As part of the transposition of directive 96/29/Euratom, transport companies carrying radioactive materials on the national territory should, as of 2008, be bound by a system of notification to or licensing by ASN. A decision by ASN, approved by the ministers responsible for nuclear safety and transports, will specify the characteristics of the radioactive materials requiring either notification or licensing, the composition of the licensing application file and the items to be enclosed with the notification, the review procedures and the conditions for renewal, revocation or suspension.

At the end of 2007, ASN was asked for an opinion by the General Directorate for Sea and Transport (Ministry for Transport), on the basis of article 62 of the "BNI Procedures" decree, with regard to the draft orders amending the orders concerning the transport of dangerous goods by road, by rail, by inland waterway, in sea ports and concerning the safety of ships. In the field of transport of nuclear materials, ASN should thus see its role as regulatory authority strengthened. In the case of incidents or accidents, events concerning the transport of class 7 dangerous goods, that is radioactive materials, must be declared to ASN. This declaration must reach ASN within two working days of detection of the event and will constitute the accident declaration.

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 risks 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.

L'unité de dose absorbée est le 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 doses must be used which take account of these exposure parameters. Weighting factors are thus applied to the “absorbed dose” when one wishes to define the “equivalent dose” which takes account of the nature of the radiation and the “effective dose” which concerns the whole body.

Equivalent dose, committed equivalent dose and sievert

Equivalent dose (H_T): dose absorbed by the tissue or organ T, weighted according to the type and energy of the radiation R. It is given by the following formula:

$$H_{T,R} = w_R \, D_{T,R}$$

where:
$D_{T,R}$ is the mean for the organ or tissue T of the absorbed dose of radiation R;
w_R is the weighting factor for the radiation R.

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

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

The equivalent dose unit is the sievert (Sv).

The ICRP 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 de 2 MeV à 20 MeV	10
Neutrons of more than 20 MeV	5
Protons of more than MeV	5
Alpha particles	20

Committed equivalent dose [$H_T(\boldsymbol{\tau})$]: integral over time ($\boldsymbol{\tau}$) 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

$$H_T(\boldsymbol{\tau}) = \int_{to}^{to+\boldsymbol{\tau}} H_T\,(t)\,dt$$

where:

$H_T\,(t)$ is the equivalent dose rate in the organ or tissue T at time t;
$\boldsymbol{\tau}$ the period over which intake is carried out.

In $H_T(\boldsymbol{\tau})$, $\boldsymbol{\tau}$ is given in years. If the value of $\boldsymbol{\tau}$ 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 formla:

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

where:

$D_{T,R}$ is the mean for the organ or tissue T of the absorbed dose of radiation R;
w_R is the weighting factor for the radiation R;
w_T is the weighting factor for the tissue or organ T.

The effective dose unit is the sievert (Sv).

Committed effective dose [$E(\tau)$] : sum of the equivalent doses in the various tissues or organs [$H_T(\tau)$] following integration, each multiplied by the appropriate weighting factor w_T. It is given by the formula:

$$E(\tau) = \sum_{T} w_T H_T(\tau)$$

In $E(\tau)$, τ is the number of years of integration

The committed effective dose unit is the sievert (Sv).

The choice made in 1990 by the International Commission on Radiological Protection (ICRP) is to express doses by the effective dose, which is the result of an equivalence calculated in terms of a 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
Oesophagus	0.05
Thyroid	0.05
Liver	0.05
Skin	0.01
Bone surface	0.01
Others[1]	0.05

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

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

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

The means of calculating the effective dose also has the drawback of having varied with time, in line with the changes made by the ICRP to the 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 up to the age of 70 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 individuals 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:

$$S = \sum H_i P_i$$

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

The collective dose unit is the man.sievert.

Commentary – For the ICRP, the advantage of the collective dose is that it can allow optimisation of collective exposure to a level that is as low as possible. 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 overvalued. 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
REGULATION 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 general public Art. R.1333-8 of the CSP (Public Health Code)	• Effective doses for the body • Equivalent doses for the lens of the eye • Equivalent doses for the skin (average dose over any area of 1 cm^2 of skin, regardless of the area exposed)	1 mSv/year 15 mSv/year 50 mSv/year	☞ These limits comprise the sum of effective or equivalent doses received as a result of nuclear activities. These are limits that must not be exceeded.
Worker limits for 12 consecutive months Art. R.231-77 of the CT (Labour Code)	Adults: • Effective doses for the body • Equivalent doses for the hands, forearms, feet and ankles • Equivalent doses for the skin (average dose over any area of 1 cm^2 of skin, regardless of the area exposed) • Equivalent doses for the lens of the eye Pregnant women (exposure of the child to be born) Young people from 16 to 18 years old*: • Effective doses for the body • Equivalent doses for the hands, forearms, feet and ankles • Equivalent doses for the skin • Equivalent doses for the lens of the eye	20 mSv 500 mSv 500 mSv 150 mSv 1 mSv 6 mSv 150 mSv 150 mSv 50 mSv	☞ These limits comprise the sum of effective or equivalent doses received. 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 ceiling limit which is no more than twice the annual exposure limit value; • emergency occupational exposure is possible in an emergency situation, in particular to save human life.

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

Optimisation levels for patient protection (Public Health Code)

	Definition	Values	Observation
Diagnostic examinations Diagnostic reference levels Article 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	☞ 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. The diagnostic reference levels, the dose constraints and the dose target levels are used by applying the principle of optimisation. They are simply guidelines. ☞ 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 forensic 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 trigger 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 *préfet* 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
Lasting exposure (contaminated sites) Art. R.1333-89 of the CSP IRSN Guide 2000	Selection level: individual dose above which the need for rehabilitation must be examined	Not defined	☞ The notion of selection level is introduced by the IRSN guide for management of industrial sites potentially contaminated by radioactive materials.
Exposure to radon			
Protection of the general public Art. R.1333-15 and R.1333-16 of the CSP, order of 22 July 2004	Premises open to the public	400 Bq/m^3 1000 Bq/m^3	☞ See recommendation published in Official Gazette of 11 August 2004 defining the radon measurement methods.
Worker protection Article R.231-115 of the CT	Working environments	400 Bq/m^3	☞ See recommendation published in Official Gazette of 22 February 2005 defining corrective action to be taken in the event of an overdose.
Enhanced natural exposure (other than radon)			
Protection of the general public Art. R.1333-13 and R.1333-14 of the CSP **Worker protection** Article R.231-114 of the CT	Effective dose	None 1 mSv/year	☞ Any population protection action to be taken will be defined on a case by case basis.
Water intended for human consumption Decree 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*…	Saleability limits		See following table.

Consumption restrictions on contaminated foodstuffs

In the event of an accident or any other radiological emergency, the restrictions on the consumption or sale of foodstuffs are determined in Europe by two regulations: Council Regulations 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 feedingstuffs 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 feedingstuffs).

A list of foodstuffs said to be of "lesser importance" has been drawn up (foodstuffs which are not consumed in quantities exceeding 10 kg/year). For these items; thyme, garlic, cocoa paste, truffles, caviar, etc., levels ten times higher are set.

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

MAXIMUM ALLOWABLE LEVELS FOR FOODSTUFFS (Bq/kg or Bq/L)	**Baby food**	**Dairy**	**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 radioactive contamination levels of feedingstuffs (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 in Bq/kg

FOODSTUFFS INTENDED FOR GENERAL CONSUMPTION	
Plutonium 238, plutonium 239, plutonium 240, americium 241	10
Strontium 90, ruthenium 106, iodine 129, iodine 131, uranium 235	100
Sulphur 35, cobalt 60, strontium 89, ruthenium 103, caesium 134, caesium 137, cerium 144, iridum 192	1.000
Tritium, carbon 14, technetium 99	10.000
BABY FOODS	
Plutonium 238, plutonium 239, plutonium 240, americium 241	1
Strontium 90, ruthenium 106, iodine 129, iodine 131, uranium 235	100
Sulphur 35, cobalt 60, strontium 89, ruthenium 103, caesium 134, caesium 137, cerium 144, iridium 192	1.000
Tritium, carbon 14, technetium 99	1.000

CHAPTER 4

1 CHECKING THAT THE LICENSEE ASSUMES ITS RESPONSIBILITIES

1 | 1 Checking compliance with the requirements of the regulations: a fundamental role

1 | 2 The principles underpinning the regulatory role

1 | 3 Regulating nuclear activities: a vast area
1 | 3 | 1 Regulating nuclear safety in BNIs and nuclear material transport
1 | 3 | 2 Regulating working conditions in nuclear power plants
1 | 3 | 3 Regulating activities involving a risk of exposure to ionising radiation (referred to as small-scale nuclear activities)

2 REGULATION THAT IS PROPORTIONATE TO THE ISSUES INVOLVED IN THE ACTIVITIES

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2 | 1 | 1 Operations subject to reinforced internal supervision by the licensee
2 | 1 | 2 Internal supervision of radiation protection by the users of ionising radiation

2 | 2 Increasing ASN resources by approving organisations and laboratories

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3 DEPLOYING THE MOST EFFICIENT INSPECTION MEANS

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3 | 1 | 1 BNI appraisals
3 | 1 | 2 Ensuring vigilance during particularly significant interventions: nucleaar power plant scheduled outages
3 | 1 | 3 Review of the procedures laid down by the Public Health Code

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4 IDENTIFYING AND PENALISING INFRINGEMENTS
4|1 Ensuring that licensee penalty decisions are proportionate, fair and consistent
4|2 Tailoring the response to the stakes: a proportionate approach
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5 OUTLOOK

1 CHECKING THAT THE LICENSEE ASSUMES ITS RESPONSIBILITIES

1 | 1 Checking compliance with the requirements of the regulations: a fundamental role

Regulation of nuclear activities by the Nuclear Safety Authority (ASN) is a fundamental role, the aim of which is to check that the individual in charge of a nuclear activity fully assumes his responsibility and complies with the requirements of the radiation protection and nuclear safety regulations, to ensure that workers, patients, the public and the environment are protected from nuclear-related risks. This helps ASN reach an opinion on the performance or issues associated with a licensee or a nuclear activity.

1 | 2 The principles underpinning the regulatory role

ASN aims to ensure that the principle of responsibility of the licensee for safety and radiation protection is respected.

It includes the concept of proportionality when determining its actions, so that the scope and extent of the inspection is commensurate with the health and environmental safety issues.

Regulation by ASN is part of a multi-level approach and is carried out with the support of the Institute for Radiation Protection and Nuclear Safety (IRSN):

– before the licensee performs an activity requiring licensing, through a review and analysis of files, documents and information provided by the licensee to back up its actions. This check aims to ensure that the information supplied is pertinent and complete with respect to the interests protected by law;
– subsequently, through visits and inspections on all or part of an installation or activity. This regulation uses the principle of spot checks and analysis of the justifications provided by the licensee concerning the performance of its activities and the analysis of any events and incidents it has observed.

To consolidate the effectiveness and quality of its actions, ASN is adopting an approach involving continuous improvement of its regulatory practices. It analyses operating feedback from more than thirty years of nuclear safety inspections, from observation of practices in the small-scale nuclear sector for five years, and from observation of the inspection methods used by the main foreign regulatory authorities.

1 | 3 Regulating nuclear activities: a vast area

Under Article 4 of Act 2006-686 of 13 June 2006 on Transparency and Security in the Nuclear Field, known as the "TSN" Act, ASN is responsible for checking compliance with the general rules and special requirements for nuclear safety and radiation protection applicable to:

– licensees of basic nuclear installations (BNIs);
– those in charge of the construction and operation of pressure vessels in BNIs;
– those in charge of radioactive material transport;
– those in charge of activities entailing a risk of exposure of individuals and workers to ionising radiation;
– those in charge of implementing ionising radiation exposure surveillance measures;
– the organisations and laboratories it approves for participation in the checks and the nuclear safety and radiation protection watching brief referred to as "licensees" in this chapter.

Although historically based on verifying the technical conformity of installations and activities with regulations or standards, regulation today also covers human and organisational factors. It takes account of individual and collective behaviour and attitudes, management, organisation and procedures, relying on a variety of sources: significant events, inspections, relations with the stakeholders (personnel, licensees, contractors, trade unions, occupational physicians, inspection services, approved organisations, and so on).

1 | 3 | 1 Regulating nuclear safety in BNIs and nuclear material transport

In its Safety Fundamentals for nuclear installations (Safety Series 110) the International Atomic Energy Agency (IAEA) laid out the following principles:

– responsibility for safety must lie with the licensee organisation;
– the regulatory body must be effectively independent of the organisation in charge of promoting or using nuclear energy. It must have responsibility for licensing, inspection, and formal notices, and must have the authority, expertise and resources necessary for performance of the responsibilities entrusted to it. No other responsibility shall compromise or conflict with its responsibility for safety.

In France, the provisions of the TSN Act mean that ASN is the regulatory authority meeting these criteria.

a) Regulating nuclear safety

Nuclear safety covers all technical and organisational measures taken at all stages in the life of nuclear installations (design, creation, commissioning, operation, final shutdown, decommissioning) to guarantee normal operation, prevent or mitigate the effects of accidents in order to protect the 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.

BNI safety is guaranteed by a series of strong, leaktight barriers, for which the safety case must demonstrate validity in normal and accident conditions. There are generally 3 or 4 of them. For reactors, they are the cladding, the primary system envelope, the primary containment and, as applicable, the secondary containment.

The safety of radioactive material transport (TMR) is guaranteed by three main factors:
– first and foremost, the engineered robustness of the packages;
– transport reliability and certain specially equipped vehicles;
– an effective emergency response in the event of an accident.

In its regulatory duties, ASN is required to look at the equipment and hardware in the installations, the individuals in charge of operating it, the working methods and the organisation, from the start of the design process up to decommissioning. It reviews the steps taken concerning safety or the monitoring and limitation of the doses received by the individuals working in the installations, and the waste management, effluent discharge control and environmental protection procedures.

b) Regulating pressure vessels

Numerous systems in nuclear installations contain or carry pressurised fluids. They are therefore subject to the pressure vessel regulations (see chapter 3, point 2|2|1).

The TSN Act states that ASN is in charge of checking compliance with the general rules and special requirements concerning nuclear safety and radiation protection applicable to the construction and utilisation of BNI pressure vessels. Responsibility for supervising application of the regulations lies with ASN for nuclear pressure

Signature of the agreement between ASN and DARQSI on 28 November 2007

1. Transport 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. Radioactive substances include radioactive materials and radioactive waste.

vessels containing radioactive materials inside BNIs, and the Directorate for Regional Action, Quality and Industrial Safety (DARQSI) at the Ministry for Ecology and Sustainable Development and Spatial Planning, for other pressure vessels. However, so that the BNI licensees only have to deal with a single point of contact, ASN in practice checks compliance with the regulations for all BNI pressure vessels. This arrangement was the subject of an agreement between ASN and DARQSI signed on 28 November 2007.

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

ASN regulation of these systems is consequently very specific. It is based:
– for the design and construction part, on the order of 12 December 2005 concerning nuclear pressure vessels;
– for the operational part, on the order of 10 November 1999 concerning surveillance of the operation of the main primary system and main secondary systems of pressurised water reactors (PWR).

Pressure vessel operation is regulated. This regulation 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 files currently being dealt with are discussed below in chapter 12.

ASN inspector checking a package for contamination

1 | 3 | 2 Regulating working conditions in nuclear power plants

In nuclear power plants, the regulation of nuclear safety, radiation protection and the conventional safety inspection aspects sometimes covers common topics, such as worksite organisation or the conditions in which subcontractors are called in. The legislator therefore gave labour inspector powers to engineers and technicians specially designated to this role by ASN from among the personnel under its authority (Article L. 611-4-1 of the Labour Code).

There is nothing new in having the conventional safety inspection duties in nuclear power plants carried out by a technical inspectorate separate from the ordinary labour inspectorate. This role previously lay with the officers designated by the DRIREs, who could also intervene in facilities or works which were regulated by the Ministry responsible for energy, such as dams or electricity transmission lines. Only the officers designated by ASN can now carry out these duties.

The officers responsible for conventional safety inspection in nuclear power plants were designated by a decision of the ASN Chairman on 19 January 2007. This list is regularly updated.

On top of the "traditional" issues aimed at improving health and safety at work and improving the conditions of work by contractors, there are now a number of new topics, such as the growth in dismantling operations or the need for greater understanding of organisational and human factors in risk management.

Owing to this change, the ASN Chairman wished to initiate a review of the "principles of a long-term organisation which should clarify the methods for controlling and supporting a network of officers responsible for inspection, the qualification criteria of these officers, how their skills are acquired and sustained, the relations to be maintained with the other safety stakeholders and an evaluation of the human resources required to carry out these duties".

The review conducted in 2007 identified six key issues linked to the conventional safety inspection role in nuclear power plants:
– exercise closer regulation of contractor working conditions and of EDF's surveillance of the activities subcontracted;
– deal with the growing problems of dismantling/construction;
– take full account of organisational and human factors;
– encourage EDF to include the goal of security in addition to safety and radiation protection;

– ensure effective and uniform application nationwide of the Labour Code and collective agreements;
– ensure the credibility of ASN's expanded conventional safety inspection role.

These issues justify setting up a more robust labour inspectorate organisation. This organisation will need to clarify:
– the status of the ASN officers tasked with conventional safety inspection duties and their scope of intervention, in particular with regard to Convention 81 of the International Labour Organisation. According to this convention, "conventional safety inspection shall be placed under the supervision and control of a central authority. The inspection staff shall be composed of public officials whose status and conditions of service are such that they are assured of stability of employment and are independent of changes of government and of improper external influences";
– the role and duties of the officers in charge of conventional safety inspection in the nuclear power plants;
– relations with the State's other departments concerned, including:
  • the central labour body (General Directorate for Labour) and the Regional/departmental Directorates for labour, employment and professional training (DR/DDTEFP) for definition of particularly significant subjects, scientific, technical and methodological support, the specific powers of action and coordination of the various departments, network-based operations with regard to contractors, and so on;
  • the regional health insurance funds (CRAM) for technical appraisal, recommendations, inquiries into health and safety conditions, etc.;
  • the professional organisation for prevention in the building and public works sectors (OPPBTP) to promote the prevention of work accidents and occupational diseases, as well as to improve working conditions of building and public works contractors, in particular for dismantling and construction activities;
  • the Directorate for Energy Demand and Energy Markets (DIDEME) for statutory and social issues concerning companies and organisations involved in providing the public gas and electricity service.

Finally, in the other BNIs for which ASN does not exercise the conventional safety inspection role, exchanges with the ordinary labour inspectors constitute a valuable source of information about the state of labour relations, as part of a more general view of nuclear safety and radiation protection that takes greater account of the importance of human and organisational factors.

Table 1: methods of ASN regulation of the various radiation protection players

	Review/authorisation	Inspection	Openness and cooperation
Users of ionising radiation	Files produced in accordance with the procedures laid down in the Public Health Code (Articles R. 1333-1 to R. 1333-54). Review of the file and visit prior to commissioning. Leads to registration of the declaration or to issue of an authorisation.	Radiation protection inspection (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. 1333-95 of the Public Health Code	Approval application file in accordance with the provisions of Article R. 1333-95 of the Public Health Code. Review of the file and audit of the organisation. Leads to issuance of approval (23 approvals issued in 2007, 52 organisations approved as at 31.12.2007).	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.

The international basic safety standards

They include:

"– the examination of requests for authorisation to carry out practices entailing or potentially entailing exposure;

– authorisation 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 regulation, 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).

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.

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 organisation and the individuals or bodies subject to regulation must take due account of general experience and the most recent innovations in the fields of radiological protection and source safety."

1 | 3 | 3 Regulating activities involving a risk of exposure to ionising radiation (referred to as small-scale nuclear activities)

The international fundamental 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 next page).

In France, ASN performs the role of regulatory authority, through its duty of drafting and monitoring technical regulations in the field of radiation protection. Article 4 of the TSN Act indicates that ASN checks compliance with the general rules and special requirements in the field of radiation protection applicable to the activities mentioned in Article L. 1333-1 of the Public Health Code and the individuals mentioned in Article L. 1333-10 of the same code. The authority organises a permanent radiation protection watch nationwide. From among its staff, it designates the radiation protection inspectors. It issues the required approval to the organisations taking part in radiation protection inspections and regulation.

The scope of ASN radiation protection regulation covers the use of ionising radiation in all activities. This duty is carried out jointly with other inspection organisations such as the labour inspectorate, the inspectorate for classified installations and the AFSSAPS inspectorate.

As required by the IAEA basic safety standard (see box), ASN regulation takes the form of review of files, pre-commissioning visits, inspections and finally discussions with professional organisations (trade unions, professional 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 are summarised in table 1.

2 REGULATION THAT IS PROPORTIONATE TO THE ISSUES INVOLVED IN THE ACTIVITIES

The licensee remains the key player in the regulation of its activities. ASN organises its regulatory work in a way that is proportionate to the stakes involved in the activities. It delegates certain inspections to organisations which are able to present the necessary guarantees, as validated by the approval issued by ASN.

2|1 Deploying the principle of licensee responsibility

The licensee is responsible for the activities it performs. The regulation carried out by ASN in no way relieves it of the duty to supervise and check its own activities.

2|1|1 Operations subject to reinforced internal supervision by the licensee

With regard to certain operations that are sensitive from the nuclear safety and radiation protection viewpoints, ASN wanted the licensees to apply a system of reinforced and systematic internal checks, called the "internal authorisations system", offering sufficient guarantees of quality, independence and transparency. This system could be applied to sensitive operations but without compromising the safety cases adopted for BNI operation or decommissioning. The decision on whether or not to carry out the operations concerned must be formally authorised by the qualified members of the licensee's staff.

The "internal authorisations" system implemented at EDF and CEA in recent years now falls within the scope of Article 27 of decree 2007-1557 of 2 November 2007 concerning basic nuclear installations and the supervision of the nuclear safety aspects of radioactive material transport. Before becoming effective, this system must be approved by an ASN decision defining the nature of the operations liable to be subject to "internal authorisation", the process used for approval of the operations, in particular with systematic, prior notification of all operations to a body independent of the individuals directly in charge of operation, identification of the individuals qualified to issue the internal authorisations, as well as the procedures for periodically informing ASN of the operations envisaged.

ASN checks correct application of the "internal authorisations system" by various means: inspections, review of the periodic reports forwarded by the licensees, cross-checking of the dossiers, etc. It can at all times either terminate or temporarily suspend an "internal authorisations system" if it considers it to be unsatisfactorily implemented, in which case the corresponding operations must be referred to ASN for prior authorisation.

2|1|2 Internal supervision of radiation protection by the users of ionising radiation

The aim of internal radiation protection supervision is to ensure regular assessment of the radiological safety of the installations using sources of ionising radiation. This supervision is performed under the responsibility of the licensees. It can be carried out by the person with competence for radiation protection (PCR) designated and mandated by the head of the facility by IRSN, or by inspection organisations approved by ASN. It does not take the place of direct regulation by ASN. It for example concerns the performance of the protection systems, monitoring of the ambient atmosphere in regulated zones, checks on medical appliances before they enter service or after modification, and so on.

2|2 Increasing ASN resources by approving organisations and laboratories

Paragraph 2 of Article 4 of the TSN Act states that ASN issues the required approvals to the organisations taking part in the supervision and surveillance of nuclear safety or radiation protection. Depending on the health or safety stakes involved in a nuclear activity or installation category, ASN may call on the services of approved organisations for all or part of its supervision work. The purpose of these approvals is to be able to perform surveillance on a larger number of entities than would be possible through the ASN staffing resources alone.

ASN in particular approves organisations for carrying out technical inspections required by the regulations in the fields within its scope of competence. The organisations approved in this way thus carry out:
– radiation protection checks;
– measurement of radon activity concentration in premises open to the public;
– evaluations of nuclear pressure vessel conformity and inspection of operational equipment.

The checks carried out by these organisations contribute to ASN's overview of all nuclear activities.

Before approving applicant organisations, ASN verifies that they have a sufficient volume of business and carry out the checks in accordance with their technical,

organisational and ethical obligations and in accordance with the rules of professional good practice. Compliance with these provisions should enable the required level of quality to be obtained and maintained.

ASN ensures that maximum benefit is gained from the approval issued, in particular through regular exchanges with the organisations it has approved and the mandatory transmission of an annual report, in order to:
– exploit operating feedback;
– improve the approval process;
– improve intervention conditions.

In 2007, the ASN Commission issued:
– 23 decisions approving or renewing approval of organisations responsible for radiation protection inspections (2007-DC-0024 to 0027, 0031 to 0035, 0037, 0038, 0041 to 0049, 0055 and 0056, 0071);
– 1 decision rejecting renewal of approval for an organisation responsible for radiation protection inspections (2007-DC-0057);
– 5 decisions approving an organisation for inspection of nuclear pressure vessels in service and subject to the decrees of 2 April 1926 and 18 January 1943 (2007-DC-0058 to 0060, 0082, 0083);
– 7 decisions accepting notified and qualified organisations (2007-DC-0053 and 0081), designated user inspection departments (2007-DC-0052), designated user inspection bodies (2007-DC-0030), one recognised and qualified third-party entity (2007-DC-0029) and notified and qualified organisations (2007-DC-0028 and 0084);
– 1 decision rejecting approval of an organisation for inspection of nuclear pressure vessels in service and subject to the decrees of 2 April 1926 and 18 January 1943 (2007-DC-0061);
– 2 decisions rejecting acceptance of a notified and qualified organisation (2007-DC-0054 and 0085);
– 1 decision delegating powers to the Chairman for taking decisions concerning approval of organisations qualified to carry out measurements of radon activity concentrations in premises open to the public (2007-DC-0062).

An updated list of approvals issued by ASN is available on its website.

ASN also approves laboratories to conduct analyses requiring a high level of measurement quality if the results are to be of any use. It thus approves laboratories:
– for monitoring radioactivity in the environment;
– for worker dosimetry;
– for metrology of radioactivity measuring instruments.

Laboratories measuring radioactivity in the environment (see chapter 5) were approved by ASN decisions 2007-DC-0023 and 2007-DC-0064 of 29 January and 10 July 2007.

Approval decision presented to the ASN Commission

2 | 3 Defining the stakes

AIn order to take account of health and environmental issues, the performance of the licensees in terms of nuclear safety and radiation protection, as well as the number of activities it is responsible for regulating, ASN periodically identifies those activities and topics of particular significance and exercises direct regulation of them.

In order to identify these activities and topics, ASN relies on current scientific and technical knowledge and uses the information collected by both itself and IRSN: results of inspections, frequency and nature of incidents, major modifications made to installations, review of dossiers, feedback of data concerning the dose received by workers, information resulting from checks by approved organisations. It can revise its priorities in the light of significant events occurring in France or around the world, as was the case in 2007 with the succession of radiotherapy incidents and accidents. These events led ASN to carry out inspections in the 180 radiotherapy centres in France during the course of the year.

In 2007, the particularly significant aspects were as follows (see table 2).

Table 2: significant activities in 2007

Field	Significant aspects
Basic nuclear installations including: – Nuclear power plants – Research reactors – Laboratories and plants – Installations undergoing decommissioning	– Reactor outage – Organisational and human factors – Operation of the installation – Condition of barriers – Condition of systems – Prevention and management of hazards, emergency situations – Radiation protection – Environment and transport
Small-scale nuclear activities	– External radiotherapy – Industrial radiography activities – Interventional medical radiology – Brachytherapy – Suppliers of ionising radiation sources – Nuclear medicine units performing therapeutic and/or in vivo diagnostic procedures – Holders of unsealed source licences – Industrial or research irradiation installations or particle accelerators – Implementation of high activity sealed sources – Interventional radiology – Tomography installations – Sites and soils polluted by radioactive materials
Radioactive material transport	– Compliance with quality assurance requirements for radioactive material transport – Safety adviser duties

3 DEPLOYING THE MOST EFFICIENT INSPECTION MEANS

The operator is required to provide ASN with all data it needs to carry out its inspection functions. The volume and quality of this data should enable the technical demonstrations presented by the licensee to be analysed and the inspections to be targeted. It should also allow identification and monitoring of the key events marking the operation of a nuclear activity. The actions specific to inspection of radioactive material transport are described in detail in chapter 11.

3|1 Assessing the supporting documents submitted by the licensee

Reviewing the supporting documents produced by the licensees and the technical meetings organised with them are one of the forms of inspection carried out by ASN.

Review of this data may lead ASN to accept or on the contrary reject the licensee's proposals, to ask for additional information or studies or to ask for work to bring the relevant items into conformity. ASN's requirements are expressed in the form of a decision.

The purpose of the documents supplied by the licensee is to demonstrate compliance with the objectives set by the general regulations, as well as those that it has set for itself. ASN is required to check the completeness of the data and the quality of the demonstration.

Whenever it deems necessary, ASN seeks the advice of technical support organisations, primarily IRSN. The safety review implies cooperation by numerous specialists, as well as efficient coordination, in order to identify the essential points relating to safety, radiation protection and protection of the environment.

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 licensee teams responsible for designing and operating the plants.

For major issues, ASN requests the opinion of the competent Advisory Committee of Experts, to which IRSN presents its analyses. For other matters, safety analyses give rise to IRSN opinions transmitted directly to ASN. ASN procedures for requesting the opinion of a technical support organisation and, where required, of an Advisory Committee, are described in chapter 2.

3|1|1 BNI appraisals

At the design and construction stage, ASN checks the safety cases 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. 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 checks the packages intended for the transport of radioactive materials.

Once the nuclear installation has entered service, after being authorised by ASN, all modifications made by the licensee and liable to affect public health and safety or the protection of nature and the environment, are submitted to ASN. In addition to these submissions, made necessary by changes to the installations or how they operate, the licensee must, pursuant to the TSN Act, carry out periodic safety reviews in order to update the evaluation of the installation in the light of changing techniques and regulations and on the basis of operating feedback. The conclusions of these reviews are submitted to ASN, which can issue new provisions in order to strengthen the safety requirements.

Other data submitted by BNI licensees

The licensee 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, and so on.

All these documents are closely examined by ASN.

3|1|2 Ensuring vigilance during particularly significant interventions: nuclear power plant scheduled outages

The nuclear power plants operated in France are periodically shut down in order to:
– replace the spent fuel;
– carry out checks and maintenance on the parts of the installation which are not accessible during operation.

These shutdowns are referred to as "reactor outages". ASN decided that it would approve the outage schedule

forwarded by EDF and rule on whether the installations could be restarted.

From preparation of the outage to implementation of the post-outage steps, ASN oversees the safety measures adopted by the licensee.

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

As part of its policy of transparency, ASN places the reactor outage information notices on-line on its website. 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 information notices are published once ASN has authorised the licensee to restart the reactor concerned.

3 | 1 | 3 Review of the procedures laid down by the Public Health Code

It is up to ASN to review applications for the use of ionising radiation for medicine, dentistry, human biology and biomedical research, as well as for any other nuclear activity. 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 checks carried out under the responsibility of the establishments themselves, ASN conducts its own checks. In this respect it directly carries out checks during the procedures for issue (pre-commissioning inspections) or renewal (periodic inspections) of the authorisations to possess and use radiation sources granted on the basis of Article R. 1333-23 of the Public Health Code. The authorisation notifications can only be issued if the requests submitted by ASN following the checks 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 ASN to ask the establishments to improve their in-house provisions for source management and radiation protection.

3 | 2 Inspection of installations and activities

3 | 2 | 1 Inspection objectives and principles

The inspection carried out by ASN is based on the following principles:

1. the purpose of the inspection is to check that the licensee assumes its responsibilities in full. It aims to detect any drift indicative of a possible deterioration in installation safety or the protection of individuals and any non-compliance with the legislative and regulatory requirements the licensee is bound to apply;

2. the inspection is proportionate to the level of risk presented by the installation or activity;

3. the inspection is neither systematic nor exhaustive, is based on spot-checks and focuses on subjects of particular significance.

3 | 2 | 2 Inspection resources

To ensure greater efficiency, ASN's action is organised on the following basis:

– inspections, according to a predetermined frequency, of the nuclear activities and topics of particular health and environmental significance;
– inspections on a representative sample of licensees in other nuclear activities;
– systematic technical inspections of all installations by approved organisations.

ASN focuses its inspection resources on particularly significant activities and topics. For the other activities, ASN relies in particular on the organisations it has approved. However, to avoid ignoring activities of lesser significance, it does devote a part of its inspection programme to them (targeted action). In 2007, medical radiology, companies detecting lead in paint and lighting conductor collection contractors were inspected. This type of action maintains an ASN presence among those in charge, evaluates application of the regulations in a particular sector and helps raise awareness within the profession. A summary of these inspections is sent out to the professional trade union organisation concerned.

ASN inspectors accompanied by a presentative of the Gravelines CLI during an inspection of the power plant – October 2007

In order to achieve the goals it set for itself:

a) ASN employs inspectors chosen for their professional experience and for their legal and technical expertise.

The inspectors carry out their inspection duties under the authority of the ASN Director General. They are sworn-in and bound by professional secrecy. They are designated once they have acquired the necessary competence through their professional experience, tutoring and appropriate training. To ensure constant progress, ASN:

– defined a system of qualification for its inspectors, based on recognition of their technical competence, in the same way as the leading foreign safety authorities. This system is today regulated by decrees and was identified as a good practice in the IRRS (Integrated Regulatory Review Service) mission report;
– adopted a number of foreign experiences identified through inspector exchanges between safety authorities. These exchanges are organised either for a particular inspection or for a longer period, via a secondment of up to 3 years. For example, after confirming the benefits to be gained, ASN adopted the in-depth inspections described in point 3|2|3. On the other hand, it did not opt for the system of inspectors resident on the nuclear sites: ASN considers that its inspectors must work in a structure that is large enough to allow experience to be shared and must take part in inspections of different licensees and installations, in order to gain a broader picture of this field of activity. This also helps to avoid a blurring of responsibilities;
– encourages an open-minded attitude on the part of its inspectors to other regulatory practices. ASN encourages its departments to take on inspectors from other regulatory authorities (installations classified on environmental protection grounds, SEVESO installations, AFSSAPS, technical services of the Ministry for Health, etc.). It also proposes holding joint inspections with these authorities (labour inspectorate, inspectorate for installations classified on environmental protection grounds, etc.) concerning the activities within its area of expertise. In order to identify other methods for risk management by the licensees, the ASN inspectors may also observe inspections on specialised subjects in installations which do not fall within their field of expertise.
– aims to ensure the uniformity of its practices. It encourages participation by its officers in inspections on different subjects, in different regions and sectors.

The ASN Chairman designates the inspectors according to procedures defined in decree 2007-831 of 11 May 2007 which determines the methods for designating and approving nuclear safety inspectors (nuclear safety inspectors, formerly BNI inspectors and officers in charge of inspecting pressure vessels specially designed for BNIs) and in Articles R. 1333-100 to R. 1333-108 of the Public Health Code (radiation protection inspectors).

Graph 1: growth in the number of nuclear safety inspectors and BNI and TMR inspections

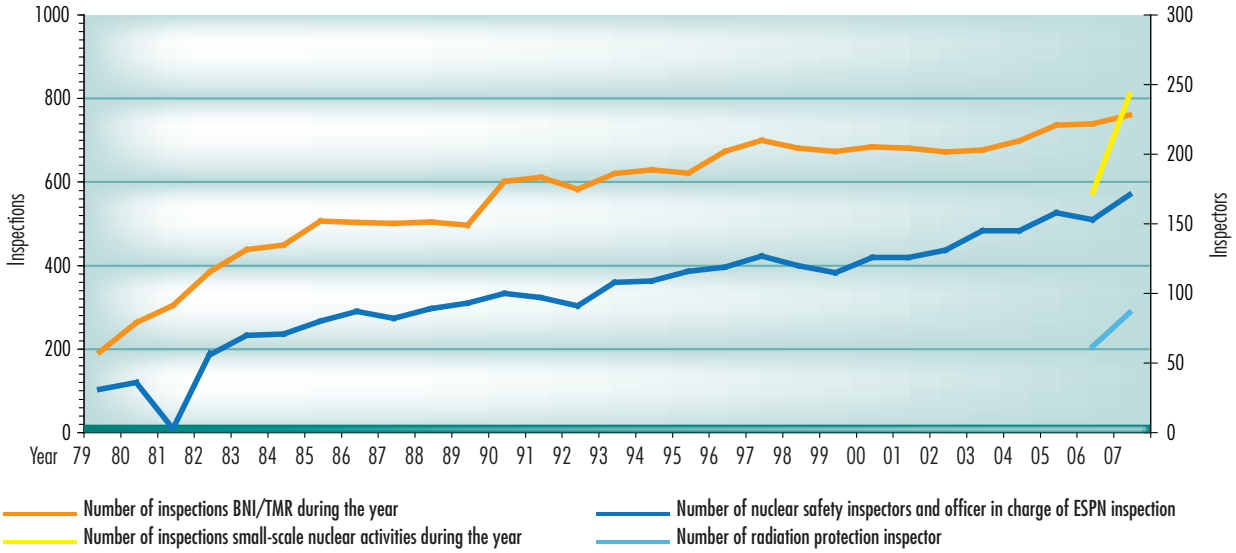


Table 3 presents the inspector staffing levels on 31 December 2007. Some officers are inspectors in several categories.

b) To guarantee an adequate distribution of the inspection resources, proportionate to the nuclear safety, radiation protection and environmental protection impact of the various installations and activities, ASN each year drafts an inspections forecast schedule.

It identifies the installations, activities and subjects targeted. This is not known beforehand to those in charge of nuclear activities.

c) ASN trains its inspectors and provides them with inspection guides and decision-making aids concerning any follow-up to infringements observed.

d) ASN performs qualitative and quantitative supervision of the inspection programme and the actions taken subsequent to the inspections.

Reports are issued on compliance with the forecast schedule of inspections and enable the activities checked to be evaluated in terms of both the licensee and the sector or particular topic concerned.

e) ASN informs the public by placing the nuclear safety inspection follow-up letters on its website, as well as through its publications.

This subject is developed further in chapter 6.

f) ASN is setting up a system for constant improvement of its inspection process.

It could be based on internal and external audits.

Table 3: breakdown of inspectors per type of inspection (on 31.12.2007)

Type of inspector	Departments	Divisions	Total
Nuclear safety inspector (BNI) and officer in charge of ESPN inspection	75	94	**169**
Nuclear safety inspector (Transport)	7	43	**50**
Radiation protection inspector	23	61	**84**
Labour inspector (site)	0	13	**13**
Number of inspectors (all fields included)	80	122	**202**

Inspectors carrying out a dosimetric inspection in Nantes university hospital (Loire-Atlantique)

3|2|3 The inspection process

The inspections may be unannounced or notified to the licensee a few weeks before the visit. They take place mainly on the site or during the course of the relevant activities (work, transport operation). They may also concern the head office departments (or design and engineering departments) at the major nuclear licensees, the workshops or engineering offices of the subcontractors, the construction sites, plants or workshops manufacturing the various safety-related components.

The inspections are generally carried out by two inspectors, with the support of an IRSN representative specialising in the installation visited or the topic of the inspection. ASN uses various types of inspections:

– standard inspections;
– reinforced inspections, on topics involving particular technical difficulties and directed by senior inspectors (see chapter 2);
– in-depth inspections, which take place over several days and mobilise about ten or so inspectors. Their aim is to carry out an in-depth examination;
– inspections with sampling and measurements. These are designed to obtain samples from discharges that are independent of those taken by the licensee;
– reactive inspections, carried out further to a particularly significant event;
– worksite inspections, ensuring a significant ASN presence on the sites on the occasion of reactor outages or particular work, especially in the decommissioning phase.

These inspections give rise to factual records, made available to the licensee. They concern:

– anomalies in the installation or points warranting additional justifications;
– deviations between the situation observed during the inspection and the regulatory texts or documents produced by the licensee pursuant to the regulations.

3|2|4 BNI inspections in 2007

In 2007, 675 inspections were conducted, 161 of which were unannounced. The breakdown according to the various installation categories is described in graphs 2 and 3.

3|2|5 Inspection of radioactive material transport in 2007

The 82 inspections on transport activities in 2007 can be broken down according to topic as shown in graph 4.

3|2|6 Checks on pressure vessels in 2007

The ASN nuclear pressure vessel division (DEP) is responsible for monitoring application of nuclear pressure vessel regulations, including for PWR main primary and secondary systems.

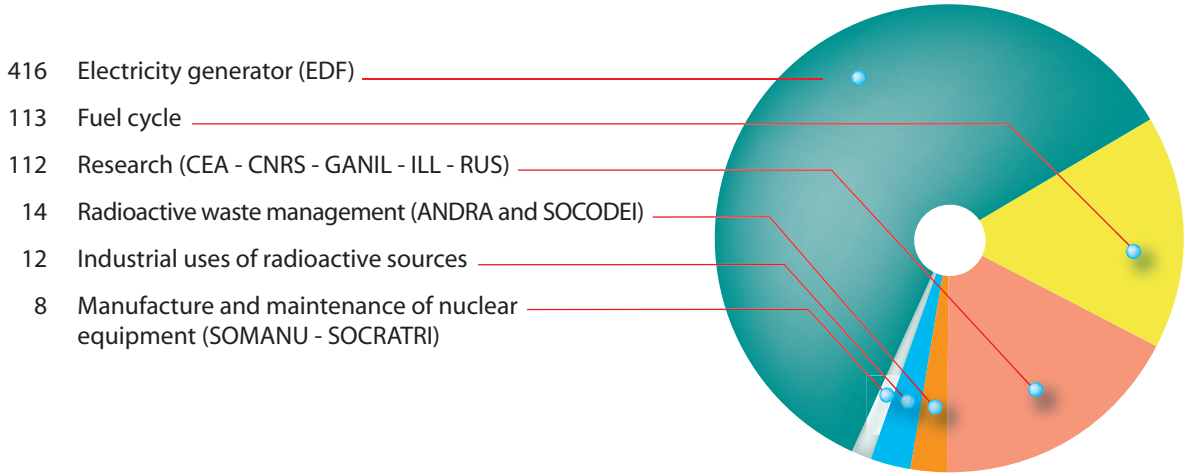
Regulation of the design and manufacture of the main primary and secondary systems (CPP and CSP), as well as assessment of the conformity of the main components (level N1 defined in the order of 12 December 2005) are the direct duty of this division (see chapter 12). Assessment of the conformity of other nuclear pressure vessels is the role of organisations approved and regulated by ASN (see point 2|2).

Regulation of the operation of nuclear pressure vessels is the responsibility of ASN regional divisions, with the support of the DEP.

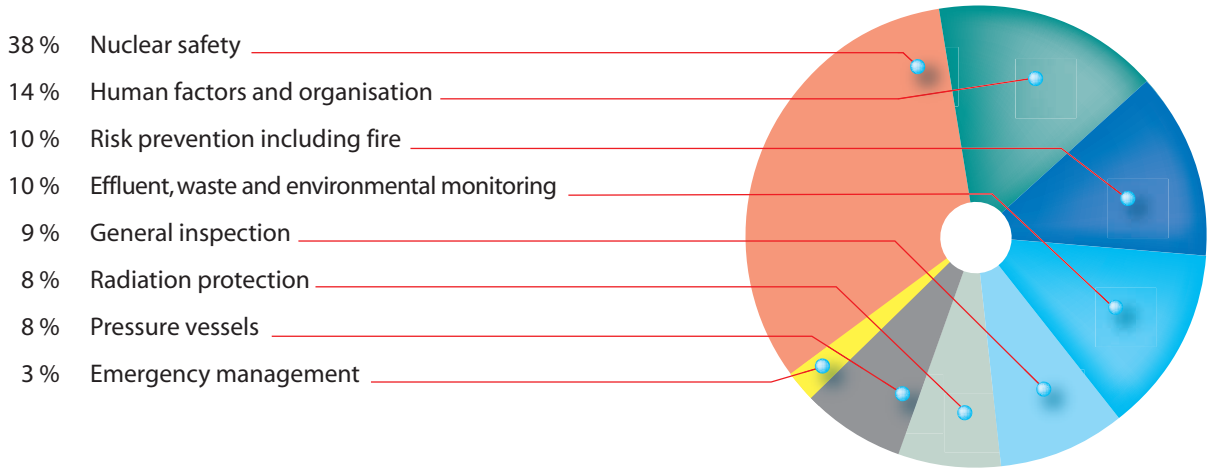
3|2|7 ASN checks on radiation protection in 2007

ASN has organised its checks and inspections so that they are proportionate to the radiological issues involved in the use of ionising radiation, and consistent with the actions of the other inspection services. Of the 50,000 or so nuclear installations and activities concerned, ASN carried out 800 inspections in 2007, 463 of which were in the medical field and 332 in industry and research, plus 5 for polluted sites and mining sites. The breakdown

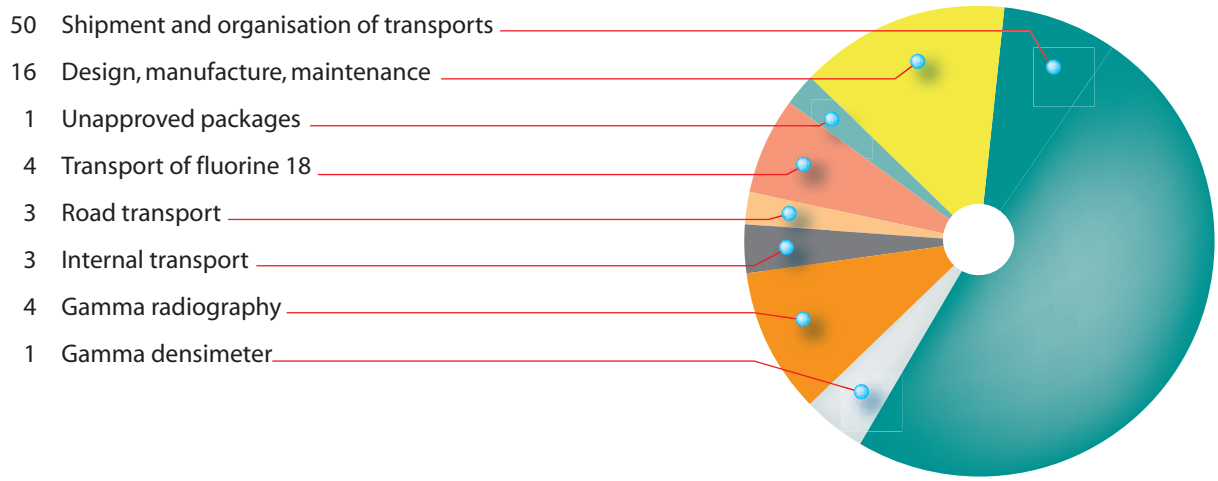
Graph 2: breakdown of 2007 inspections per type of licensee



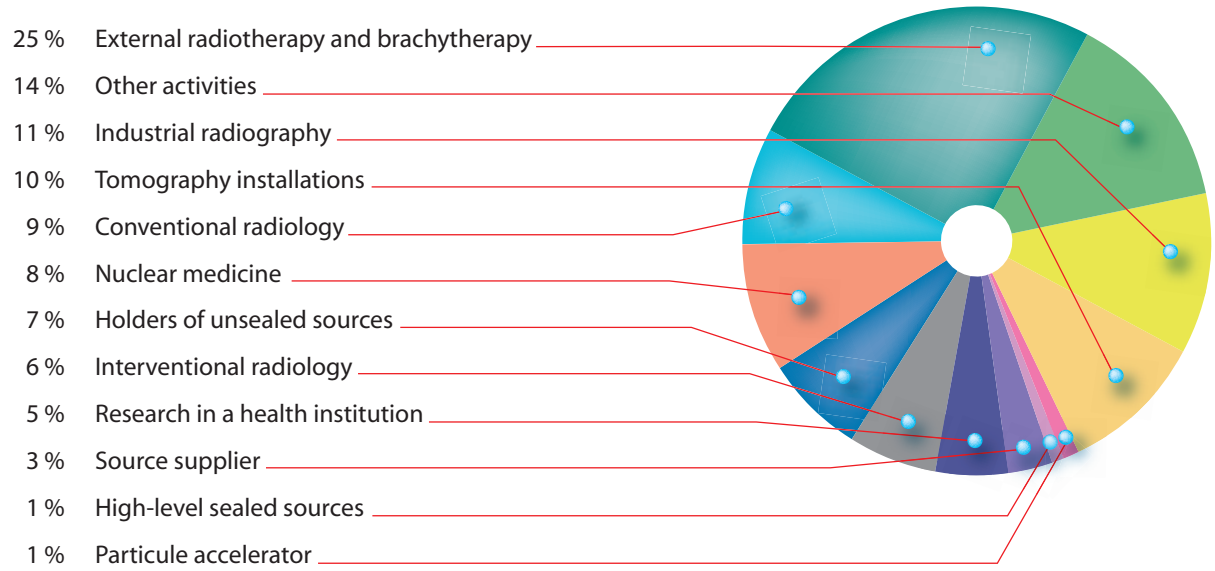
Graph 3: breakdown of BNI inspections in 2007, per priority topic



Graph 4: breakdown of radioactive materials transport inspections per priority topic



Graph 5: breakdown of inspections per activity category performed in 2007 in the small-scale nuclear sector



according to the various categories of activity is described in graph 5.

3 | 2 | 8 ASN checks on approved organisations in 2007

ASN carries out a second level of inspection on approved organisations and laboratories. In addition to reviewing the application dossier and issuing the approval, this comprises surveillance such as the following:

– approval follow-up or renewal audits;
– checks to ensure that the organisation and operation of the entity concerned comply with the applicable requirements;
– supervisory checks, which may be unannounced, to ensure that the organisation's staff work in satisfactory conditions.

In 2007, the following inspections were carried out:
– organisations carrying out radiation protection technical checks: 52 including 21 unannounced supervisory checks;
– organisations measuring activity concentration of radon in premises open to the public: 15 visits;
– organisations evaluating the conformity of nuclear pressure vessels and checking equipment in service: 9 audits and one supervisory action.

3|2|9 Checks on exposure to radon and NORM in 2007

ASN also regulates radiation protection in premises where exposure of individuals to NORM 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).

a) Checking exposure to radon

Since August 2004, the activity concentration of radon in places open to the public has to be measured, in accordance with the order of 22 July 2004, by organisations approved by ASN. The measurement campaigns must take place between 15 September of year N and 30 April of the following year.

For the 2007-2008 measurement campaign, the number of approved organisations is detailed in table 4.

Based on the information transmitted by the approved organisations, initial results can be presented for the 3000 establishments that underwent screening during the 2006-2007 campaign:
– in 2560 establishments, or about 85%, a radon activity level of less than 400 Bq/m^3 was measured;
– in 315 establishments, or about 11%, a radon activity level of between 400 and 1000 Bq/m^3 was measured;
– in 125 establishments, or about 4%, a radon activity level in excess of 1000 Bq/m^3 was measured.

The Departmental Health and Social Action Directorates (DDASS) in the 31 priority *départements** (see chapter 3), together with ASN (circular of 20 December 2004 concerning management of the radon risk in premises open to the public) are responsible for monitoring establishments in which radon concentrations higher than 400 Bq/m^3 were measured.

b) Checking exposure to NORM in non-nuclear industries.

The order of 25 May 2005 published the list of professional activities (industries, spas and plants treating water for human consumption) in which surveillance of human exposure to NORM is required. This obligation is due to the fact that the materials used contain natural radionuclides and are liable to generate significant doses from the radiation protection standpoint.

Checks on implementation of these new measures began at the end of 2007 and will continue in 2008. They 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 installations classified on environmental protection grounds and the radiation protection inspectors are competent to monitor the steps taken by the licensee to reduce public exposure, if necessary, whenever these industrial activities are subject to authorisation under the terms of the regulations applicable to installations classified on environmental protection grounds.

c) Checks on natural radioactivity in water intended for human consumption

Since 1 January 2005 (order of 12 May 2004), checks on natural radioactivity in water intended for human consumption are an integral part of the health monitoring carried out by the DDASS. The checks take account of the recommendations issued by ASN (DGS circular of 13 June 2007) and the results concerning the radiological quality of this water are jointly analysed by the Ministry

Table 4: number of organisations approved to measure radon in premises open to the public

	Approval until 15 September 2008	Approval until 15 September 2009	Approval until 15 September 2010
Level 1 (screening)	32	21	10
Level 2 (additional investigations)	5	0	2

*Administrative regions headed by a *Préfet*.

for Health and ASN. A summary of these results is presented in chapter 1.

3 | 3 Learning the lessons from significant events

3 | 3 | 1 Anomaly detection and analysis

a) History

Following the Three Mile Island accident, the BNI licensees were obliged to adopt an anomaly notification system. This system is part of the defence in depth approach and was incorporated into the international conventions ratified by France (Article 9v of the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management of 5 September 1997; Article 19vi of the Nuclear Safety Convention of 20 September 1994). The licensee is required to implement a reliable system for detecting possible anomalies, such as equipment failures or errors in application of operating rules. This system should lead to early detection of any abnormal operation. These anomalies must be notified to the regulatory authority.

Based on twenty years of experience, ASN felt that it would be useful to transpose this approach to radiation protection and protection of the environment. ASN thus drafted two guides defining the principles and obligations on the licensees with regard to notification of incidents and accidents:

– the 21 October 2005 guide contains the requirements applicable to BNI licensees and to carriers. It concerns significant events affecting BNI safety, radioactive material transport (TMR) safety, radiation protection and protection of the environment;

– the ASN/DEU/03 guide of 15 June 2007 is intended for those in charge of nuclear activities as defined in L. 1333-1 of the Public Health Code and the heads of the facilities in which ionising radiation is used (medical, industrial and research activities using ionising radiation). It was experimentally implemented as of 1 June 2007, in order to familiarise the professionals with this approach and take account of any problems they could encounter, while enabling them to meet their legal obligations straight away.

These guides can be consulted on the ASN website, www.asn.fr.

Significant event notification guides available on the ASN website

b) What is a significant event?

Detection of events (anomalies, deviations, incidents, etc.) by those in charge of the activities using ionising radiation, and implementation of corrective measures highlighted by this analysis, play a fundamental role in accident prevention. To give an idea of what this entails, the nuclear licensees detect and analyse 100 to 300 anomalies a year for each EDF reactor and about 50 a year for a research laboratory.

Classification of these anomalies must ensure that the more important ones are given priority treatment. For this purpose, ASN has defined a category of anomalies called "significant events". These are events that are sufficiently important in terms of safety or radiation protection to justify rapid notification of ASN, followed by a subsequent and more complete report. Significant events must be notified to it, as specified in the Act of 13 June 2006 (Article 54), the Public Health Code (Articles L. 1333-3 and R. 1333-109 to R. 1333-111) and the Labour Code (Article R. 231-105-1). About ten or so significant events are notified every year for an EDF reactor. The criteria for notification to the public authorities of events considered to be "significant" take account of the following:

– the actual or potential consequences for workers, the public, patients or the environment, of events that could occur and affect nuclear safety or radiation protection;
– the main technical, human or organisational causes that could lead to the occurrence of such an event.

This notification process is part of the continuous safety improvement approach. It requires the active participation of all licensees (users of ionising radiation, carriers, etc.) in the detection and analysis of deviations. It enables the authorities:

– to ensure that the individual in charge of the activity has carried out a pertinent analysis of the event and taken appropriate measures to correct the situation and prevent it happening again;
– to analyse the event in the light of the experience available to other parties in charge of similar activities.

The purpose of this system is not to identify or penalise any individual person or party (see point 4).

3 | 3 | 2 Implementation of the approach

a) Event notification

In the event of an incident or accident, whether or not nuclear, with a real or potential risk of significant consequences for the safety of the installation or transport or, as a result of significant exposure to ionising radiation, liable to constitute a risk to individuals, property or the environment, the Act of 13 June 2006 requires that the BNI licensee or individual in charge of a radioactive material transport immediately notify ASN and the State's representative in the *département* in which the incident or accident occurred and, as applicable, the State's maritime representative.

As specified in the Public Health Code, the individual required to notify the significant event is the individual in charge of the nuclear activity.

According to the provisions of the Labour Code, the party declaring a significant event affecting a worker is the head of the facility. When the head of a facility carrying out one of the activities mentioned in the previous paragraph calls in an external contractor or non-salaried worker, the significant events concerning salaried or non-salaried workers are notified in accordance with the prevention plans and the agreements concluded pursuant to Article R. 231-74 of the Labour Code.

b) ASN analysis of the notification

Within two months of the notification, it is followed by a report indicating the conclusions the licensee has drawn from analysis of the events and the steps it intends to take to improve safety. This information is extremely valuable for ASN and its technical support organisation, IRSN, in particular for the periodic safety reviews conducted on basic nuclear installations.

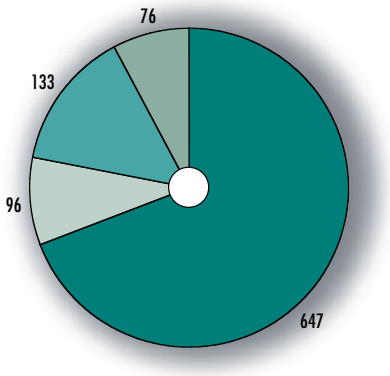
ASN ensures that the licensee has carried out a pertinent analysis of the event and taken appropriate steps to remedy the situation, prevent it happening again and ensure that operating feedback is sent out to the licensees.

The regional divisions are responsible for immediate analysis of significant events in order to check that urgent corrective steps have been taken and, if necessary, prepare for the necessary information of the public. ASN coordinates the actions of the regional divisions in this field and every year provides training for the engineers concerned.

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

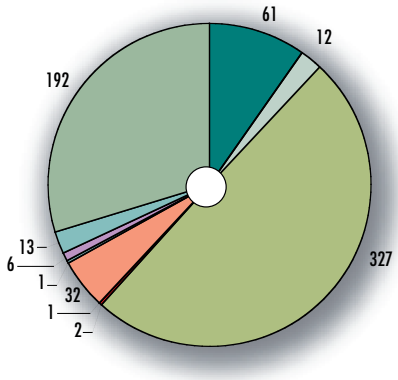
ASN and its technical support body, IRSN, carry out a subsequent examination of the operating feedback from the events. The data supplied by the regional divisions and analysis of significant event reports, together with periodic records sent in by the licensees, form the basis of ASN operating feedback structures. This operating

Graph 6: breakdown per type of events for BNIs



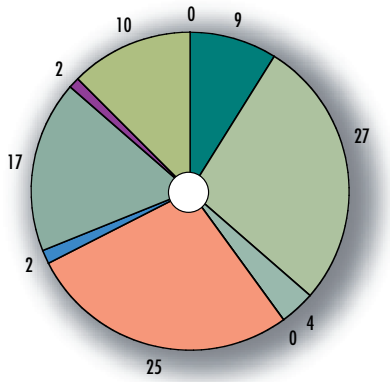
- Event involving nuclear plant safety
- Event involving the safety of BNIs other than nuclear power plants
- Event involving BNI radiation protection
- Event involving BNI environment

Graph 7: events involving nuclear power plant safety



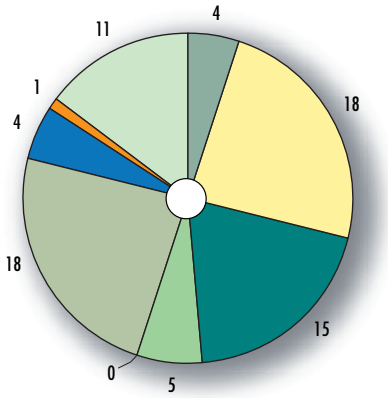
- Reactor trip
- Unscheduled activation of a protection or safeguard system
- Non-compliance or event which could lead to non-compliance with technical operating specifications (STE)
- Internal or external hazard affecting the availability of important equipment
- Actual or attempted vandalism
- Shutdown through application of the STE or accident procedures
- Event which caused or could have caused multiple failures
- Event or anomaly specific to the primary or secondary system
- Design, manufacturing or assembly fault
- Other significant event that could affect safety

Graph 8: significant events for BNIs other than nuclear power plants



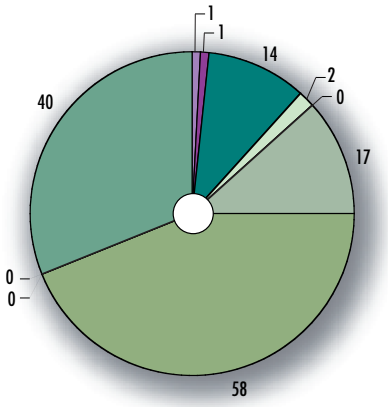
- Event leading to death or serious injury
- Unscheduled start-up of a protection or safeguard system
- Event leading to overshoot of safety limit(s)
- Internal or external hazard affecting the availability of important equipment
- Actual or attempted vandalism
- Event compromising or potentially compromising the containment of dangerous materials
- Event which caused or could have caused multiple failures
- Fault, damage or failure affecting a safety function
- Events affecting a safety function that could constitute accident warning signs
- Other significant event that could affect safety

Graph 9: significant environmental events for the year 2007 (BNI)



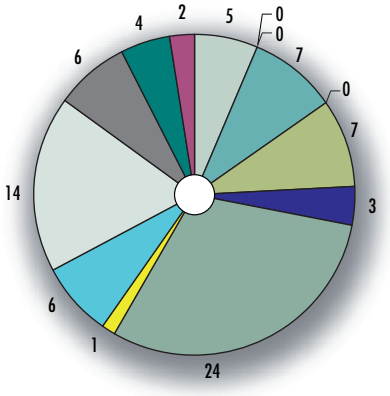
- Radioactive discharges
- Chemical discharges
- Bacteriological risks
- Non-compliance with an operational requirement which could lead to a significant impact
- Actual or attempted vandalism
- Non-compliance with the order of 31 December 1999
- Non-compliance with the site or installation waste study
- Discovery of a significantly polluted site
- Other significant events that could affect the environment

Graph 10: events involving radiation protection in BNIs



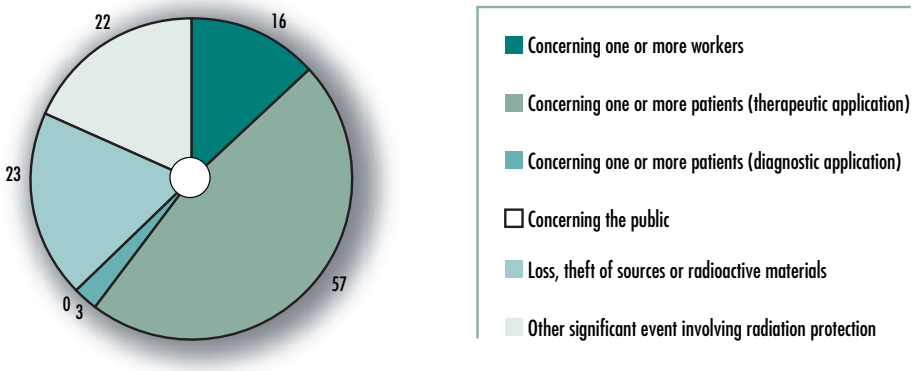
- Overshoot of an annual dose limit or event that could lead to this situation
- Overshoot of one quarter of the annual dose limit or event that could lead to this situation
- Any significant deviation concerning radiological cleanness
- Operation involving a radiological risk performed without analysis or ignoring the analysis
- Actual or attempted vandalism
- Abnormal situation affecting a source with activity higher than the exemption threshold
- Incorrect signage or non-compliance with zone access conditions
- Uncompensated failure in radiological monitoring systems
- Overshoot of radiological monitoring appliance inspection interval
- Other significant events that could affect radiation protection

Graph 11: radioactive material transport events



- Loss or theft of a package or radioactive material during transport
- Shipment of a package even through the consignee is not ready for delivery
- Actual or attempted vandalism
- Inadvertent discovery of a package of radioactive material
- Event liable to lead to erroneous or malicious interpretation
- Hazard that affected or could affect the safety of transport
- Event leading to death or serious injury
- Fault, damage or failure affecting a safety function
- Events which affected at least one barrier with actual or potential consequences
- Non-compliance with radioactive material transport regulations
- Repetitive event with unknown cause affecting a safety function
- Non-compliance with one of the radiation intensity or contamination limits
- Other significant events that could affect transport
- Deviation from approval certification without impairing safety functions

Graph 12: events involving radiation protection (non-BNI)



feedback can lead to requests for improvement of the condition of the installations and the organisation adopted by the licensee, as well as for changes to the regulations.

3|3|3 Public information

Independently of this process, the public must be informed of those events with consequences that so warrant (see chapter 6).

3|3|4 Statistical summary of events during 2007

The following graphs describe in detail the significant events notified to ASN in 2007, differentiating between the various notification criteria for each domain:
– nuclear safety, radiation protection and environment for BNIs
– TMR, all activities included,
– radiation protection excluding BNIs (statistics limited to second half of 2007)

Apart from the technical analysis specific to each criterion, it can be seen that half of the events notified are due to non-compliance with requirements or rules.

3|4 Raising awareness

Compliance with the regulations can also be obtained through education. Regulation is thus supplemented by awareness programmes designed to ensure familiarity with the regulations and their application in practical terms appropriate to the various professions. 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. These initiatives are mentioned in chapter 9.

Raising 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.

This approach is illustrated by the joint creation by ASN and the French Oncology Radiotherapy Society (SFRO) of a common scale for rating radiation protection events affecting patients undergoing radiotherapy treatment.

Finally, jointly with the General Directorate for Labour (DGT), ASN initiated coordination of conventional safety inspections and radiation protection inspections. This will in particular include local and national exchanges of information, joint inspections and cross-training exercises.

3|5 Conducting a technical inquiry in the event of an incident or accident concerning a nuclear activity

Before it was modified by the TSN Act, the Act of 3 January 2002 made it possible to conduct a technical inquiry following an event at sea, a terrestrial transport accident or an air accident, in order to prevent future events, accidents or incidents. This inquiry consists in collecting and analysing all useful information, without prejudice to the judicial inquiry, in order to determine the circumstances and the identified or possible causes of the event, if necessary drawing up the necessary recom-

mendations. A specialist organisation is designated to carry out the inquiry, although it can call on outside individuals or even convene a board of inquiry.

Pursuant to this Act, a number of bodies with national competence were set up: the "Maritime events investigation bureau" (BEA-mer), the "terrestrial transport accident investigation bureau" (BEA TT), the "air transport accident investigation bureau" and the "air defence accident investigation bureau" (the investigation and analysis bureau for civil aviation safety (BEA "air") already existed before this Act).

In giving ASN, an independent administrative authority, the role of regulating nuclear safety and radiation protection and information of the public in these areas, the TSN Act (5° of Article 4) expanded the scope of application of the Act of 3 January 2002 to incidents or accidents concerning a nuclear activity and gave ASN the prerogatives accorded to the investigation bureaux for other accidents. This expansion covers incidents and accidents associated with both basic nuclear installations and radioactive material transport as well as with those which can occur during activities entailing a risk of human exposure to ionising radiation, in particular activities carried out for medical purposes.

Insofar as ASN previously carried out incident and accident investigations as part of its regulatory duties, the main innovation of the TSN Act in this respect is to give ASN the right to conduct inquiries and access the necessary information in the event of a judicial inquiry.

However, unlike the investigation bureaux mentioned above, whose sole purpose is to conduct inquiries, disseminate information gleaned from operating feedback and conduct research into accidents and their causes, ASN's main role is regulation. This entails certain particularities in how the investigators and ASN work together.

This primarily concerns three aspects:
– the objectives of the BEAs and the boards of inquiry they can set up are one and the same. For inquiries into a nuclear activity, it is necessary to differentiate between the board of inquiry, whose aim is to determine the circumstances and causes of the event, and ASN, whose goal is to regulate and supervise nuclear safety and radiation protection in order to protect workers, patients, the public and the environment from the risks related to nuclear activities. It is for this purpose that ASN will use the recommendations issued by the board of inquiry;
– the BEA officers whose duty is to take part in the inquiries, receive permanent commissions as technical investigators. ASN's staff primarily carry out a regulatory duty and can be commissioned on a case by case basis;
– the investigators must offer guarantees of independence and impartiality. This requirement applies to ASN's staff given that they might have taken part in regulating the activity covered by the inquiry.

The Act of 3 January 2002 specifies the purpose of the inquiry, defines the organisation responsible for it, lays down the principles of the independence of the organisation or individuals and of protection of medical secrecy. It determines the links with the Public Prosecutor and the judicial procedure and defines the penalties. It restates the

Radioactive material transport package involved in a traffic accident

right of access to the site on which the event occurred, of preservation of clues and the release of information in the event of a risk. Finally, it clarifies how the safety recommendations and the inquiry report are to be publicised.

Decree 2007-1572 of 6 November 2007 on technical inquiries into accidents or incidents concerning a nuclear activity, specifies the procedure to be followed for accidents or incidents concerning a nuclear activity. It is based on the practices established for the other accident investigation bureaux and takes account of the specific characteristics of ASN, particularly its independence, its ability to impose requirements if necessary and the co-existence of its investigative and other duties. ASN issued opinion 2007-AV-0021 on 26 March 2007 with regard to this draft decree.

4 IDENTIFYING AND PENALISING INFRINGEMENTS

4|1 Ensuring that licensee penalty decisions are proportionate, fair and consistent

In certain situations in which the licensee fails to conform to the regulations or legislation, or when it is important that appropriate action be taken immediately to remedy the most important risks, ASN may impose the penalties provided for by law. The principles of ASN's penalty policy are based on:

1. penalties that are impartial, justified and appropriate to the level of risk presented by the situation concerned. Their scale is proportionate to the health and environmental consequences of the infringement detected and also takes account of intrinsic factors relating to the behaviour of the party at fault and external factors relating to the context of the infringement;

2. administrative action initiated on proposals of the inspectors and decided on by ASN in order to remedy risk situations and non-compliance with the legislative and regulatory requirements as observed during its inspections.

When it detects an infringement during its checks, ASN must ensure that its enforcement tools are fair and consistent. Demands should be understood to mean all oral and written reactions on the part of ASN or its staff during the course of an inspection. Sanctions should be understood to mean all administrative or penal measures that ASN can take or propose in the event of failure to comply with an Act, regulation, general rule or particular requirement. ASN has a range of tools at its disposal, in particular:

– a verbal warning by the inspector to the licensee;
– the official letter from the ASN departments to the licensee;
– formal notice from the ASN Commission to the licensee to regularise the administrative situation or meet certain conditions placed on the licensee of an installation or on the individual responsible for transport, within a specified time-frame;
– a scale of administrative penalties applied after formal notice;
– deposit with a public accountant of a sum corresponding to the cost of the work to be performed;
– automatic performance of the work at the expense of the licensee;
– suspension of operation of the installation or of performance of an operation until the licensee conforms;
– revocation by the Commission of an authorisation or approval, when so provided for by law;
– legal proceedings through referral by the inspector to the public prosecutor's office (procureur de la République).

Of the recommendations made by the IRRS review, two concerned the need for ASN to provide its inspectors with tools enabling them to determine the scale of the problems observed and deal with minor infringements, in order to implement a level of penalties that is appropriate with regard to safety on the one hand and radiation protection on the other. ASN therefore drew up procedures and decision-making tools regarding the position to be adopted by the inspectors when an infringement is identified. These documents cannot cover the full complexity of the actual situation, but they provide a structured framework for reaching an impartial decision proportionate to the infringement observed, that is applied consistently by all inspectors and is in line with the policy defined by ASN. More indirectly, they also constitute a learning aid for the less experienced inspectors and contribute to the transparency of ASN's decisions, by explaining a decision, in particular to the licensees.

The decision to issue demands is based on the observed risk for people or the environment and takes account of factors specific to the licensee (history, behaviour, repeated nature of the problem), contextual factors and the nature of the infringements observed (regulations, standards, "rules of good practice", etc.).

4 | 2 Tailoring the response to the stakes: a proportionate approach

4 | 2 | 1 For BNIs

When ASN regulatory actions reveal failures to comply with safety requirements, penalties can be imposed on the licensees concerned, in some cases, after service of formal notices. Penalties in such cases may consist in prohibiting restart or suspending operation of a nuclear installation until the corrective measures have been taken (see point 1 | 4).

The Act of 13 June 2006 set up an infringements system based on:

– a scale of administrative penalties applied after formal notice and defined in Articles 41 to 44 of the Act:
  • deposit with a public accountant of a sum corresponding to the cost of the work required,
  • automatic performance of the work at the expense of the licensee (any sums deposited beforehand can be used to pay for this work),
  • suspension of operation of the installation or of performance of an operation, until the licensee has ensured conformity.

  If the licensee has any observations concerning these penalties it shall present them to the ASN Commission;
– penal sanctions ranging from a fine of 7,500 euros to three years imprisonment and a fine of 150,000 euros depending on the nature of the violation. They are defined in Articles 48 to 51 of the Act. They may apply to corporate bodies, with the amount of the fine rising to up to 1,500,000 euros.

4 | 2 | 2 For small-scale nuclear activities

As in the field of nuclear safety, infringement of the provisions of the "ionising radiation" chapter of the Public Health Code leads to administrative and penal sanctions.

Administrative decision-making powers lie with ASN and can entail:

– revocation of licence (after formal notice);
– interim suspension of an activity (whether licensed or notified) if urgent measures are required to safeguard human health.

The formal notice prior to revocation of licence (based on Article L.1333-5 of the Public Health Code) concerns implementation of all the requirements of the "ionising radiation" chapter of the legislative part of the Public Health Code (Articles L.1333-1 to l.1333-20), regulatory requirements and the stipulations of the licence. Temporary or final revocation of the licence by ASN must be fully explained in a decision within one month following serving of formal notice.

The formal notices prior to penal sanctions (based on Article L.1337-6 of the Public Health Code) are served by ASN. They concern the provisions of Articles L.1333-2, L.1333-8 (surveillance of exposure, protection and information of individuals), L.1333-10 (surveillance of exposure to TENORM and of premises open to the public) and L.1333-20 (decrees implementing certain legislative provisions).

Infringements are written up in reports by the radiation protection inspectors and transmitted to the Public Prosecutor's Office, which decides on what subsequent action is to be taken. The parts of the Public Health Code providing for penal sanctions are detailed in Articles L.1337-5 to L.1337-9 and range from a fine of 3,750 euros to one year of imprisonment and a fine of 15,000 euros. These penalties may also apply to corporate bodies.

ASN served its first formal notices under the Public Health Code in 2007:

– formal notice served on the Director of the Bytest company, to suspend all industrial radiology operations on the site of the future methane tanker terminal at Fos sur Mer (Bouches-du-Rhone *département*);
– formal notice served on a radiotherapist in Orléans (Loiret *département*) requiring submission of an application for a licence to operate a radiotherapy installation.

4 | 2 | 3 For labour law

In the performance of their duties, the ASN's labour inspectors have at their disposal all the inspection, decision-making and constraining resources of ordinary inspectors. Observation, formal notice, official report, injunction (to obtain immediate cessation of the hazard) or even shutdown of the site, offer a range of persuasive and constraining measures for the labour inspector that is broader than that available to a nuclear safety inspector or a radiation protection inspector.

The labour inspector has special decision-making powers enabling him to check the employer's disciplinary capability, to protect the general interest from an economic standpoint and to act as arbitrator, if necessary by delegation from the DDTEFP. He is also tasked with examining approval applications by the occupational health departments, jointly with the occupational physicians.

The labour inspector is in contact with many parties from different EDF entities. Management of these internal interfaces is an integral part of his duties. The inspector is first of all in contact with the unit senior management, the risk prevention departments and the occupational health departments. He is in direct contact with the members of

the health, safety and working conditions committees (CHSCT) and the trade union representatives. The members of the CHSCT are a vital means of transmitting information for the labour inspector, in the light of their knowledge of the facility, the operating procedures, working conditions and accidents that occur in the installation. The members of the CHSCT are informed of the inspector's visits and of his observations during the inspections.

The inspector is notified of the ordinary meetings of the CHSCT (one every quarter) and the inter-company working conditions and safety committee (CIESCT) meetings held on the power plant sites, and can attend them. He takes part in extraordinary meetings held following a work accident, and in issuing an alert in the event of serious and imminent danger.

The mandatory posting of the contact details of the inspector with competence for each nuclear power plant leads to him being frequently contacted both by EDF personnel and by the personnel of the contractors working in the nuclear power plants. The main subjects concern performance of their employment contract (working times, rest periods, travel, leave, etc.), but also notification of degraded working conditions.

The labour inspector is in contact with the occupational health departments. He may be required to validate (or invalidate) a decision by the occupational physician. Close relations with the occupational physician may enable him to gain a relatively clear picture of the "health" of the facility, in particular with regard to the organisational and human factors to be monitored.

Relations on the site can also concern EDF entities from outside the plant, which have their own staff consultation and medical supervision structures. The entities most concerned are the National Electricity Generation Equipment Centre (CNEPE) which is in charge of carrying out and supervising major non-nuclear works, the Engineering Centre for Operating Plants (CIPN) for major operations on the nuclear island (in particular steam generator replacement), the Engineering Centre for Decommissioning and Related Environmental Issues (CIDEN) for all work relating to the decommissioning of retired nuclear power plants, and which on some sites has a separate structure, the workforce of which will rise as the decommissioning phases progress.

4 | 3 Information about ASN's inspections

As part of the process to coordinate government departments, ASN informs the other departments concerned of its inspection programme, the follow-up to these inspections, the penalties imposed on the licensees and any significant events that could be of interest to them.

To ensure that its inspection work is transparent, ASN informs the public (both general and specialised) by placing the following on its website:

– nuclear safety inspection follow-up letters,

– approval authorisations or rejections,

– incident notifications,

– the results of reactor outages,

– its publications on specific subjects (*Contrôle* magazine, etc.).

The conditions in which this information is made public must protect medical secrecy, industrial secrecy, national defence interests and individual freedoms. ASN makes every effort to avoid publishing any nominative information (patients, employers, employees, etc.).

5 OUTLOOK

Inspection is one of ASN's fundamental duties. In 2008, ASN will focus its inspections on radiotherapy centres and make its presence more strongly felt in the inspection of small-scale nuclear facilities. It will also be strengthening its inspection of organisations in all the areas in which it issues approvals. It has scheduled about 1900 inspections on BNIs, radioactive material transport, activities using ionising radiation, organisations and laboratories it has approved and activities involving pressure vessels.

In 2008, ASN will be developing an appropriate conventional safety inspection organisation in nuclear power plants, in order to:
– encourage the integration of conventional safety inspection of the nuclear power plants with the role of checking nuclear safety and radiation protection;
– forge essential ties with the other local and national conventional safety inspection and prevention stakeholders.

In 2008, ASN intends to reinforce its arsenal of compulsory measures and use the tools at its disposal in all the fields under its responsibility.

Finally, in order to increase the effectiveness of the inspections carried out by government departments, the various components of ASN (divisions and departments) will regularly meet their counterparts from the administrations and organisations with responsibility for health institutions, for discussions concerning the inspection programmes and the data arising from them. These meetings will also be designed to implement joint actions targeted at both the central level (hospitalisation and health care directorate) and the regional levels (regional hospitalisation agencies). ASN will also be meeting the High Health Authority to set up joint action for including the conformity of medical installations and practices involving ionising radiation in the evaluation and accreditation procedures for which it is responsible.

CHAPTER 5

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6 OUTLOOK

1 PROTECTING THE ENVIRONMENT

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.

In the field of environmental protection, Act 2006-686 of 13 June 2006 on Transparency and Security in the Nuclear Field (TSN Act) clarifies ASN's areas of competence.

– with regard to environmental monitoring, ASN organises a permanent radiation protection watch nationwide;

– with regard to regulation, it issues opinions on draft regulations concerning basic nuclear installations and takes technical decisions concerning implementation of the regulations;

– with regard to licensing, it defines the provisions applicable to the installations. The decisions defining the discharge limits applicable to basic nuclear installations (BNIs) must be approved by the Ministers.

This legislative change reinforces the importance attached to considerations of safety, radiation protection and the environment. ASN therefore tackles them in a global manner, using the same tools and the same requirements of stringency, competence, transparency and independence.

With regard to the environment, ASN actions are primarily focused on 3 areas:

– monitoring radioactivity in the environment with a view to informing the population about the health impact of nuclear activities in France;

– limiting the dispersion of radioactive or toxic materials resulting from nuclear activities. This involves strict control of effluent discharges and waste management.

– preventing and limiting the detrimental effects and risks, resulting from BNI operation, for public health and safety or for the protection of nature and the environment.

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 the non-nuclear industries.

To ensure that the licensees assume their responsibilities in full, ASN has in recent years extended inspections to management of effluents and waste and protection of the environment. It is responsible for following-up the significant events declared to it by the licensees, based on the criteria harmonised in 2005 (guide of 21 October 2005).

2 MONITORING ENVIRONMENTAL RADIOACTIVITY

Articles R. 1333-11 and R.1333-11-1 of the Public Health Code provide 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 field of radioactivity measurements;

– to develop transparency in information concerning the health impact of nuclear activities in France.

On the advice of a steering committee, ASN is responsible for setting guidelines for this network, which is managed by the Institute for Radiation Protection and Nuclear Safety (IRSN).

2|1 Maintaining the quality of environmental measurements

2|1|1 The approval procedure

In order to guarantee the quality of the measurements published on the national network, an approval procedure has been introduced.

The order of 27 June 2005 organising a national network of environmental radioactivity measurements and setting criteria for approval of laboratories defines this procedure. This text will shortly be modified to take account of recent changes to the Public Health Code.

The approval procedure in particular includes:

Four-year planning programme for interlaboratory tests

		Type 1		Type 2		Type 3		Type 4		Type 5		Type 6	
Code	Radioactive measurements category	Water		Soil matrices		Biological matrices		Aerosols on filter		Gas air		Ambient environment (soil/air)	
.. -01	Gamma emitter radionuclides > 100 keV		1_01		2_01		3_01		4_01		5_01		-
.. -02	Gamma emitter radionuclides < 100 keV		1_02		2_02		3_02		4_02		5_02		-
.. - 03	Total alpha		1_03		-		-		4_03		-		-
.. -04	Total beta		1_04		-		-		4_04		-		-
.. -05	H-3		1_05		2_05		3_05		-		see water		-
.. -06	C-14		1_06		2_06		3_06		-		see water/Na OH		-
.. -07	Sr-90/Y-90		1_07		2_07		3_07		4_07		-		-
.. -08	Other pure beta emitters (Ni-63, ...)		1_08		2_08		3_08		-		-		-
.. -09	U isotopes + daughter products		1_09		2_09		3_09		4_09		-		-
.. -10	Th isotopes + daughter products		1_10		2_10	?	3_10		4_10		-		-
.. -11	Ra-226 + daughter products		1_11		2_11		3_11		-		Rn 222: 5_11		-
.. -12	Ra-228 + daughter products		1_12		2_12	?	2_12		-		Rn 220: 5_12		-
.. -13	Isotopes Pu, Am, (Cm, Np)		1_13		2_13		3_13		4_13		-		-
.. -14	Halogenated gases		-		-		-		-		5_14		-
.. -15	Rare gases		-		-		-		-		5_15		-
.. -16	Gamma dosimetry		-		-		-		-		-		6_16
.. -17	Weighted uranium		1_17		2_17		3_17		4_17		-		-

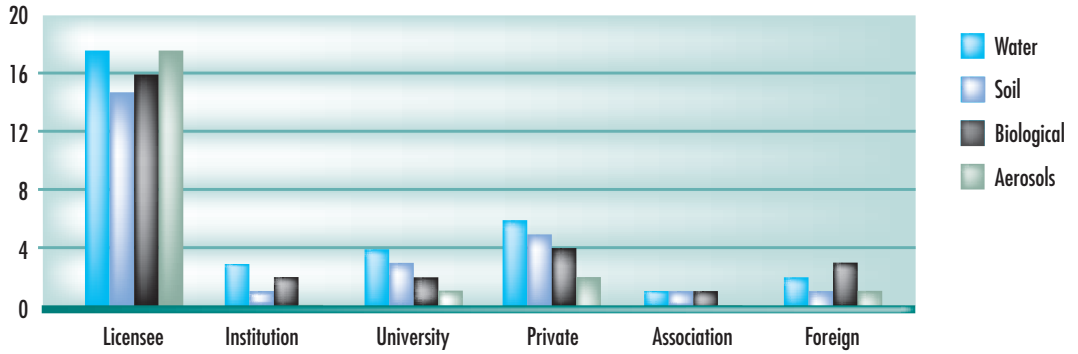
2007 2008 2009 2010

– presentation of an application file by the laboratory interested;
– review of it by ASN;
– review of the application files by a pluralistic approval commission which issues a decision on anonymous files.

Laboratories are approved by an ASN decision.

Two guides concerning the conditions for presentation of approval applications and conditions for remedying an unfavourable opinion from the approval commission respectively, were prepared and published in 2006.

Breakdown of approved laboratories per type and per measurement category



2|1|2 Approval conditions

Laboratories seeking approval must set up an organisation meeting the requirements of standard NF EN ISO/CEI 17025 concerning the general requirements for the competence of calibration and test laboratories.

In order to demonstrate their technical competence, they must take part in inter-laboratory tests (EIL) organised by IRSN. The four-year EIL programme is updated annually. It is reviewed by the approval commission and published on the national network's website (www.mesure-radioactivite.fr).

The EIL organised by IRSN involve up to 40 laboratories per test, including a few from other countries.

To ensure that the laboratory approval conditions are fully transparent, precise assessment criteria are used by the approval commission. These criteria are published on the national network's website.

The EIL results (2006 campaign) on which approvals are based in 2007, concerned the measurement of:
– carbon 14, isotopes of plutonium and americium in water;
– gamma emitters, 90Sr and artificial alpha emitters in soils;
– isotopic uranium, mass concentration of uranium, radium in a biological matrix.

Since 2003, 29 types of approval were proposed to the laboratories through the 15 inter-laboratory tests organised by IRSN. The tests carried out in 2006 led to 106 new approvals being issued in 2007. At the end of 2007, 34 laboratories were approved to carry out environmental radioactivity measurements, bringing the total number of approvals to 444.

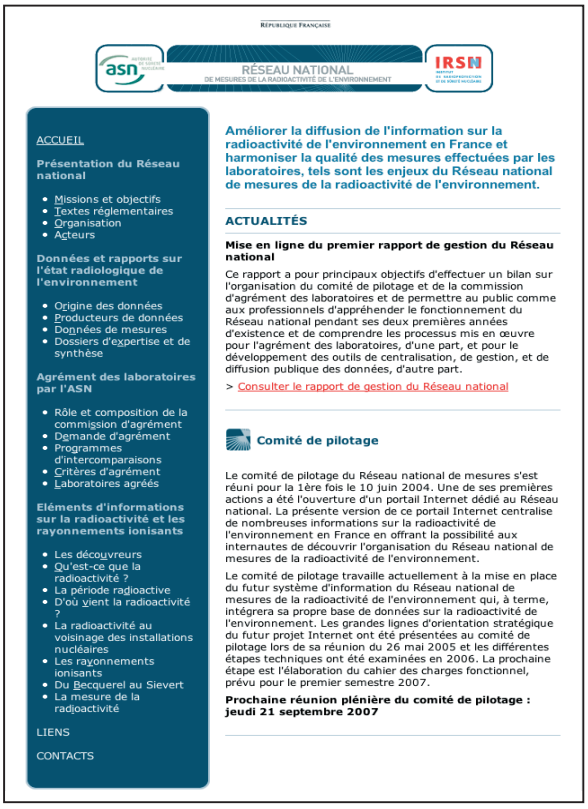
The detailed list of approved laboratories and their areas of competence was the subject of ASN decision 2007-DC-0064 of 10 July 2007. It is now kept up to date in the ASN's Official bulletin on www.asn.fr.

Photo "TELERAY ambient dose rate monitor"

2|2 Developing transparency in information on environmental radioactivity

The Public Health Code set up the national network of environmental radioactivity measurements "in order to contribute to informing the public about the doses to which they are exposed as a result of nuclear activities".

Two aspects are involved in setting up this network:
– development of a data bank containing the environmental radioactivity measurements;
– publication of these results and relevant information on this subject on the internet.



Portal of the national network for environmental radioactivity (www.mesure-radioactivite.fr)

2|2|1 Data management

Database development was undertaken by ASN and IRSN, under the supervision of the national network steering committee. The aim of this development is to address the concerns of all stakeholders contributing to the national network of environmental radioactivity measurements.

The work done in 2007 led to the definition of technical specifications for the data management tools and the website used to disseminate the data. They were evaluated by a large number of those involved in the national network (government departments, licensees, associations, etc.). These specifications will lead to the development of data management tools during the course of 2008, for operation in 2009.

2|2|2 Public information

The purpose of this database is to contribute to public information via the development of a web portal through which the results of radioactivity measurements will be accessible, along with an interpretation of the data in terms of radiological impact.

Documentation of use to the network stakeholders, as well as to non-specialists in environmental radiation protection, is already available on the national network web portal. This portal is accessible via the ASN and IRSN websites.

The national network portal constitutes a window onto the national network currently being developed and is the main source of information, in particular concerning approvals. Until such time as the measurements database is ready, scheduled for 2008, this site contains links to the websites of network players and to other institutional sites dealing with environmental radioactivity.

3 MANAGING EFFLUENTS FROM NUCLEAR ACTIVITIES

In the same way as all other industries, nuclear activities (nuclear industry, nuclear medicine, research installations, etc.) generate by-products, which may or may not be radioactive, regardless of the efforts made in terms of prevention, recycling or re-use. These by-products can be treated before disposal as waste or, when their characteristics so allow, discharged into the environment in the form of effluents.

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 effluents, as the complexity and cost of the processes used for containment in the form of waste tend to increase, the lower the concentration of radionuclides. Below a certain level, the radionuclides can no longer be reasonably recovered, in particular because the containment operations imply a radiological impact on the workers that it totally disproportionate to the anticipated gain for the public. They are then discharged into the environment after verification that their impact on the public and the environment is acceptable.

ASN ensures that the licence application explains the choices the producer envisages making, in particular the necessary decisions between containment or dispersal of materials, and the decision to abandon certain reduction at source or treatment options for safety and radiation protection reasons.

This approach means that the radioactivity discharged in effluents represents a marginal fraction of that contained in waste.

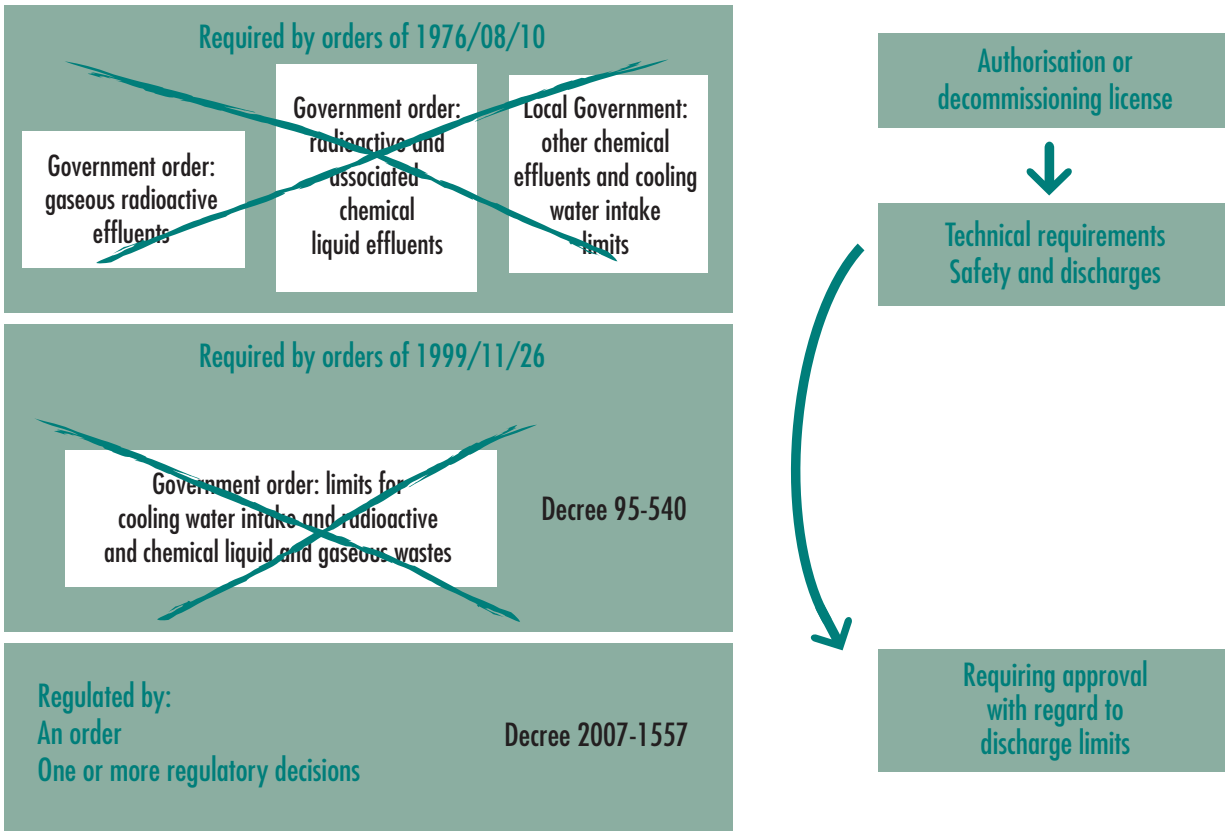
At the end of this process, the choice of the form of discharge (liquid or gaseous) also plays a part in the approach designed to minimise the overall impact of the nuclear installation.

3|1 Regulating BNI discharges

3|1|1 Review of applications

Until decree 2007-1557 of 2 November 2007 concerning basic nuclear installations and the nuclear safety aspects of the regulation of radioactive material transport, water intake and discharges of liquid or gaseous effluents, whether or not radioactive, were regulated by ministerial order pursuant to decree 95-540 of 4 May 1995 concerning the discharge of BNI liquid and gaseous effluents and water intake.

Evolution of the regulatory system concerning basic nuclear installations: towards an integrated approach



This text constituted a key step in improving control of the administrative procedures regulating BNI effluent discharges into the environment. It in particular enables a single administrative procedure to examine all liquid or gaseous discharges, whether or not radioactive, and water intake.

3|1|2 Towards an integrated procedure

The TSN Act considerably modifies the conditions in which BNI discharges are controlled.

The purpose of the modification is to take greater account of environmental considerations alongside those concerning safety and radiation protection.

The licensee will therefore now be required to submit a single application covering all aspects: the installation creation (or decommissioning) application. The content of the application and the corresponding procedure are defined in above-mentioned decree 2007-1557. In the event of a favourable outcome, the application leads to the authorisation decree.

The technical considerations regarding discharges (limit values, monitoring, information, etc.) are then defined by ASN in technical requirements. As regards the discharge limits more specifically, the ASN decision is subject to approval by the Ministers responsible for nuclear safety.

3|1|3 Determination of limit values

The initial discharge limits were set on the basis of an impact lower than the health effect thresholds in force at the time.

The optimisation efforts required by the authorities and made by the licensees, led to these emissions being considerably 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. This in particular means that the former regulatory limits are no longer representative of the current levels actually discharged.

Table 1: trends in BNI discharge limits since 1995

Reduction factors of limit values 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:	*2.3*
– for the 1300 MWe nuclear power plants:		
Gaseous discharges:	*– gases (rare gases + tritium)*	*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*
	– alpha emitters:	*10*

ASN hopes that even though setting these limits does indeed reflect the very slight health or environmental impact, it will also encourage the licensees to maintain their efforts to optimise and contain discharges. It therefore wants to see the discharge limits set as low as can be made achievable using the best available techniques. In recent years, ASN has undertaken a revision of the discharge limits so that they are closer to the actual discharges observed, thus maintaining pressure on the licensees to comply.

The lowering of the discharge limit values leads to a reduction by the factors given in table 1.

ASN will supplement this approach by requiring BNI licensees to produce an annual forecast of their possible discharges. This forecast, which will necessarily be lower than the regulation limit, is designed to encourage them to carry out forward-looking management of their discharges that is as precise as technically possible.

3|2 Continuing the revision of discharge requirements

Updating the discharge requirements in line with the principles mentioned above on all the sites, requires continuation of the efforts that have been under way for a number of years now (60% of installations are currently regulated in full by measures implementing the above-mentioned decree 95-540). The improvements to be gained from implementation of these provisions are justification for continuation of this process.

In this respect, 14 dossiers are currently being reviewed (CEA: Saclay site, RJH, AGATE, MAGENTA; SOCODEI: CENTRACO; SET: GBII; COGEMA: TU5; EDF: Civaux, Chooz, Dampierre, Flamanville, Penly, Saint-Laurent A and B, Tricastin).

For the main licensees, the following progress has been made with regard to these procedures:

– EDF installations: at the request of ASN, EDF prepared a schedule for production of the licence renewal dossiers;
– CEA installations: the CEA centres are complex sites on which the installations are usually regulated by different authorities (ASN for the BNIs, Defence Nuclear Safety Authority (ASND) for secret BNIs, Regional Directorate for Industry, Research and the Environment (DRIRE) for installations classified on environmental protection grounds located outside a BNI perimeter). For these centres, procedures relating to discharges are in progress and are being coordinated by the various administrations concerned. To make analysis of the dossiers easier and inform the public better, ASN asked CEA to produce a dossier for each centre enabling the overall environmental impact of

the site's discharges to be assessed. 2007 was in particular an opportunity to carry out a number of public inquiries (Saclay site, AGATE, RJH and MAGENTA on the Cadarache site);

– fuel cycle and radioactive waste disposal installations: the site mainly concerned is that of La Hague, operated by COGEMA. This installation was regulated by an order of 10 January 2003 which stipulated that the licensee was required to submit certain studies into limitation of its discharges by 1 January 2006. These studies were submitted and led to new technical discharge rules, as laid down in the order of 8 January 2007. 2007 also saw progress in the procedures covering the TU5, SOCATRI and COMHUREX installations on the Pierrelatte site.

3|3 Managing radioactive discharges from small-scale nuclear installations

The Public Health Code (Article R. 1333-12) states that the regulatory provisions for management of radioactive waste and effluents in installations other than ICPEs or BNIs must be specified in an ASN decision approved by the Minister responsible for health.

Discharges from medical installations are currently governed by the DGS/DHOS circular of 9 July 2001 concerning the management of effluents and waste from health care activities contaminated by radionuclides.

Problems with application of this circular by research and health professionals were mentioned, in particular during meetings on preparation of the national plan for management of radioactive materials and waste. A working group was set up to propose solutions.

Together with the professionals handling radioactive sources and the administrations concerned, ASN is drafting a text on this subject. This text will apply to all small-scale nuclear activities generating radioactive effluents.

To ensure that this regulation can be implemented in full, ASN is carrying out wide-ranging consultations. Thus in 2007, the professionals concerned and the stakeholders were questioned for the second time. Numerous meetings to present the principles of this draft text were organised.

It is ASN's intention to implement these regulations in 2008.

At Saint-Laurent-des-Eaux (41): the Loire river, a UNESCO world heritage site needing protection

3|4 The radiological impact of nuclear activities

Under the principle of optimisation, the licensee is required to reduce the radiological impact of its installation to values as low as reasonably achievable based on economic and social factors.

The purpose of minimising the health impact of nuclear installations in normal operation is to prevent possible effects prejudicial to health associated with exposure to ionising radiation, however slight. This primarily concerns the cancer risk.

The licensee is required to assess the dosimetric impact of its activity. Depending on the case, this obligation arises from Article L. 1333-8 of the Public Health Code, or from the regulations concerning BNI discharges.

This assessment takes account of the discharges through the identified outlets (stack, discharge pipe to river or seawater). It also includes diffuse emissions and the sources of irradiation present in the installation. These elements are the "source term".

The impact is estimated in relation to one or more identified reference groups. These are homogeneous groups of individuals receiving the highest average dose from among the population exposed to a given installation according to realistic scenarios. This approach enables the total dose to be compared with the allowable annual dose limit for the public (1mSv/year) defined in Article R. 1333-8 of the Public Health Code.

Prior to licensing, the impact is assessed against the specified annual limit, taking account of the radionuclides liable to be discharged. This assessment is checked every year on the basis of the radionuclide activity measured in the discharges, to which should be added irradiation (in particular due to interim storage of waste).

In practice, only traces of artificial radioactivity are detectable in the vicinity of the nuclear installations. As soon as one moves away from the installation, the activity levels fall below the sensitivity threshold of the measuring instruments and cannot therefore be used for dose estimates. It then becomes necessary to use models of radioactivity transfer to man, fed by installation discharge measurement data. Nonetheless, programmes to monitor the radioactivity present in the environment (water, air, milk, grass, earth) are imposed on the licensees in order to check compliance with the scenarios postulated in the impact assessment. The laboratories performing these measurements must first be approved (see point 2|1).

An estimation of the doses from BNIs is presented in table 2. This table constitutes a step towards complying with one of the recommendations expressed by IRRS: "ASN should consider inclusion of doses to the critical group from Basic Nuclear Installations in its Annual Report as well as descriptions of their meaning in terms of public health protection, and should assess the cause for differences between sites and different operational years". The doses presented are estimated by the licensees using methods that need to be harmonised.

Aerial view of the mine and ore processing plant today decommissioned – Hérault (34)

Table 2: compilation of information supplied by the nuclear licensees concerning the dose received by the most exposed reference group in the vicinity of the nuclear site

Licensee/Site	Most exposed reference group (population/distance from site in km)	Estimation of received doses, in mSv				
		2002	2003	2004	2005	2006
AREVA/La Hague	Digulleville (Child/2.6) Fisherman, Goury (Adult/7.5)	1.10^{-2} 6.10^{-3}	1.10^{-2} 7.10^{-3}	1.10^{-2} 6.10^{-3}	1.10^{-2} 6.10^{-3}	1.10^{-2} 6.10^{-3}
CEA/Saclay	Fishermen, Christ de Saclay (Adult/1) Farmers, Christ de Saclay (Adult/1)	6.10^{-3} 3.10^{-3}	4.10^{-3} 1.10^{-3}	4.10^{-3} 7.10^{-4}	4.10^{-3} 5.10^{-4}	5.10^{-3} 5.10^{-4}
EDF/Flamanville	La Berquerie (Adult/0.8)	3.10^{-3}	3.10^{-3}	3.10^{-3}	5.10^{-3}	5.10^{-3}
GANIL/Caen	IUT (Adult/0.6)	2.10^{-3}	2.10^{-3}	3.10^{-3}	2.10^{-3}	3.10^{-3}
EDF/Paluel	Le Tôt (Adult/1.45)	2.10^{-3}	2.10^{-3}	2.10^{-3}	2.10^{-3}	2.10^{-3}
AREVA/Tricastin (Areva NC, Comurhex, Eurodif, Socatri)	Les Prés Guérinés (Adult (2005: child)/ 3; 3.1 ; 2.16 ; 1.3)	3.10^{-3}	2.10^{-3}	2.10^{-3}	2.10^{-3}	1.10^{-3}
EDF/Nogent	Port Saint-Nicolas (Adult/2.25)	*	*	6.10^{-4}	7.10^{-4}	8.10^{-4}
ANDRA/Manche	Hameau de La Fosse (Adult/2.5) Fisherman, Goury (Adult/8)	8.10^{-4} 2.10^{-7}	9.10^{-4} 6.10^{-8}	9.10^{-4} 7.10^{-8}	8.10^{-4} 7.10^{-7}	8.10^{-4} 8.10^{-8}
EDF/Cattenom	Garche nord (Adult/2.15)	*	*	4.10^{-4}	4.10^{-4}	7.10^{-4}
CEA/Marcoule (Atalante, Centraco, Phénix, Mélox, Cis-Bio)	Codolet (Adult/2)	3.10^{-4}	4.10^{-4}	4.10^{-4}	4.10^{-4}	4.10^{-4}
EDF/Blayais	Le Bastion (Adult/1.1)	*	3.10^{-4}	3.10^{-4}	4.10^{-4}	4.10^{-4}
CEA/Cadarache	Saint-Paul-Lez-Durance (Adult/2)	$<8.10^{-3}$	$<8.10^{-3}$	$<8.10^{-3}$	$<8.10^{-3}$	3.10^{-4}
EDF/Gravelines	Petit-Fort-Philippe (Adult/1.45)	*	5.10^{-5}	2.10^{-4}	2.10^{-4}	3.10^{-4}
EDF/Chinon	Le Neman (Adult/1.25)	*	2.10^{-4}	3.10^{-4}	3.10^{-4}	3.10^{-4}
EDF/Belleville	Neuvy sur Loire (Adult/1.3)	2.10^{-4}	2.10^{-4}	2.10^{-4}	2.10^{-4}	2.10^{-4}
EDF/Cruas-Meysse	Ferme de Grimaud (Adult/1.25)	*	6.10^{-5}	2.10^{-4}	2.10^{-4}	2.10^{-4}
EDF/St-Alban	Les Crès (Adult/1.45)	8.10^{-5}	9.10^{-5}	9.10^{-5}	2.10^{-4}	2.10^{-4}
EDF/Golfech	Pascalet (Adult/0.85)	*	*	*	*	2.10^{-4}
EDF/St-Laurent	Port au Vin (Adult/0.7)	9.10^{-5}	2.10^{-4}	7.10^{-5}	7.10^{-5}	9.10^{-5}
CEA/Fontenay aux Roses	Fontenay aux Roses (Adult/1.5)	*	*	*	6.10^{-4}	1.10^{-5}
ANDRA/CSA	CD24 overpass (Child/2.1)	5.10^{-6}	8.10^{-5}	8.10^{-6}	6.10^{-6}	5.10^{-6}
CEA/Grenoble	Fontaine (gaseous discharges); Saint-Egrève (liquid discharges) (Baby (2003, 2004: adult)/1 ; 1.4) Saint-Egrève (liquid and gaseous discharges) (Baby (2004: adult)/1.4 ; 3.9)	3.10^{-6} 2.10^{-6}	2.10^{-5} 2.10^{-6}	7.10^{-6} 3.10^{-6}	7.10^{-7} 4.10^{-7}	2.10^{-6} 8.10^{-7}

* Information not supplied by the licensees.

Source: Annual reports from the licensees concerned when this is required by the discharge licenses (data rounded up to the higher unit).

Therefore certain licensees overstate the impact of their site by using the sensitivity threshold of the instrument in their calculation, instead of the actual value. As this estimate was not required in the past, the data concerning certain years or certain sites are not available.

For all the nuclear sites presented, the radiological impact remains far lower than one percent of 1 mSv per year. ASN is of the opinion that in France, the discharges produced by the nuclear industry have an extremely small health impact.

3|5 The other discharge characteristics

3|5|1 Discharges of chemical materials

Application of above-mentioned decree 95-540 led to improved regulation of discharges of chemical materials. This aspect had for a long time been hidden, but BNIs also discharge such materials. ASN wanted to see BNIs regulated in this field in the same way as industrial installations. Monitoring of these recently regulated materials provided a clearer picture of the quantities actually discharged. This led to a real reduction in the discharges, particularly with respect to metals. This integrated approach is little used abroad, where chemical discharges are often regulated by an authority different from that in charge of radiological matters.

3|5|2 Thermal discharges from BNIs

Some BNIs (in particular the nuclear power plants operated by EDF and the EURODIF facility) discharge cooling water effluents, 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 lead to a temperature rise, between upstream and downstream of the discharge, of between a few tenths of a degree and several degrees. They are thus subject to regulation.

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 installation.

The measures taken following the 2003 heat wave and drought meant that the 2005 drought episode was dealt with in good conditions, in particular ensuring full compliance with the discharge licences applicable. The summer of 2007 did not lead to any severe low-water situations or any very high temperatures in the watercourses concerned by the BNIs.

3|6 Monitoring discharges

3|6|1 Discharge surveillance

Surveillance of discharges from an installation is essentially the responsibility of the licensee. The provisions regulating discharges stipulate the minimum checks that the licensee is required to carry out. These checks in particular concern effluents (monitoring of discharge activity, characterisation of certain types of effluent prior to discharge, etc.). They also contain provisions for monitoring in the environment (checks at mid-discharge, sampling of air, milk, grass, etc.). Finally, related parameters must also be measured whenever necessary (in particular meteorology).

The results of the regulatory measurements must be stored in registers which, in the case of BNIs, are forwarded on a monthly basis to ASN, which checks them.

BNI licensees are also required regularly to transmit a number of discharge samples to an independent laboratory for analysis. The results of these "cross-checks" are communicated to ASN. The nature of the cross-check programme, specified by ASN, is designed to bolster the conviction that the results obtained by the licensees are in fact accurate. 2007 saw a complete revision of the cross-check programmes on most of the installations.

Finally, ASN uses a system of unannounced inspections to ensure that the licensees abide by the regulations.

IRSN measurement laboratory

During the course of these inspections, inspectors – assisted when necessary by technicians from a specialised, independent laboratory – check compliance with the regulation requirements, take samples from the effluents or the environment, and have them analysed by this laboratory. Since 2000, ASN has carried out 10 to 30 inspections - with sampling - every year (17 in 2007).

3|6|2 Accounting of BNI discharges

The lowering of the activity level of the radioactive effluents discharged by BNIs, the changes made 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 ASN to change the radioactive discharge accounting rules in 2002.

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 measurements;
– compulsory detection limits are defined 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. These evolving reference spectra are based on experience feedback from the analyses carried out. When the activity is lower than the decision threshold, then the latter value is used;
– other radionuclides, which are occasionally present, are considered if their activity concentration is higher than the decision threshold.

These rules are now applied in all nuclear power plants and in most laboratories and other plants (CENTRACO, the COGEMA and ANDRA La Hague establishments, FBFC in Romans-sur-Isère, CEA centre at Cadarache, and so on). They will be applied to the other sites as their discharge licence orders are renewed. Other countries around the world use different accounting methods. This diversity makes it difficult to compare the results published by the various national authorities.

Quality of measurement is a precondition if the results obtained and published are to be conclusive. The desire to improve this quality has led ASN to set up a system for approval of laboratories measuring radioactivity in the environment. Complex tests were organised and have without doubt improved practices. In the field of effluent measurement, in view of the shortcomings in the available body of standards, ASN supported the creation of a working group by the nuclear equipment

ASN inspection with sampling in the Cattenom nuclear power plant

With regard to the measurements:

– The decision threshold (SD) is the value above which the measurement technique guarantees that a radionuclide is present.

– The detection limit (LD) is the value above which the measurement technique gives a reliable result.

In practice LD ≈ 2 x SD

standardisation office (BNEN). This programme will eventually produce a set of high-quality methods that are standardised and therefore comparable.

3|7 Informing the public about discharges

ASN feels that a key issue for regulation of discharges is to allow appropriate involvement of the stakeholders.

The public is involved in the authorisation procedures via the public inquiry. ASN ensures that this public inquiry process enables the public and the associations interested to express their points of view.

During the life of the installation, ASN ensures that the licensees send it an annual report on the environmental impact of their installations. This report (whose content is defined by the ministerial order of 26 November 1999 setting the general technical requirements concerning the limits and procedures for sampling of BNI discharges subject to licensing) presents all relevant information for the past year. It is sent to the local information committee for review.

Finally, as part of the work to revise the order of 26 November 1999, ASN is conducting wide-ranging consultations including the associations. In 2007, the professionals concerned and the stakeholders were questioned, once with regard to what they expected from such a text, and a second time to obtain their comments on the principles adopted in the drafting of the new regulations. Numerous meetings were held to present the principles of this draft text.

3|8 Joining an international movement

3|8|1 "Oslo-Paris" or OSPAR Convention

France has ratified the OSPAR international convention which entered into force on 25 March 1998. This convention replaces and follows on from the previous Oslo and Paris conventions.

ASN duly noted 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 materials into the North-East Atlantic, so that the concentrations in the marine

Reference spectra used for EDF

As an example, the following reference spectra are used for EDF:

– Liquids:
  – ^{3}H,
  – ^{14}C,
  – Iodines: ^{131}I,
  – Other fission and activation materials: ^{54}Mn, ^{58}Co, ^{60}Co, ^{110m}Ag, ^{123m}Te, ^{124}Sb, ^{125}Sb, ^{134}Cs, ^{137}Cs.

– Gases:
  – ^{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 materials: ^{58}Co, ^{60}Co, ^{134}Cs, ^{137}Cs.

environment fall to close to zero by 2020 for artificial materials, and close to background values for NORM.

In 2006, the OSPAR "Radioactive materials" committee examined the four-yearly report produced by France on the use of the best available techniques. Following this review, the Commission confirmed that France had met its obligation.

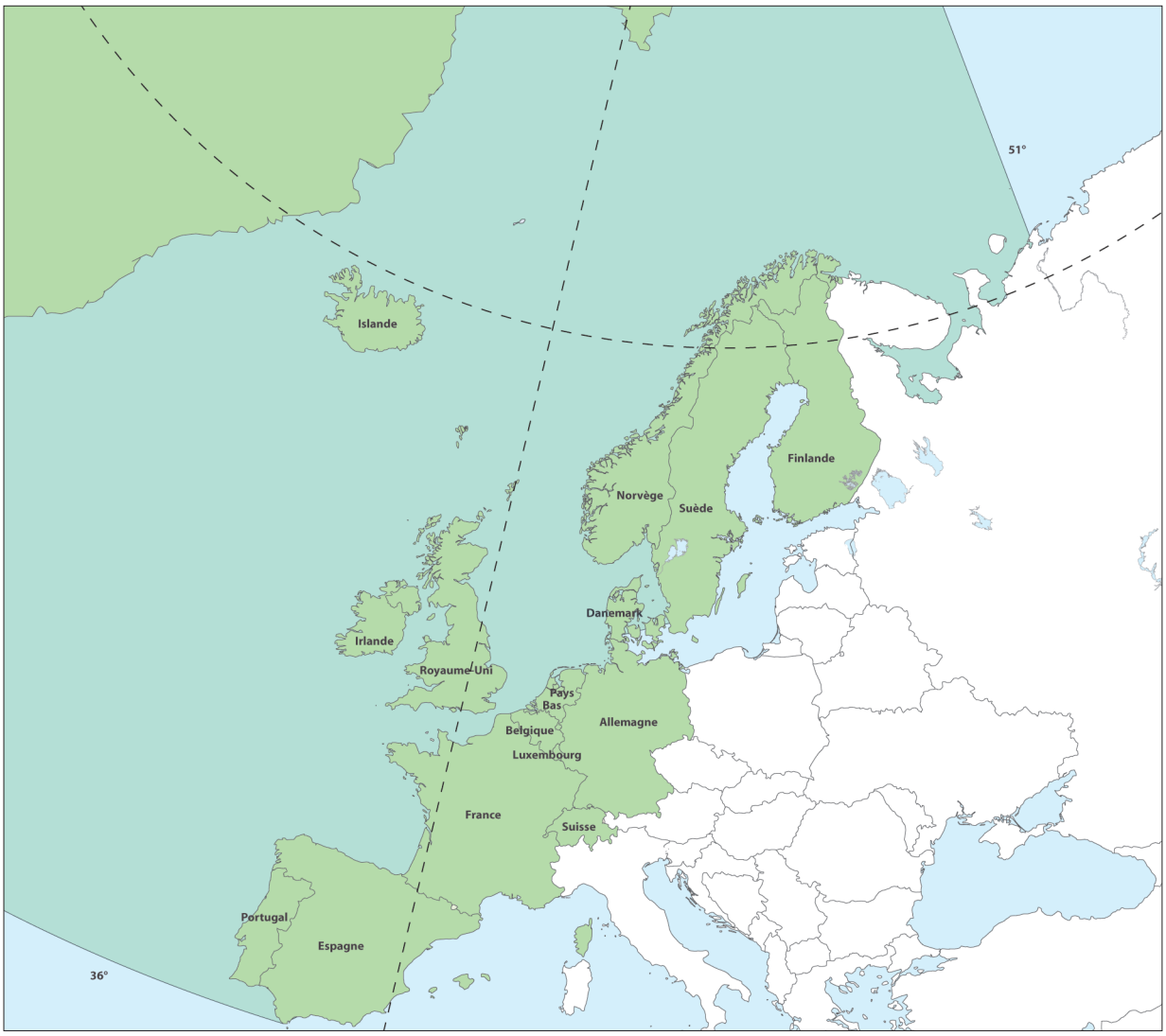
The Commission also carried out a review of implementation of the "discharges" part of the "radioactive materials" strategy. This report states that the comparison between discharges in recent years and the reference (baseline) indicates a fall in most of the characteristics included. It also indicates that the shortage of available data still means that this trend cannot be statistically proven. In 2007, the report on the estimation of concentrations in the environment was examined. It should be adopted by the Commission in 2008.

3|8|2 Euratom treaty

Chapter III of part II of the Euratom treaty deals with health protection as linked to ionising radiation.

Articles 35 (implementation of means for checking compliance with the basic standards by the member states), 36 (information to the Commission on environmental radioactivity levels) and 37 (information to the Commission on planned effluent discharges) deal with the issues of discharges and environmental protection.

Pursuant to Article 35, France agrees to verification by the European Commission. A verification within this context was conducted at the La Hague installation and IRSN's laboratories in October 2005. The international team in charge of the verification brought to light no significant deviation and underlined the quality of the monitoring system in place. The corresponding report



Ospar zone map

was published by the European Commission and can be accessed on its website. A verification will take place on the Pierrelatte site in 2008.

3|8|3 IAEA

In 2006, the International Atomic Energy Agency resumed work on creating a worldwide database of radioactive discharges, irrespective of the nature of the radionuclides discharged (natural or artificial) and their origin (nuclear installations, laboratories and miscellaneous industries, medical facilities, etc.). ASN contributed to this work by drawing the participants' attention to the difficulty of interpreting such a database given the diversity of the practices used by the various parties concerned in drawing up their discharge results. So far, ASN has forwarded the BNI radioactive discharge results for the period 2002 to 2006.

4 PREVENTING ACCIDENTAL POLLUTION, RISKS AND DETRIMENTAL EFFECTS, RESULTING FROM BNI OPERATION

4|1 Maintaining an appropriate regulatory framework

4|1|1 The order of 31 December 1999

The TSN Act identifies three distinct categories of installations present within the perimeter of a BNI, according to their use and the nature and scale of the risks they create:
– the BNI itself, according to the definition given in Article 28 of the act;
– the equipment and installations required for its operation;
– the other installations entered on one of the lists specified in Articles L. 214-2 (water) and L. 511-2 (ICPE) of the Environment Code.

The installations in the first two categories are bound by specific rules covering public health and safety as well as protection of nature and the environment. The general technical regulations that apply to them are defined by orders from the Ministers responsible for nuclear safety, clarified by ASN general decisions. Each installation is also subject to individual requirements defined by ASN.

The third category of installations remains subject to the provisions implementing the Environment Code. ASN is responsible for individual decisions and for regulation as specified in these provisions.

This requirement of the TSN Act enables the specific characteristics of nuclear activities to be taken into account. It guarantees consistency between the rules applicable to the BNI and its equipment and those applicable to installations governed by ordinary law, in particular with regard to prevention of pollution, detrimental effects and non-radioactive hazards.

The order of 31 December 1999 sets the general technical regulations designed to prevent and mitigate detrimental effects and off-site risks arising from BNI operations. It is supplemented by the requirements specific to each installation. More specifically, and in addition to the on-site 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).

4|1|2 Recent modifications

The order of 31 December 1999 led to progress in the way that detrimental effects and off-site risks resulting from BNI operations are dealt with. It represented an innovative breakthrough in 1999, and contained a number of intrinsic limits, concerning both the subjects it covered and the nature of its requirements.

The order of 31 January 2006 amending the order of 31 December 1999 led to adaptation of this order as follows:
– the procedures applying to fires were reformulated to concentrate on specific objectives;
– a special section was created for installations and equipment which do not significantly differ from installations classified on environmental protection grounds and to which general rules can be applied;
– the possibility of calling in an expert third-party at the expense of the licensee was introduced;

– a system of waivers to the resource deployment obligations contained in the order was introduced in order to deal with certain particular situations, although the objectives to be reached naturally remain unchanged.

4|2 Taking account of the various risks

4|2|1 Prevention of accidental pollution

The 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 led to:
– review of the design of storage, loading and unloading zones, with effective leak collection areas being required;
– implementation of an organisation able to deal with accidental spillage of liquids before they can transfer into the natural environment;
– installation of containment tanks in particular for collecting and treating fire-fighting water.

Application of these measures by the licensees led to significant progress in preventing accidental pollution. Pipeline routes and condition were checked, as was the condition of retention areas. Resources and organisational measures for fighting water pollution were put in place and tested.

4|2|2 Noise protection

The order of 31 December 1999 sets acceptable limits for noise. It requires a check on compliance with the specified noise limits. Implementation of these provisions showed that in certain operating configurations, installations exceed the emergence levels specified in the order of 31 December 1999.

Within the specified time, EDF therefore presented studies into the noise generated by the installations for which it was the licensee. These studies led EDF to take steps to reduce the emergence generated by its installations. During the review of these conformity alignment dossiers, it became apparent that river weirs made a significant contribution to the emergence levels on a site, even though they were not initially targeted by the regulations. To clarify this point, the decision was taken in the amending order of 31 January 2006 to explicitly exclude the noise produced by these works from emergence measurements.

4|2|3 Protection against the microbiological risk (legionella, amoebae)

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.

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.

Micro-organisms can therefore be found inside various installations: sanitary installations (showers, taps, etc.), air-conditioning installations and cooling systems (cooling towers, industrial cooling circuits), ponds and fountains, spa waters and medical equipment producing aerosols.

Legionella
Legionnaire's disease is an infectious pathology caused by legionella bacteria. The germ responsible is a bacillus living in fresh water, with an optimum proliferation temperature of between 35 and 40 °C. It can be found in all natural or man-made 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 conducive to the development of these micro-organisms:
– warm water between 25 and 45 °C;
– the presence of nutrients and elements essential for 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. Given current knowledge, ASN considers that owing to the complexity and size of BNIs, if a system is contaminated, then it will remain so and there will be a risk. Curative treatment will therefore be of only temporary effectiveness and will need to be regularly repeated.

The recent cases of legionnaire's disease in wet cooling towers led the Ministers for Health and the Environment

Cooling towers

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.

Therefore, to be able to react appropriately to a possible outbreak of legionnaire's disease, the authorities defined the required organisation in circular DGS/DPPR/DGSNR/DRT/2006/213 of 15 May 2006 concerning how to organise the government departments in the event of an outbreak of a cluster of cases of legionnaire's disease.

In the amendment to the order of 31 December 1999, ASN defined requirements for preventing and limiting the risk of legionella spreading. These requirements are comparable to those adopted for installations classified on environmental protection grounds. The characteristics of the cooling towers on PWR secondary system cooling systems justified the adoption of special measures. They are presented in chapter 12.

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 location conducive to 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 licences were issued to deal with releases linked to these treatments (see point 3|1).

4|2|4 Waste management

The order of 31 December 1999 sets the regulatory procedures for waste management, in particular the obligations with regard to collection and sorting of various categories of waste produced, conditions for interim storage and removal of waste, while ensuring consistency with plans and rules laid down by law, as well as requirements concerning traceability, specific and enhanced management of waste produced in nuclear waste zones and information to the public authorities concerning waste management.

To take account of the existence of radioactive and conventional waste within BNIs and ensure optimum management of it, the order states that the licensee must produce a waste management study, known as the "waste study". This stipulates the licensee's objectives in terms of reducing the volume and chemical, biological and radiological toxicity of the waste produced in its installations and of optimising waste management, with emphasis on reuse and treatment as opposed to final disposal, which is reserved for ultimate waste. The licensee defines the steps it employs in order to achieve these objectives. Decree 2007-1557 now requires the transmission of a first version of the waste study before the commissioning authorisation.

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 licensee 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 management framework which can be used for the statutory inspection.

ASN defined the precise requirements to be met by the nuclear licensees in drafting their waste studies and their annual waste inventories, in two instruction notes, SD3-D-01 (Nuclear waste study drafting guide) and SD3-D-02 (Specifications for the nuclear installations annual waste inventory), available from the ASN's website.

Waste management issues are described in greater detail in Chapter 16.

4|2|5 Checking installation conformity

Considerable work has been done by the licensees to check installation conformity with the requirements of the order of 31 December 1999, 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.

ASN for its part analysed these proposals. As applicable, it set deadlines for conformity of the installations.

ASN also conducted spot-checks during the site inspections on the completeness and accuracy of the information provided in the dossiers.

An "accidental pollution" exercice conducted during an inspection

As part of its annual programme of inspections and among the range of topics inspected, ASN systematically looks at the following aspects in each BNI, according to a predetermined frequency: requirements of the order of 31 December 1999, fire, environment, waste, external hazards including lightning.

On the basis of the checks it carried out, ASN estimates that most of the work to ensure conformity of the installations with the requirements of the 31 December 1999 order has been taken into account.

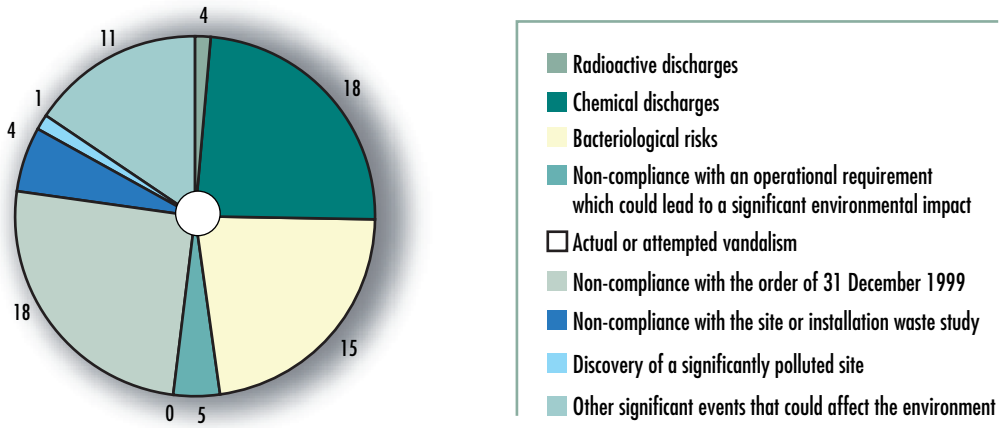
5 LEARNING THE LESSONS FROM ENVIRONMENTAL EVENTS

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. 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. The significant events declaration guide of 21 October 2005 in particular defines declaration criteria for environmental events (see chapter 4).

These provisions were implemented as of 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 materials inducing an impact, non-compliance with a technical or organisational requirement 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 contributed to achieving uniform declaration conditions and to ensuring that all available lessons are learned.

In 2007, 76 significant environmental events (including those relating to waste management) were declared by the BNI licensees, as shown by the following breakdown.



Significant environmental events for the year 2007 (BNI)

6 OUTLOOK

ASN is of the opinion that in France, the radioactive discharges produced by the nuclear industry, medical activities and other industrial and research activities, have an extremely small health impact.

Nonetheless, in order to respond to public expectations, ASN feels that the reduction in radioactive discharges in France must continue. It will contribute to this by setting discharge licence limits, by encouraging the producers to use the best available technologies and by performing checks in complete transparency.

ASN will check that the producer assumes its responsibilities from the design of the installation onwards, and throughout its operation. It will be attentive to optimising discharges and reducing their impact. ASN will also ensure that the public and CLIs are better informed by the producer about discharges and their impacts, in accordance with the obligations of the Act on Transparency and Security in the Nuclear Field (TSN).

ASN in particular wishes to improve the quality of the information given to the public, by setting up a system

more closely focused on the calculated health impact (doses in micro- Sieverts) than on accounting of the discharges (measurements in Becquerels). It will work on defining an index for assessing this impact. ASN also wishes to see a real strategy drawn up so that the objectives of the various surveillance programmes can be clearly defined. In order to achieve this complex goal, it is chairing a think tank involving various stakeholders.

With regard to discharges from small-scale nuclear installations, a draft decision has been prepared. Its implementation in 2008 should further improve the conditions for management of these discharges.

Finally, ASN will ensure that the nuclear licensees correctly apply the revised criteria for declaring significant events, particularly in the environmental field. This review will be conducted with the goal of maximising the lessons learned from experience.

CHAPTER 6

1 DEVELOPMENT OF RELATIONS BETWEEN THE NUCLEAR SAFETY AUTHORITY AND THE PUBLIC

1 | 1 From public information to transparency

1 | 2 ASN's information media
1 | 2 | 1 ASN's website, www.asn.fr
1 | 2 | 2 The *ASN report on the state of nuclear safety and radiation protection in France*
1 | 2 | 3 *Contrôle* magazine
1 | 2 | 4 ASN publications intended for the general public

1 | 3 The public information and documentation centre

1 | 4 ASN's regional actions
1 | 4 | 1 Public information actions by the regional representatives and division heads
1 | 4 | 2 Exhibition: "Nuclear applications and society: from understanding to regulation"

1 | 5 ASN and the media
1 | 5 | 1 Press relations
1 | 5 | 2 ASN and the media in emergency situations
1 | 5 | 3 Training in communication and media relations

1 | 6 ASN and professionals
1 | 6 | 1 Publications intended for professionals
1 | 6 | 2 Professional symposia

2 THE RIGHT TO NUCLEAR SAFETY AND RADIATION PROTECTION INFORMATION

2 | 1 Information released by the licensees
2 | 1 | 1 Distribution of information by the licensees
2 | 1 | 2 Access to information in the possession of the licensees

2 | 2 Public information procedures

2 | 3 Information released by the other stakeholders

3 LOCAL INFORMATION COMMITTEES AND NATIONAL ASSOCIATION OF LOCAL INFORMATION COMMITTEES

3 | 1 Local Information Committees

3 | 2 The Federation of Local Information Committees: the National Association of Local Information Committees

4 THE HIGH COUNCIL FOR NUCLEAR SAFETY AND INFORMATION AND THE HIGH COMMITTEE FOR TRANSPARENCY AND INFORMATION ON NUCLEAR SECURITY

5 INSTITUTE FOR RADIATION PROTECTION AND NUCLEAR SAFETY

6 OUTLOOK

As part of ASN's duty to inform, recalled in Act 2006-686 of 13 June 2006 on Transparency and Security in the Nuclear Field (known as the "TSN" act), this report presents a picture of nuclear safety and radiation protection in France in 2007. In this chapter, ASN describes its actions and tools for public information and transparency.

The information released by ASN is aimed at a variety of audiences, that ASN places in three main categories.

The first category is the "general public". This concerns people who either for personal reasons or because of current events find themselves at one time or another interested in ASN and what it is doing. Their interest in nuclear matters is generally linked to topical, newsworthy events. In this category, patients who are the victims of a medical error during treatment involving ionising radiation figure prominently. The information released by ASN in this context, and which does not deal with the medical aspects of the event, can in no way take the place of the professional obligations incumbent upon those in charge of treatment with regard to information of the patients concerned.

The second category is the "informed public". This concerns people interested in nuclear matters in general and its regulation in particular: elected officials, members of parliament and in particular the members of the Parliamentary Office for the Assessment of Scientific and Technological Options (OPECST), environmental protection associations, members of Local Information Committees (CLI), the media, and so on.

The last category is the "professional public". This includes licensees of nuclear installations, carriers of radioactive materials, health professionals, learned societies and trade unions which require operational and regulatory information issued by ASN.

This chapter presents ASN public information activities. Since 2003, it also presents the tools and actions concerning public information about nuclear safety and radiation protection under the responsibility of other nuclear 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 regulating 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 setting up the General Directorate for Nuclear Safety and Radiation Protection (DGSNR) expanded this public information duty to cover radiation protection: DGSNR is responsible for "contributing to public information on subjects related to nuclear safety and radiation protection".

Finally, the above-mentioned TSN act, which gives ASN the status of an independent administrative authority, states that ASN takes part in information of the public on nuclear safety and radiation protection.

Thus, at each institutional change concerning how civil nuclear activities regulation is organised in France, ASN's public information role was confirmed.

In order to discharge these duties, 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.

It informs and notifies the various information providers and in particular contributes to regularly informing the media by holding thematic press conferences. It also aims to encourage the actions of the CLIs. By virtue of article 23 of the TSN Act, it is a member of the High Committee for Transparency and Information on Nuclear Security (HCTISN). Until it was dissolved, it also handled the secretariat for the High Council for Nuclear Safety and Information (CSSIN) to which it regularly reported on its actions. ASN maintains ongoing relations with elected officials and environmental protection associations.

In addition, ASN wishes to expand participation by the stakeholders (elected officials, representatives of environmental protection associations, of industry or administrations, and

ASN – Image and awareness

In 2007, together with the TNS SOFRES poll institute, ASN once again used the profile and image barometer used for the first time in 2005. This barometer is designed to quantify ASN's recognition level and the degree of satisfaction of two samples of the public with regard to its information actions. It enables ASN to adapt its information policy both locally and nationally.

The third round of this opinion survey took place in October and November 2007 with a representative sample of the general public and a sample representing the more informed public (in particular consisting of journalists, elected officials, association managers, administrators, CLI chairmen, health professionals and teachers).

The latest survey shows that ASN's profile with the general public is stable: 21% of those questioned spontaneously mentioned or recognised the name of ASN as the organisation responsible for regulating nuclear matters in France, a proportion similar to that of 2006 and 5 points higher than in 2005.

Among the informed public, ASN's recognition level has progressed significantly, as 68% of this public mentioned or identified ASN, representing a 5 point improvement over 2006 and a 7 point jump in relation to 2005.

Identification of its missions varies little: the general public still places greater emphasis on the regulation of nuclear installations and activities (79% of those questioned) than on legislative duties (8% in 2007, 13% in 2006) or its information role (5% in 2007, 4% in 2006).

The informed public confirmed its greater familiarity with ASN because 90% (3 points up over 2006) identified the regulatory role, 37% the legislative role (+ 8 points in relation to 2006) and 23% the information role (improvement of 2 points over 2006).

so on), in the drafting of general legislative and regulatory texts. 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.

Information of the public and transparency concerning nuclear activities were further enhanced by the TSN Act, which recognises the public's right to access the information in the possession of the nuclear installation licensees and the persons responsible for the transport or in the possession of radioactive materials.

1 | 2 ASN's information media

1 | 2 | 1 ASN's website, www.asn.fr

The ASN website, www.asn.fr, is ASN's main public information tool, with a monthly average of more than 52,000 visits and a constantly rising audience after 7 years of existence.

It presents nuclear safety and radiation protection news in France, as well as ASN's actions and positions within its areas of competence. The www.asn.fr site informs the web user about a range of subjects as varied as nuclear installations, radiotherapy, radioactive waste management, protecting installations against earthquakes, or even detecting lead in paint.

The homepage shows the last 8 news subjects published, plus a link for subscription to a streaming news service (RSS). The site is organised around 10 main headings presenting ASN and its activities, regulation of civil nuclear activities in France, reference texts, publications, reports on specific topics and local information. Alongside the institutional headings, ASN proposes thematic headings for professionals, concerning the ASN's public information and documentation centre, the CSSIN, or the CLIs.

As part of its move towards greater transparency, ASN has since 1 January 2002 been publishing on its website www.asn.fr the results of all inspections carried out by its inspectors on basic nuclear installations (about 700 per year). It also places on-line the letters sent out 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 regulation actions it carried out and

Homepage of the ASN website: www.asn.fr

the main events that occurred during the outage. These notices are published after the ASN has approved restart of the reactor concerned.

In order to make it easier to find the information being looked for, ASN has since October 2006 proposed a renovated site in a more pleasant graphic environment, with simpler browsing and enhanced content.

In 2007, new content and services were added to the site.

Therefore, pursuant to article 6 of the TSN Act which requires that ASN "brings to public notice its opinions and decisions deliberated by the college […]", an "ASN Official Bulletin" heading, devoted to the opinions, issues and decisions of the ASN commission, was created on www.asn.fr and is accessible from the homepage.

A new heading "*Sur l'agenda*" (Diary) for events in which ASN is participating or which it is organising, was also created.

At the same time, the content of the site was enhanced by new information in the professional area and the publication of two new thematic dossiers concerning the fuel cycle and the decommissioning of nuclear installations. These dossiers offer the readers a certain number of reference points (glossary, map of France, etc.) as well as a bibliography so that they can investigate a particular subject in greater detail.

The content was adapted to the web by adding greater interactivity. The web user can thus browse within a public information notice, for example that dealing with radon, read a summary before downloading the chapter of the annual report, give an opinion, subscribe to the report, or order it.

With regard to current news, the incident notifications heading has, since July 2007, been enhanced by information about events occurring in the medical, industrial and research fields. The events occurring in the medical field, in particular those concerning radiotherapy, were grouped on a thematic basis.

The English part of the site was also developed in 2007, with the creation of a dedicated access link, http://nuclear-safety.asn.fr, containing all site content in English and a heading devoted to the ASN annual report in English (http://annual-report.asn.fr). Information about French nuclear safety and radiation protection news is also regularly placed on-line.

Since it was first set up in May 2000, ASN's website has seen its audience steadily grow. During the course of 2007, it was visited more than 625,000 times, with a monthly peak of more than 67,000 visitors in June 2007.

1 | 2 | 2 The *ASN Report on the state of nuclear safety and radiation protection in France*

The ASN Report on the state of nuclear safety and radiation protection in France is the result of collective analysis and summary work involving all ASN entities. Its aim is to constitute a reference document offering a yearly inventory of changes and of the problems encountered within the organisations regulated by ASN. It also enables coverage to be extended to take in nuclear safety and radiation protection projects and prospects and consequently proposes summary sheets on topical events or subjects raising particularly important issues.

In terms of distribution, this report is sent out to a list of subscribers. The subscribers to the ASN Report on the state of nuclear safety and radiation protection in France are representatives of the administration, local elected officials, licensees and those in charge of regulated activities or installations, associations, professional trade unions, learned societies, private individuals, and so on.

Since 1996, this report has been translated into English to promote exchanges between regulatory bodies and inform foreign nuclear safety and radiation protection stakeholders (experts, members of international organisations, licensees, researchers, journalists, teachers, etc.). This version has its own subscriber list, made up 70% of residents of non-French speaking countries, mainly in Europe (60%), Asia (14%) and North America (12%). The subscribers are usually from a scientific professional background.

The French and English versions of the ASN report can be downloaded from www.asn.fr, giving it a reach extending far beyond the subscriber distribution lists and enabling the reader easily to consult the chapter(s) of particular interest to him or her. Since 2006, for the English version, the ASN website has a heading dedicated to the http://annual-report.asn.fr address, which is more interactive than the PDF files available for downloading (implementation of a range of tags for searches and for sending a page to a friend, submitting an opinion, subscribing to a newsletter about recent ASN publications in English, and so on).

1 | 2 | 3 *Contrôle* magazine

Every two months, ASN publishes a magazine called *Contrôle*. The readers of *Contrôle* in France are national and local elected officials, the media, journalists, members of the HCTISN and the CLIs, associations, licensees, administrations, private individuals, etc. Abroad, *Contrôle* is sent out in particular to the regulatory bodies of countries with which ASN has close relations.

Covers of the issues of *Contrôle* magazine published in 2007

Contrôle comprises a special report on a specific subject concerning nuclear safety and radiation protection, entitled "*Les Dossiers de Contrôle*", and a current affairs part reporting in particular on ASN activities, especially at regional level.

The special report presents the ASN view of the subject covered and gives an opportunity for the various stakeholders concerned to express themselves: licensees, administrations, experts, environmental protection associations, journalists, etc. ASN's foreign counterparts are also asked for their viewpoint and an article is regularly devoted to an example from a sector of activity other than nuclear. The readers are thus offered a broad panorama and diverse approaches to the same subject, enabling them to draw their own conclusions. The "*Dossiers de Contrôle*" are also published separately and can be consulted on the website www.asn.fr.

In addition, *Contrôle* presents nuclear safety and radiation protection news in the regions, major national and international events, as well as ASN's main decisions. It reports on the activities of the CLIs, the HCTISN, the BNI Consultative Commission (CCINB) and the Advisory Committees of experts.

Press conferences are organised when each issue of *Contrôle* is published. They are regularly attended by journalists from the general press and the specialist "nuclear", "environment" and "medical" press.

In 2007 *Contrôle* covered the following subjects:

– February: radioactive material transport safety (n° 174);

– March: nuclear safety and radiation protection in France in 2006 (abstracts) (no. 175)

– July: experimental reactors and their regulation (n° 176);

– November: radioactive discharges in France (n° 177).

Contrôle is a free publication and is distributed on the basis of voluntary subscription (subscription form available on www.asn.fr or by mail from the following address: ASN Publications, 6, place du Colonel Bourgoin, 75572 Paris Cedex 12). Out of print numbers can be consulted at the ASN's public information and documentation centre.

1 | 2 | 4 ASN publications intended for the general public

ASN's national presentation brochure

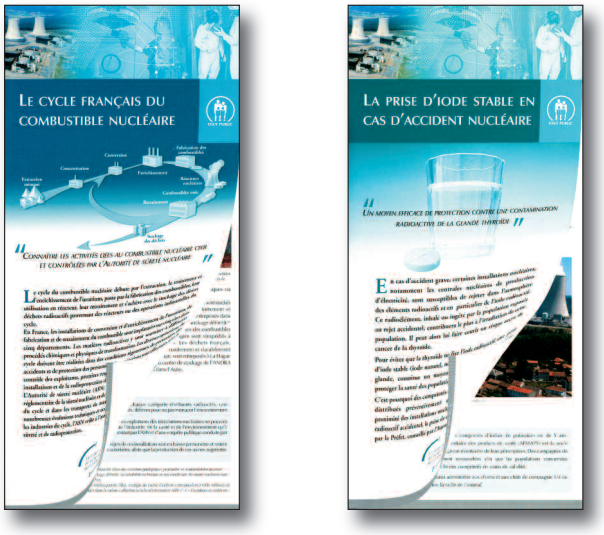
ASN's new brochure presents its status and the resources it deploys so that, on behalf of the State, it can regulate nuclear safety and radiation protection and inform the citizens. The brochure describes ASN's organisation, aims, values and roles and its organisation chart. It is in particular distributed at meetings and events attended by ASN and is also available in English.

ASN regional division presentation brochures

ASN's new status has led to a higher profile for it in the

ASN presentation brochure

regions, which is why the presentation brochures for each of ASN's eleven regional divisions were published in 2007. These brochures present the regulation of nuclear safety and radiation protection in the regions under the responsibility of each of the ASN regional representatives, along with the contribution by the divisions to information of the public. They present the nature of the installations regulated and give figures on the make-up of the



Some public information sheets

ASN teams in the regions and the number of inspections performed every year.

Each regional brochure is incorporated into the ASN national presentation brochure.

The brochures are distributed at meetings, at training sessions and at the regional symposia attended by the divisions. They are also communicated to the local administrations (*préfectures**, DRASS, DDASS, DRTEFP, etc.), to the stakeholders (CLI, environmental protection associations, media, etc.), to the heads of the installations and activities regulated, to professional trade unions, and so on.

ASN's public information and documentation centre brochure

This document presents the information centre and outlines its documentary base and the practical aspects of how it works. It is widely distributed to various information providers: documentation centres for teachers, "major risks" contact persons in the academies, science museum media libraries, libraries of the leading colleges, CLIs, exhibition and symposia sites in which ASN participates, as well as the communication departments of DRASS, DDASS and the *préfectures*.

The information sheets

The "ASN information sheets" are designed to provide targeted, concise and teaching 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 ASN participates and are sent out to various information providers such as CLIs and the documentation centres for teachers. They are also available to the regional divisions for local communication operations.

The collection currently comprises 7 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.

Sheet no. 3, "Nuclear or radiological: which term to use?" clarifies the definition and usage of these two words in various fields of activity (industry, medical, research) 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 regulated.

Sheet no. 6, "Radiological emergency situations", presents the 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.

Sheet no. 7, "Radon", explains the origin of this radioactive gas, the risk it presents for individual health, the possible preventive or corrective steps and the measures provided for in the regulations to reduce this risk.

Sheets n° 1, 2 and 6 were republished in 2007.

*Office of the *préfet* (in a *département*, représentative of the State appointed by the President).

1|3 The public information and documentation centre

The Public Information and Documentation centre was inaugurated in 2004 and is open to all (professionals, students, associations, private individuals) in ASN's Paris premises.

It offers more than 1,000 documents for consultation, covering ASN's areas of competence: nuclear safety, radiation protection, but also radiophysics, radiochemistry, design of nuclear installations, nuclear medicine, radioactive waste management, the fuel cycle, risk management, the environment, regulations, etc. The centre also offers on-site consultation of original administrative documents such as the public inquiry files pertaining to Basic Nuclear installation licensing or modification procedures and impact assessments.

In this centre, the public has access to all ASN publications (*Contrôle* magazine, annual reports, information sheets, etc.). It can also consult French and international publications on nuclear safety and radiation protection produced by the various stakeholders (CLIs, nuclear licensees, IRSN and other technical experts, radiology and radiation protection learned societies, professional associations, environmental protection associations and so on).

Two computers are available to visitors for consultation of the websites of the various nuclear and radiation protection stakeholders, along with educational CD-Roms. Audiovisual documents can also be viewed.

In 2007, ASN's Public Information and Documentation Centre answered requests from more than 1600 people (answers to questions from web users, transmission of publications) and welcomed about a hundred visitors.

1|4 ASN's regional actions

1|4|1 Public information actions by the regional representatives and division heads

The actions by the regional ASN representatives and division heads with regard to information of the public are a means, at regional level, of informing elected officials, the media and the public of the state of nuclear safety and radiation protection, along with ASN's regulatory, legislative and emergency situation management actions.

In 2007, in addition to their presence at several symposia and professional events (see point 1|6|2), the ASN's eleven regional divisions each organised a regional press conference, giving them an opportunity to explain their new status and the new organisation of ASN, to raise their profile locally and to present their nuclear safety and radiation protection achievements. During these press conferences, the regional representatives clarified the national and regional organisation and workings of ASN. They were in particular questioned on ASN's new status and its enhanced powers and duties.

1|4|2 Exhibition: "Nuclear applications and society: from understanding to regulation"

ASN and IRSN organise a permanent 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, 2 or 3 towns are chosen to host this 250 m² exhibition for a few weeks.

At each stop, the regional divisions help 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 2007, the "Nuclear applications and society: from understanding to regulation" exhibition visited Fontainebleau and then Tours. The 10 week exhibition received a total of 4,400 visitors, including about 225 school and high school students.

In 2007, some of the modules were updated and new animated models are under construction to help improve the interactivity of the exhibition.

1|5 ASN and the media

1|5|1 Press relations

The ASN press department is in charge of informing the media about ASN activities and current events as related to nuclear safety, radiation protection and their regulation.

In 2007, ASN's press relations were driven by the change in ASN's status to an independent administrative authority. In particular at a regional level, this helped raise the ASN profile and strengthened its credibility and legitimacy in its areas of competence.

Poster for the ASN/IRSN exhibition "Nuclear applications and society: from understanding to regulation

During the course of 2007, ASN's media relations activities were sustained at a very high level: more than 20 national and regional press conferences, 10 press releases, 60 information notes and numerous interviews informed the media of ASN's strategic positions as well as of latest developments in the field of nuclear safety and radiation protection.

A national press conference to present the ASN report on the state of nuclear safety and radiation protection in France gave ASN an opportunity to review 2006 and present its priorities for the coming year. At a regional level, a number of interviews, combined with the press conferences organised by the ASN regional divisions, were given on the subject of how ASN regulates nuclear safety and radiation protection in each region.

At the same time, the ASN inspections and its checks in the nuclear power plants and radiotherapy centres were of particular interest to the press. The *France 2* television channel accompanied ASN's Lyon division inspectors on an inspection of the Bugey nuclear power plant. National Geographic Magazine covered the inspections carried out by ASN's Caen division at La Hague. The France 3 Brittany local TV channel also covered a waste inspection in the Brennilis nuclear power plant.

The ASN press department was frequently contacted concerning topical subjects: the EPR authorisation decree, the lifetime of the Fessenheim power plant and, more generally, the lifetime and decommissioning of nuclear installations, the protection of nuclear power plants against earthquakes, The National Management Plan for Radioactive Materials and Wastes (PNGMDR).

The role and actions of ASN in the field of radiation protection of patients, in particular in the light of the radiotherapy accidents at Épinal and Toulouse, were the subject of sustained interest throughout the year and gave rise to numerous interviews, primarily in the audiovisual media.

In this context, and in order to facilitate communication with the public and media concerning radiation protection events involving patients, ASN in collaboration with the French Oncology Radiotherapy Society (SFRO), set up an experimental scale for rating of radiotherapy events. This scale was presented at a joint ASN-SFRO press conference in July 2007.

Throughout the year, ASN strengthened its role as the safety authority responsible for information of the public within its areas of competence. This was in particular the case with regard to radiotherapy incidents and accidents and the earthquake that struck Japan in July 2007.

ASN was queried by the international media (Australia, New Zealand, Germany) on subjects concerning the future of nuclear power around the world, the advantages and drawbacks of this power source in terms of safety, and the associated environmental issues.

The safe transport of radioactive materials, experimental reactors and radioactive discharges and releases were also the subject of press conferences timed to coincide with the publication of the *Contrôle* magazine.

1 | 5 | 2 ASN and the media in emergency situations

ASN will have to offer a suitable response should a serious event occur, in particular in a nuclear installation or during the transport of radioactive materials. It is preparing for this, and many of the emergency exercises (about ten a year) now include simulated media pressure. This media pressure, simulated by journalists hired for the exercise, is designed to assess the responsiveness of ASN when faced with the media, as well as the consistency 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 observing decision and

information channels in action, the deployment of the emergency assistance teams in the field, 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, elected officials, CLIs, etc.) during the exercises constitutes a further step forward in managing a real nuclear accident situation, which would inevitably lead to many and varied voices being heard at the same time.

In April 2007, ASN triggered its emergency response arrangements on two occasions:

– a Marne river traffic accident involving a radioactive package;
– failure of a component of the Dampierre-en-Burly (Loiret) nuclear power plant, which led to shutdown of an electrical switchboard supplying the reactor's safety system equipment.

ASN distributed press releases and placed them on-line to explain the reasons for and the consequences of each event, as well as the steps the licensees were asked to take.

1 | 5 | 3 Training in communication and media relations

With the aim of issuing high-quality, clear and comprehensible information, stripped of any over-technical vocabulary, ASN offers all of its staff training in spoken and written communication and emergency management.

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 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.

Type of events to which the INES scale applies
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 ASN, IAEA's member States are experimenting with a new INES part dealing with radiation protection incidents and covering radioactive sources and transport of radioactive materials. This new part, which concerns BNIs, incorporates the principle of the relationship between the radiological risk and the severity of the event. It is currently being experimentally applied to medical (excluding patients), industrial and research installations. The publication of the new INES manual by IAEA in 2008, incorporating this radiation protection part, will signify the end of this trial period.
Furthermore, ASN together with the French Oncology Radiotherapy Society (SFRO) initiated a one-year trial in July 2007 of a radiotherapy incidents rating scale inspired by the INES scale and which, in the longer term, is destined to be incorporated into it.

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 ASN, which alone is responsible for the final rating decision.
Using the INES scale enables ASN to select those events and incidents which are sufficiently important for it to issue a communication:
– all the events rated level 1 and above are systematically the subject of an incident notification published on the website, www.asn.fr. Events rated level 2 and above are also the subject of a press release and a declaration to IAEA;
– events rated level 0 are not the subject of an incident notification, unless they are of particular interest.

Rating of nuclear events on the INES scale in 2007

Level	Pressurised water reactor	Other facilities	Transports	Total
3 and above	0	0	0	0
2	0	0	0	0
1	56	20	10	86
0	708	89	45	842
Total	764	109	55	928

This training is tailored to their various responsibilities.

In 2007, communication training enabled:
– ASN's 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;
– 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 | 6 ASN and professionals

For ASN, the professionals in the field of nuclear safety and radiation protection are a particularly important audience. In addition to the section of its website, ASN drafts publications intended specifically for them and organises or takes part in many symposia, seminars and other events.

1 | 6 | 1 Publications intended for professionals

ASN produces publications intended for professionals, in order to highlight its actions and roles and to explain and encourage implementation of the regulations.

In 2007, it thus published guides, aimed at the professionals whose activities it regulates, presenting regulations and good practices in the fields of nuclear safety and radiation protection:
– the national guide for the declaration of significant events in the field of radiation protection outside basic nuclear installations and during the transport of radioactive materials (ASN/DEU/03);
– the national guide for medical intervention in the case of a nuclear and radiological event, intended for all emergency health professionals (hospitals, SMUR, SAMU). This guide contains all the information needed to take charge of nuclear or radiological accident victims. It is the result of collective work by the medical emergency professionals, coordinated by ASN.

All the ASN guides are available on the website www.asn.fr.

ASN also wishes to develop a collection of information brochures offering a concise presentation of the main provisions contained in certain of these guides, in order to facilitate implementation by the professionals concerned. For example, at the same time as the ASN/DEU/03 guide was issued in 2007, a summary was published to explain the principles of this new approach.

Furthermore, ASN more generally addresses those professionals who could be in contact with a radiological risk. Thus, for professionals who are not nuclear safety and radiation protection specialists, ASN produced an information brochure intended for those intervening in the event of a radiological emergency, in collaboration with the Directorate for defence and civil security.

This brochure, available on ASN's website ("Professionals" section) summarises the information and basic instructions to be followed by personnel liable to intervene in managing a radiological emergency, whether or not radiological risk specialists.

1 | 6 | 2 Professional symposia

ASN is also developing relations with professionals through the symposia it organises and through its participation in the events they organise. These events are also opportunities for exchanges with its foreign counterparts.

The professional symposia organised by ASN

An international workshop on operating experience feedback from ASN's IRRS review, carried out in November 2006, was organised by ASN on 22 and 23 March 2007 in Paris. This event brought together about a hundred regulatory boy heads from many countries, who were

National guide for medical intervention in the case of a nuclear or radiological event

thus able to discuss the goals, organisation and possible follow-up to such a review. ASN was thus able to share its experience and place France at the forefront of the process to harmonise international approaches and practices in the fields of nuclear safety and radiation protection.

Concerning post-accident management following a nuclear or radiological accident, an area in which ASN is responsible for drafting a national policy, a symposium was held on 6 and 7 December 2007. It enabled ASN to bring together the members of the thematic working groups set up to submit policy proposals and compare their work with that of their foreign counterparts, who were also invited.

The regional divisions also organise seminars for professionals, taking account of their regional particularities.

For example in 2007, the Caen division had discussions with industrial radiography professionals to present the principles of a charter of good practices aimed at assessing and preventing professional radiological risks in industrial radiography operations. This charter of good practices was signed at Le Havre on 11 December.

On 25 April 2007, The Lyon division organised a presentation of ASN and the issues of nuclear safety and radiation protection aimed at the professionals concerned in the Rhône-Alpes and Auvergne regions. The participants came from both the conventional nuclear industry and the small-scale nuclear sector: industrial radiology, nuclear medicine, radiology, radiotherapy, veterinary medicine, etc.

ASN participation in professional symposia

In 2007, ASN also took part in a large number of professional symposia.

It took part in scientific medical conferences, in particular organised by learned societies in the medical field: French Radiation Protection Society, French Radiology Society, French Medical Physics Society, French Oncology Radiotherapy Society, International Society of Radiobiology in the French language. ASN was thus able, with the professionals concerned, to look at changes in the regulation of radiation protection or its legislative framework, and answer specific questions. In addition to presentations by ASN during the course of these events, ASN stands were set up, in particular at the French radiology fair (20-24 October 2007) and the conference of the French Oncology Radiotherapy Society (28-30 November 2007).

Other events were an opportunity for ASN to present its positions in the field of nuclear safety. A round-table on the subject of radioactive waste was thus organised as part of the National Conference at la Baule on 26 and 27 September 2007.

ASN also made a contribution during the international ESOPE (European Symposium on Pressure Equipment) event organised by AFIAP (French association of pressure vessel engineers) and presented French regulations applicable to nuclear pressure vessels, at the opening session on 9 October.

At a regional level, the ASN divisions also took part in professional symposia.

In June, the Orléans division co-organised with EDF the 3rd Val de Loire Conference on the topic of dismantling nuclear installations and the Douai division took part in the "Industry and environment" symposium organised in September by the Nord Pas-de-Calais DRIRE.

In the medical field, the Nantes division took part in the nuclear medicine congress in Rennes, held in May, while the Marseille division took part in the radiology congress held in Monaco in June. In October, the Bordeaux division took part in the 13th edition of Hopitech, a trade fair devoted to national training in hospital techniques and engineering, in order to raise the radiation protection awareness of the professionals attending.

9th national waste conference at La Baule on 26 and 27 September 2007

More generally, the ASN divisions took part in professional meetings such as the regional seminars held by the Regional Union of independent physicians and the regional assemblies of health professionals (radiotherapists, radiation physicists, radiologists, oncologists, dental surgeons, dentists, etc.) and in professional continuous training courses, in particular for biomedical engineers or radiology operators, and for persons "with competence for radiation protection".

For example, the Caen division took part in the 9th meeting of the regional network (West and North) of the persons with competence for radiation protection, which took place in Caen University, on 18 October 2007.

These interventions, and this national and regional presence, help to raise the profile of ASN and establish ties with professionals, particularly in the small-scale nuclear sector, in order to improve implementation of the principles of safety and radiation protection.

Finally, on 5 December, in partnership with the National Association of Local Information Committees (ANCLI) ASN organised the 19th national conference of Local Information Committees, devoted to waste management and the role of the CLIs (see point 3|1).

2 THE RIGHT TO NUCLEAR SAFETY AND RADIATION PROTECTION INFORMATION

The TSN Act contains a number of extremely important provisions with regard to information of the public. Nuclear activities are now among those for which the Act requires the greatest possible transparency.

The Act in particular guarantees "the public's right to reliable and accessible information on nuclear security" (article 1).

This right to information concerns all fields of ASN activity, and in particular:
– informing the public about events occurring in BNIs or during the transport of radioactive materials, about discharges or releases from BNIs;
– informing workers about their individual radiological exposure;
– informing patients about the medical procedure, in particular its radiological aspect.

For its part, ASN has for a number of years been developing a public information policy and will therefore ensure the implementation of these new measures, which primarily target the licensees it regulates. As many of these new rules are being seen for the first time, questions may well arise. ASN will do all it can to allow discussion between all stakeholders concerning the problems encountered and the good practices to be employed.

2|1 Information issued by the licensees

2|1|1 Distribution of information by the licensees

The main licensees of nuclear activities operate a policy of voluntary information of the public.

They are also subject to a number of legal obligations, either general (such as the environmental report required by the Commercial Code for public limited companies), or specific, such as those pertaining to the nuclear sector. The TSN Act now requires that all BNI licensees issue a yearly report on their situation and their nuclear safety and radiation protection actions (see box for text of article 21 of the TSN Act). The report on any given year must be published no later than 30 June of the following year.

The first reports were drafted for 2006. ASN carried out an analysis of these reports, the main conclusions of which are summarised below.

All licensees fulfilled their official obligations within the allotted time. In order to do so, some reused reports that they had already written previously, but the vast majority of them produced a new document.

The reports always concern a site as a whole (or all the installations on a site operated by the same licensee). Some licensees even produced a standard report which was adapted to each of their sites.

The presentation, layout and content of the reports are relatively varied. Nonetheless, it is clear that these reports did at the least tackle the various issues mentioned by the Act and their presentation and vocabulary are compatible with being read by the general public.

Apart from the content of the reports, it is also worth looking at how they are produced and distributed. In this respect, the following aspects should be pointed out:
– the requirement to consult the Health, Safety and Working Conditions Committee (CHSCT) and to include its recommendations in the report, would seem to have been widely followed;
– the report was generally presented to the CLI concerned, whenever there was one;
– the conditions for distribution to the public vary (for example, some reports are available on the licensee's website, others are not) but publication of the report was generally kept quiet and surrounded by very little publicity.

The results of the first year in which article 21 of the TSN Act was applicable, would therefore seem to be positive: the reports were produced in good time and on the whole comply with the obligations laid down by the Act. ASN would like to see consultation with the licensees and public representatives, so that they can share their

A few licensee reports transmitted pursuant to article 21 of the TSN Act

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Chapter I
Right of information concerning nuclear safety and radiation protection

Article 18
The State is responsible for informing the public about nuclear safety and radiation protection regulation measures and results. It provides the public with information on the consequences in France of nuclear activities conducted outside the country, in particular in the event of an incident or accident.

Article 19
I. - Any person is entitled to obtain information from the licensee of a basic nuclear installation or, when the quantities are higher than thresholds laid down by decree, from the person in charge of a radioactive substances transport or in possession of such substances, whether said information is received or produced by it, concerning the risks linked to exposure to ionising radiation as may result from this activity and concerning the safety and radiation protection measures taken to prevent or mitigate these risks or this exposure, in the conditions defined in articles L. 124-1 to L. 124-6 of the Environment Code.
[…]

Article 21
All licensees of basic nuclear installations shall produce a yearly report setting forth:
– the steps taken concerning nuclear safety and radiation protection;
– nuclear safety and radiation protection incidents and accidents, subject to the declaration obligation pursuant to Article 54, which have occurred within the boundary of the installation, along with the steps taken to contain them and the consequences for human health and the environment;
– the type of measurements and results concerning radioactive and non-radioactive discharges from the installation into the environment;
– the nature and quantity of radioactive waste stored on the site of the installation, along with the steps taken to minimise the volume and the effects on health and the environment, in particular on soil and water.
[…]

experiences and, for the coming years, improve on the achievements of 2007, which nonetheless represent a good starting point.

2 | 1 | 2 Access to information in the possession of the licensees

Since the TSN act came into force, the nuclear field now has a unique system of public access to information.

Previously, access to nuclear-related documents was governed by two general texts which also applied to other fields:

– the act of 17 July 1978 introducing a variety of measures designed to improve relations between the administration and the public, which in particular instituted freedom of access to administrative documents: the administration was thereby required to release to whoever so requested the documents in its possession, whether it had received or produced them, with a number of exceptions primarily designed to prevent prejudice to public safety, industrial or commercial confidentiality, or to protect individual privacy and personal data; preparatory documents for a decision yet to be taken are also excluded from this right of access;
– chapter IV of part II of book I of the Environment Code, entitled "right of access to environmental information", which states that the public authorities and persons tasked with a public service duty relating to the environment, must communicate to anyone who so requests the information in their possession concerning the environment: this in particular concerns information regarding the state of the environment, information concerning decisions, activities and factors liable to have an impact on the environment, and information on human health, safety or living conditions whenever they could be altered by the environmental factors, or decisions taken in this field. As with the 1978 act, there are exceptions.

These two systems for access to documents and information naturally apply to the nuclear field. What they both share is an obligation of communication placed on the public authorities or those acting on their behalf.

Chapter I of part II of the TSN act of 13 June 2006, contains a major innovation in that it creates a right of access to information that is binding on the licensees. They are now required to communicate to whoever so requests, the information in their possession, whether received or produced by them, concerning the risks related to their activities and the safety or radiation protection measures they have taken to prevent or mitigate these risks.

This arrangement is consistent with the principle of the responsibility of the licensee: as the licensee has overall responsibility for the safety of its installation, but also for communicating about the risks created by its installation and the steps it intends taking to prevent or mitigate their consequences.

As with the other access rights mentioned above, the TSN act contains provisions, designed in particular to protect public safety or industrial and commercial confidentiality.

The procedures involved in the enforcement of this right are similar to those concerning the other information access rights: if a licensee refuses to communicate the information requested, the applicant may refer the matter to the administrative documents access commission (CADA) an independent administrative authority, which will then rule on whether or not the refusal is justified. Should the parties involved fail to abide by the CADA ruling, the administrative courts will decide on whether or not the information should be released.

This new right is a major change to the legal framework of transparency as applied to nuclear activities. Currently, there is no equivalent applicable to other fields.

This right of access entered into force on 14 June 2006 for licensees of BNIs. It could be extended to those in charge of transporting radioactive substances and those in possession of radioactive sources, other than BNI licensees, exceeding thresholds to be determined by decree.

ASN is regulating the implementation of this new right. The information collected in 2007 show that it is as yet little used. A few organisations have however invoked it and a request for release of information was even referred to the CADA at the end of 2007.

In a letter dated 24 December 2007, ASN asked the licensees to inform it of the measures they intend to take to comply with articles 19 and 21 of the TSN Act concerning information of the public.

2|2 Public information procedures

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

Articles L.121-1 and following of the Environment Code 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 of the *Conseil d'Etat**, if their socio-economic stakes are high or they have significant impacts on the environment or regional planning.

Nuclear projects are often subject to the public debate procedure. In 2005 and 2006, three public debates concerned the ASN, but in 2007, there were none.

The TSN Act and its implementing decree of 2 November 2007 reinforced public information and consultation concerning BNI-related procedures. The authorisation decree and the final shutdown and decommissioning authorisation for a BNI are now systematically subject to a public inquiry. These authorisations are also subject to the approval of the *Conseil général***, the municipal councils concerned and the CLI. Draft requirements to be issued by ASN concerning BNI water intake, discharges or detrimental effects are also presented to the CLI and the Departmental Council for the Environment and for Health and Technological Risks (CODERST).

2|3 Information issued by the other stakeholders

Nuclear safety and radiation protection are complex areas in which many parties are involved.

*France's highest administrative court.
***Département* level administrative council.

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 placed on-line varies in nature, from the most general to the most scientific, from the most general public to the most professional.

Below is a non-exhaustive list of the main websites dealing with nuclear matters in the broadest sense:

- 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).
  - www.irsn.fr (site of the Institute for Radiation Protection and Nuclear Safety).

- 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 National Assembly);
  - www.senat.fr (site of the Senate).

- Associations
  - www.criirad.com (site of the Commission for Independent Research and Information on Radioactivity);
  - www.fne.asso.fr (site of the French federation of nature and environmental protection associations);
  - www.greenpeace.fr (Greenpeace site);
  - www.robindesbois.org (site of the "*Robin des bois*" association);
  - www.sortirdunucleaire.org (site of the "*Sortir du nucléaire*" association).
  - www.wise-paris.org (Wise site);

- Local Information Committees (CLIs) and High Council for Nuclear Safety and Information (CSSIN)
  - www.ancli.fr (site of the National Association of CLIs, with links to the individual CLI sites);
  - www.asn.fr (the Nuclear Safety Authority's site is also the point of entry for the CLI and CSSIN sites).

- Higher education establishments and research centres (engineering colleges, universities, university hospitals, etc.).

- Licensees
  - www.andra.fr (site of the National Agency for Radioactive Waste Management);
  - www.areva-np.com (site of Framatome-ANP, manufacturer of the French nuclear reactors);
  - www.cea.fr (site of the Commissariat à l'énergie atomique);
  - www.areva-nc.fr (site of AREVA NC, formerly Cogema - *Compagnie générale des matières nucléaires*);
  - www.in2p3.fr (site of the National Institute for Nuclear Physics and Particle Physics);
  - www.laradioactivite.com (popularisation site, produced jointly by the CEA and the CNRS).
  - http://nucleaire.edf.fr (EDF site devoted to the French nuclear power plants).

- International organisations and bodies
  - www.ec.europa.eu (site of the European Commission);
  - www.iaea.org (site of the International Atomic Energy Agency);
  - www.nea.fr (site of the Nuclear Energy Agency).

- Learned societies
  - www.aidnsf.org (site of the International Nuclear Law Association (INLA));
  - www.sfen.org (site of the French Nuclear Energy Society).
  - www.sfr-radiologie.asso.fr (site of the French Radiology Society);
  - www.sfrp.asso.fr (site of the French Radiation Protection Society).

- Government sites
  - www.developpement-durable.gouv.fr (site of the Ministry for Ecology, Sustainable Development and Spatial Planning);
  - www.industrie.gouv.fr (site of the Ministry for the Economy, Finance and Employment);
  - www.interieur.gouv.fr (site of the Ministry for the Interior, Overseas Territories and Local Authorities);
  - www.ladocumentationfrancaise.fr;
  - www.legifrance.gouv.fr;
  - www.sante.gouv.fr (site of the Ministry for Health, Youth and Sports).

3 LOCAL INFORMATION COMMITTEES AND NATIONAL ASSOCIATION OF LOCAL INFORMATION COMMITTEES

3|1 Local Information Committees

The working framework for the Local Information Committees (CLIs)

Further to the circular from the Prime Minister, dated 15 December 1981, Local information Committees were set up in the 1980s around most of the nuclear installations, at the initiative of the *Conseils généraux*.

The TSN act further enhanced CLIs by giving them a legal status. Article 22 of this act provides for the creation of a CLI for each basic nuclear installation (a CLI may be common to several installations if they are located close to each other). It defines the role of a CLI as being a general one of monitoring, information and discussion concerning nuclear safety, radiation protection and the impact on individuals and the environment of the nuclear activities carried out on the site's installations.

The act confirms that creation of a CLI is the duty of the Chairman of the *Conseil général* and gives the list of the various categories of members: representatives of *Conseils généraux*, of the municipal councils or representative bodies of groups of *communes** and *Conseils régionaux* (regional councils) concerned, members of Parliament for the *département*, representatives of associations for protection of the environment or economic interests, representative employee and medical profession labour unions, as well as qualified personalities. The representatives of the State's departments, ASN, and those of the licensee have an automatic right to participate in the work of CLI, in an advisory capacity.

CLI is chaired by the Chairman of the *Conseil général* or by an elected official from the *département*** designated by him for this purpose.

CLI receives the information it needs to function from the licensee, from ASN and from the other State departments. It may request expert assessments or have measurements taken on the installation's discharges into the environment.

CLIs are financed by the regional authorities and by ASN. In 2007, ASN devoted about 400,000 euros to CLIs and the CLI association.

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 pursuant to the act 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.

The TSN act will lead to the creation of CLIs for a number of other basic nuclear installations which do not yet have one. A new CLI is therefore being set up for the Large National Heavy Ion Accelerator (GANIL) in Caen, as are the CLIs for various ionisers.

In 2007, ASN initiated consultation with the *Assemblée des Départements de France* (ADF) in particular concerning the actions of the *Conseils généraux* and ASN with regard to CLIs. This consultation also covered the draft decree for implementation of the TSN Act with respect to CLIs.

CLI activity

As in previous years, CLI activity reached high levels in 2007.

The CLIs generally held one or more plenary sessions, often supplemented by meetings of the specialist committees ("population protection" or "monitoring plant operations and impact" committees at Golfech, monthly "technical committee" at Nogent s/Seine, "technical", "population safety" committees and "MOX fuel" and "communication" working groups at Gravelines, "economics" and "environment" committees at the Valduc SEIVA, and so on).

A presentation of the annual operating results for the site was submitted to most of the CLIs, in particular to coincide with publication of the licensee's annual report as required by the TSN Act.

The CLIs also dealt with subjects such as the TSN act and its implementation (Belleville CLI, Chinon CLI, Chooz CLI, Gard CLI, Gravelines CLI, Nogent s/Seine CLI, Saint Laurent CLI, Saclay CLI, SOMANU CLI, La Hague CSPI), the safety of the electrical grid and natural

*Smallest administrative subdivision administrated by a mayor and a municipal council.
**Administrative region headed by a Prefect.

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Chapter II
Local Information Committees

Article 22
I. - A local information committee is set up at all sites comprising one or more basic nuclear installations as defined in Article 28. Its role is a general one of monitoring, information and discussion concerning nuclear safety, radiation protection and the impact of the activities of the site's installations on individuals and the environment. The local information committee disseminates the results of its work widely, in a form accessible to the largest number possible.
[...]

II. - [...]
The representatives of the Nuclear Safety Authority and the other State departments concerned, as well as the representatives of the licensee, may attend the sessions of the local information committee in an advisory capacity. They have an automatic right of access to its findings.
[...]

[...]

V. - [...]
The licensee, the Nuclear Safety Authority and the other State departments send it all documents and information it needs to carry out its duties. Depending on the case, the provisions of Article 19 of this act or those of chapter IV of part II of book I of the Environment Code and of abovementioned act 78-753 of 17 July 1978 apply to this transmission.
The licensee informs the committee of any incident or accident mentioned in Article 54 of this act, as promptly as possible.
[...]

radioactivity (Civaux CLI), the earthquake in Japan (Gravelines CLI), the consequences of the heat wave in the early part of the summer of 2006 (Gravelines CLI).

CLIs are generally involved in the emergency exercises, the conclusions of which are presented to them.

The CLIs are invited to take part in ASN's inspections: in 2007, the CLIs at Golfech, Gravelines, Nogent s/Seine, Saclay and Saint Laurent replied to these invitations. They can also ask for or carry out separate particular investigations (Flamanville CLI concerning the EPR project, Soulaines CLI on the impact of the centre, Saclay CLI on the revision of the discharges from the centre, and so on).

In order to inform the population, nearly half of CLIs publish newsletters. Others are offered space in the publications of the *Conseil général* or the *commune*. Information about CLI activities appears on ASN's website and that of the national CLI association (ANCLI). Some CLIs also have their own websites (Bure CLIS, Cadarache, Gard, Golfech and Gravelines CLIs, La Hague CSPI, Valduc SEIVA). Others have pages on local authority websites (Nogent s/Seine and Saclay CLIs).

3|2 The Federation of Local Information Committees: 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 CLIs, to provide a resource centre and to act as the interface with the public authorities and national and international nuclear organisations.

In 2007, ANCLI held a general meeting and 2 board meetings.

ANCLI has a full-time quick-response administrative centre.

It manages a website (www.ancli.fr) and publishes the DECLIC information bulletin (several thousand copies).

ANCLI has a scientific committee which was reactivated at the end of 2005 and responded to numerous queries from CLIs. This eleven-member committee met three times in 2007 and set up two specialist working groups, "safety" and "environmental monitoring". A technical data sheet presenting the committee was produced for distribution to the CLIs.

ANCLI has also set up three "Advisory Committees" devoted to radioactive materials and waste, the EPR and to the topic "Territories - After a nuclear accident". These groups held a total of 8 meetings in 2007.

In 2007, ANCLI played an active role in various symposia and seminars (seminar organised by the Golfech CLI on the subject "Territories - After a nuclear accident", ANDRA symposium on what the public expects in terms of waste management information, and so on). It offered two training days for the CLIs, concerning radioactivity and nuclear power.

It also helped organise the 19th annual CLI conference.

ANCLI continued to cooperate with IRSN and they held ten meetings in 2007.

ANCLI and the CLIs are taking part in various European programmes (COWAM, PAREX, SARnet, Trustnet).

At the initiative of the ANCLI chairman, the decision was taken in October 2006 to create the European Association of Local Information Committees and European Dialogue forums (EUROCLI). This initiative aims to provide CLIs with a debating platform and participative democratic forums where the goal is not simply to defend a single point of view but to use operating experience feedback from all parties for a cross-functional analysis and reporting on the overall impact of nuclear activities at a European level. The EUROCLI articles of association were filed in November 2007. Mr Jean-Claude Delalonde was appointed the first Chair of EUROCLI.

ANCLI maintains regular contacts with the French and European authorities and ANCLI members take part in the working groups set up by ASN (CODIR-PA, working group on the PNGMDR, etc.).

Regular contacts are organised between ANCLI and ASN for discussion of topical issues and to deal with subjects concerning the CLIs (preparation of the decree implementing the TSN Act, financing, etc.), or of interest to them (PNGMDR, management of post-accident situations, and so on).

The TSN Act authorises the CLIs to create a federation, in the form of an association, responsible for representing them to the national and European authorities and for providing the committees with assistance on matters of common interest. The implementing decree should specify the criteria that an Association of CLIs would need to meet in order to be recognised as a federation of this type. The situation of ANCLI means that it should indeed be able to meet these criteria.

CLI information brochures

19th Conference of Local Information Committees

The 19th Conference of Local Information Committees was held on 5 December 2007 in Paris at the initiative of ASN and in partnership with ANCLI.

Just over 140 people took part.

As in previous years, particular efforts were made to mobilise the CLIs around this conference, involving them in its preparation and encouraging them to send larger delegations. This led to a diversification of the CLI representation: more than sixty local elected officials and representatives of associations or labour unions thus actively took 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 Conseils généraux *and* préfectures *of* départements *with a CLI, the administrations concerned, associations and licensees operating nuclear installations.*

The conference was devoted to radioactive waste management and to the role of the CLIs. It was preceded by an "Inter-CLI meeting" organised by ANCLI, which in particular comprised a debate between CLI representatives and ASN on the new legislative and regulatory provisions applicable to the CLIs.

A first round-table was an opportunity to present the institutional changes that have occurred in the past year, along with their impact on the CLIs. Particular emphasis was placed on the now mandatory CLI involvement in certain procedures concerning basic nuclear installations and on the need for the CLIs to organise themselves in such a way that they derive the most benefit from this new entitlement.

The second round-table was devoted to waste policy, via the Act passed in June 2006, presented by its rapporteur to the National Assembly, Mr Claude Birraux, to the situation arising as a result of this Act and to the National Plan for the Management of Radioactive Material and Waste (PNGMDR).

The last round-table enabled the participants to examine the consultation process set up around radioactive waste. The chairman of the special committee for the public debate on radioactive waste held in 2005 presented the lessons he learned from this debate. The Director General of ANDRA discussed the consultations held with her establishment. Several CLI representatives recounted their experiences. Finally, an international dimension was added by a Belgian speaker who is a participant in a local partnership for management of radioactive waste.

The event was closed by the chairmen of ANCLI and ASN.

This conference underlined a new issue for the CLIs: now that they enjoy the legal recognition they were claiming and have new rights, how to ensure that they optimise performance of the duties entrusted to them? This question also raises that of the means of developing pluralistic expertise from which the CLIs could benefit.

Wednesday 3 December 2008 was chosen as the date for the 20th conference.

19th conference of Local Information Committees on 5 December 2007 in Paris

4 THE HIGH COUNCIL FOR NUCLEAR SAFETY AND INFORMATION AND THE HIGH COMMITTEE FOR TRANSPARENCY AND INFORMATION ON NUCLEAR SECURITY

The High Council for nuclear safety and information (CSSIN), created by the decree of 13 March 1973 and whose role was extended by the decree of 2 March 1987, has been replaced by the High Committee for Transparency and Information on Nuclear Security (HCTISN) created by the TSN Act.

Its role covered all issues concerning nuclear safety and radiation protection and information of the public and media with regard to these matters.

The Council comprised 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 trade unions, of nuclear facility licensees and of the administrations concerned.

The last composition of the Council was set by the order dated 27 May 2005 from the Minister for Ecology and Sustainable Development and the Minister Delegate for Industry. Its chairman was Mr Michel van der Rest, Director of the life sciences department at CNRS and then Director General of the SOLEIL synchrotron on the Saclay site.

The Council held its last three meetings in 2007. They in particular concerned:
– the EPR reactor;
– decommissioning of basic nuclear installations;
– nuclear medicine, particularly the radiotherapy accident in Épinal;
– the working of the consultation and information bodies on nuclear activities, on the basis of a summary of the results achieved during the final mandate of the CSSIN.

Owing to the imminent creation of the HCTISN, the CSSIN suspended its work in June 2007. On this occasion, it published four documents resulting from its activities during the 2005-2007 mandate:
– a summary reviewing this last mandate and presenting proposals for the future consultation and information bodies on nuclear activities;

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Chapter III – High Committee for Transparency and Information on Nuclear Security

Article 23
A High Committee for Transparency and Information on Nuclear Security is created.
[…]

Article 24
The High Committee for Transparency and Information on Nuclear Security is an informative, discussion and debating body concerning the risks involved in nuclear activities and the impact of these activities on human health, on the environment and on nuclear security. For this purpose, it can issue an opinion on any matter in these fields, as well as on the relevant checks and information. It may also deal with all matters pertaining to the accessibility of information on nuclear security and propose any measure such as to guarantee or improve transparency in the nuclear field.
[…]

Article 25
The High Committee for Transparency and Information on Nuclear Security may request any expert assessments necessary for the performance of its duties and organise joint debates.
Its opinions are made public.
It issues an annual activity report, also made public.
The persons in charge of nuclear activities, the Nuclear Safety Authority and the other State departments concerned, send the High Committee all documents and information of use in the performance of its duties. Depending on the case, the provisions of Article 19 of this act or those of chapter IV of part II of book I of the Environment Code and the provisions of above-mentioned act 78-753 of 17 July 1978 apply to said transmission.

– a report on the EPR reactor;
– a report on the decommissioning of basic nuclear installations;
– a report on the lessons learned from the Chernobyl accident, twenty years after the event.

The minutes of CSSIN sessions and the reports are available on ASN's website (under "CSSIN").

The HCTISN was created by article 23 of the TSN Act. The High Committee takes over and enhances the roles of the CSSIN. It is a body for information, consultation and debate concerning the risks linked to nuclear activities and their impact on human health, on the environment and on nuclear security.

The High Committee comprises thirty-four members appointed by decree for six years. They include:
– two deputies appointed by the National Assembly and two senators appointed by the Senate;
– representatives of the local information committees;
– representatives of environmental protection associations and approved health system users associations;
– representatives of persons in charge of nuclear activities;
– representatives of representative employee labour organisations;
– personalities chosen for their scientific, technical, economic or social competence, or information and communication skills, including three appointed by the Parliamentary Office for the assessment of scientific and technological options, one by the Academy of Sciences and one by the Academy of Moral and Political Sciences;
– a representative of the ASN, a representative of the Minister for Labour, a representative of the Minister responsible for civil security and a representative of the Institute for radiation protection and nuclear safety.

The Chairman of the High Committee is appointed by decree from among members of Parliament, representatives of the local information committees and personalities chosen for their competence.

The High Committee was created by a decree of 28 February 2008 and Mr Henri Revol, senator for Côte-d'Or *département*, was appointed as its Chairman. The composition of the High Committee can be consulted on the ASN website, www.asn.fr.

5 INSTITUTE FOR RADIATION PROTECTION AND NUCLEAR SAFETY

IRSN (see chapter 2, point 2|3|3) 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 2006 version of this activity report is available in French (VF) and in English (VA) on the IRSN website and can be obtained on request, in paper format (VF) and/or on a CD-Rom (VA), from the Institute's communication department (IRSN, BP 17, 92262 Fontenay-aux-Roses Cedex).

In accordance with the requirements of the decree that created it, IRSN published the results of its R&D programmes, except for those concerning defence. In 2007, a presentation of three of the Institute's flagship programmes concerning new methodological approaches, ecosystem hazard assessment tools, dosimetry R&D and the first review of the experiments conducted in Phébus, was organised at the National Library of France to coincide with the publication of IRSN's annual scientific and technical activity report for 2006. The Institute also regularly publishes scientific information on its science website (http://net-science.irsn.org.).

2007 was marked by the following:
– a report on the radiation protection aspects of radiotherapy;
– a report on assistance with local or general irradiation diagnostics;
– a presentation of the "So what is radiation protection?" exhibition organised by the Franche-Comté CCSTI in partnership with the Montbéliard local authority and IRSN;
– a new heading entitled "*Nos Achats*" (Suppliers) dedicated to IRSN's suppliers;
– a new site on the environmental radioactivity portal, on which the results of the atmospheric aerosols radioactivity monitoring network can be consulted;
– publication of about thirty press releases and memoranda on topical subjects;
– new content in the glossary, FAQ and on-line library.

This same year, www.irsn.org counted more than 2,000,000 hits and received about 1,000 messages in its contact mailbox, contact@irsn.fr.

In terms of media coverage, more than two hundred requests were sent to IRSN by national and international journalists for interviews with its experts. IRSN has been mentioned in the press nearly 600 times in 2007.

The changes to the roaming exhibition "Nuclear applications and society: from understanding to regulation", co-managed by ASN and IRSN, continued in 2007. The renovation of two of its modules, "Radioactivity and health" and "Artificial radioactivity and the environment" was completed. A study is in progress to look at the changes required in 2008. Finally, the exhibition's website underwent a complete graphic overhaul, consistent with its new visual identity.

The roaming exhibition visited Fontainebleau and then Tours, welcoming more than 4,400 visitors of all ages. In each of the towns, a cycle of 4 conferences enabled members of the local public to learn more and discuss with members of IRSN and ASN subjects such as "Reactors of the future", "ionising radiation working for health: from diagnostic to therapy", "monitoring of radioactivity in the environment", or "nuclear waste and environmental protection". For any information concerning the roaming exhibition, consult the site www.irsn.org/expo.

The Institute took part in the national trade fairs Pollutec, Medec, JFR, SFMN and international fairs such as Eurosafe. It also organised international conferences on the subject of nuclear security and the role of TSOs in partnership with IAEA as well as with Esarda on the subject of defence.

To find out more about IRSN, see the website www.irsn.org.

6 OUTLOOK

The TSN Act reinforces the public's ability to access nuclear information. It recalls and confirms ASN's role in this respect. The public information actions conducted by ASN were continued and expanded in 2007. Whether via its website, the *Contrôle* magazine or its various publications or thanks to its information and documentation centre, ASN gave the public the opportunity to learn about its actions, its organisation and its regulation of nuclear safety and radiation protection.

ASN also took part in or organised several symposia and professional events, both regional and national. It was thus able to raise its profile and consolidate its relations with professionals.

Relations were developed further with the press in 2007, especially at a regional level, and clearly showed the media's interest in the new status of ASN, its regional organisation and important topical subjects (radiotherapy accidents, EPR, installation ageing, and so on).

In parallel with the information it issued in 2007, ASN began a review of the concrete implementation of certain provisions of the TSN Act aimed at improving information of the public. This is the case with article 21 which requires that each licensee of a basic nuclear installation produce an annual report that is made public and transmitted to the CLI concerned and to the HCTSIN, in particular presenting the steps taken with regard to nuclear safety and radiation protection.

In 2008, ASN will be continuing this analysis work and will ensure that the parties concerned satisfactorily apply the requirements of the TSN Act concerning information of the public.

In 2008, ASN will also be developing other communication tools aimed at the various audiences: newsletters on its website, "4 pages" aimed at professionals and the informed public, thematic brochures, etc. Particular efforts will also be made in the direction of both teachers and students.

ASN's new status, which means that more than ever it is accountable for its actions, will lead it to develop its institutional relations with all French and international stakeholders, so that it can make its positions known and explain them to the various audiences.

On all these topics of debate, ASN has a duty to contribute to encouraging exchanges between the various stakeholders, in particular civil society, for example by organising meetings or creating forums for debate around subjects such as research into nuclear safety and radiation protection, revitalising the nuclear industry, post-accident situations, risks and how they are perceived by society, and so on.

CHAPTER 7

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6 OUTLOOK

1 ASN OBJECTIVES IN EUROPE AND WORLDWIDE

The nuclear plant population regulated by the Nuclear Safety Authority (ASN) is one of the largest and most diverse in the world, meaning that ASN has to devote considerable time and effort to relations with its foreign counterparts.

1 | 1 ASN international actions: a legislative basis

Article 9 of the of 13 June 2006 Act on Transparency and Security in the Nuclear Field (TSN Act), states that "ASN will send the Government its proposals for defining the French position in international negotiations within its areas of competence" and that "at the request of the Government, it will take part in representing France with international and community bodies and organisations competent in these fields". Finally, the article states that "for implementation of international agreements or European Union regulations concerning radiological emergencies, ASN is competent to alert and inform the authorities of third party States or to receive alerts and information from them". These legislative arrangements underpin the legitimacy of ASN's international actions.

ASN is thus required to devote considerable resources to cooperative work, both within multilateral frameworks and in the context of bilateral agreements with its foreign counterparts, with the aim of contributing to strengthening the culture of safety and radiation protection around the world, and with the goal of becoming recognised as an "international benchmark for good practice".

1 | 2 Europe

Europe is ASN's priority area for international action, thus making a contribution to the ongoing construction of Europe.

Thanks to the work of WENRA (Western European Nuclear Regulators' Association), an informal club created in 1999 at the initiative of the ASN Chairman, which today comprises the Heads of all the regulatory bodies of the expanded Europe, harmonisation of safety rules for reactors in operation in Europe will be effective by 2010.

In 2007, following proposals from the German chairmanship of the European Union, the European Commission decided to create a High Level Group (HLG) of European regulatory body Heads. The purpose of this initiative is to reinforce community integration on nuclear safety issues.

In the European bilateral context, ASN strengthened its ties with countries which announced their intention of building new plants in order to provide safety and radiation protection assistance with future decisions and those already taken. ASN's goal is to share its experience of licensing new EPR type reactors with the regulatory bodies of these countries.

1 | 3 Harmonisation of nuclear safety worldwide

Outside Europe, nuclear safety harmonisation initiatives are on the increase. ASN therefore ensures that they are taken further and contribute to a permanent improvement of nuclear safety and radiation protection around the world.

Within the International Atomic Energy Agency (IAEA), ASN plays an active part in the work of the Commission on Safety Standards (CSS) which is drafting international standards for the safety of nuclear installations, waste management, the transport of radioactive materials and radiation protection. These standards are not legally binding but they do constitute a reference for the entire international nuclear community, including in Europe. The ASN Chairman has been the Chairman of the CSS since 2005.

The MDEP initiative

The American "Nuclear Regulatory Commission" (NRC) and ASN have been working closely for many years and took the initiative of launching an international project known as the "Multilateral Design Evaluation Program" (MDEP) for joint evaluation of the design of new reactors. This programme, which has been expanded to take in many partners from around the world, and for which the secretariat is handled by OECD's Nuclear Energy Agency (NEA), is based around the joint safety evaluation of the EPR by France, Finland and the United States. This is the aim of phase 1 of the programme. Phase 2 for its part aims to harmonise the safety objectives, the codes and the standards associated with the safety analysis of a new reactor.

1|4 A high level of safety and transparency

At a time when a number of development projects for new nuclear power generating programmes are being announced and built, care must be taken to ensure that these initiatives remain consistent with nuclear safety. In this context, promoting a culture of transparency would also seem to be extremely important.

The ASN Commission thus proceeded with an analysis of this new situation and developed areas of strategy to enable ASN to adopt a stance with regard to the requests for assistance sent to it. In terms of the potential impact on nuclear safety, ASN will analyse the situation of each country contacting it for assistance with its regulatory infrastructure. As a result of this analysis, should ASN conclude that safety cannot be guaranteed, it will make known its reservations concerning the suitability of the envisaged cooperation. In cases in which ASN does decide to go ahead with cooperation, it will do so in order to enable the country concerned to assume its own responsibilities and develop the safety and transparency culture essential to a national system of nuclear safety and radiation protection regulation such as to guarantee effective protection of man and the environment.

ASN cooperates with counterparts in all regions of the globe and is active within international frameworks dealing with nuclear safety and radiation protection issues. Its aim is to achieve recognition as an international benchmark for good practice, promoting a high level of nuclear safety and radiation protection.

2 MULTILATERAL RELATIONS

2|1 European Union

With the Treaty setting up the European atomic energy community (Euratom) and its derived law, and with the work done by the WENRA association, the European Union is today at the very heart of the regulatory work being done in the field of nuclear safety and radiation protection, and is among ASN's top priorities.

2|1|1 The Euratom Treaty

The Euratom Treaty, which celebrated its fiftieth birthday in 2007, enabled harmonised European development of a strict system of regulation of nuclear security (chapter 7) and radiation protection (chapter 3). In an order of 10 December 2002 (aff. C-29/99 Commission of European Communities against Council of the European Union), the European Court of Justice, ruling that no artificial boundary could be established between radiation protection and nuclear safety, recognised the principle of the existence of community competence in the field of nuclear safety, linked to chapter 3 of the treaty. ASN actions at a European level are in particular designed to help develop this new field of community competence.

2|1|2 The "Nuclear Action Plan" and the "European High Level Group"

On 30 January 2003, following the above-mentioned ruling by the European Court of Justice, the European Commission adopted two proposed directives, one defining general principles concerning installation safety, the other concerning the management of spent fuel and radioactive waste. These two texts, commonly referred to as the "nuclear package", could not however be adopted by the Council of the European Union, owing to opposition from several member States of the Union, who considered that these proposals did not really add significantly to improving nuclear safety.

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 2|1|4). This was the "Nuclear Action Plan".

ASN, which believes a move towards harmonisation of nuclear safety principles and standards is required, thus played an active part in the activities of the ad hoc group created for implementation of this European action plan. On 17 July 2007, the Commission adopted a decision officially creating the European "High Level Group"

(HLG) for nuclear safety and waste management. The ASN Chairman was designated by France to sit on the HLG. At its first meeting on 12 October 2007, the HLG undertook to define nuclear safety priorities and set for itself a sustained pace of work, with three meetings planned for the first half of 2008.

2|1|3 The European working groups

ASN also takes part in the work being done by 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 regulation of radioactivity in the environment);
– article 37 experts group (notifications concerning radioactive effluent discharges).

Finally, 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 fields of nuclear safety and radiation protection: in particular transposition of directives and the workings of the Euratom Treaty committees.

2|1|4 The Western European Nuclear Regulators Association (WENRA)

The WENRA association was officially created in February 1999, the founder members being the Heads of the regulatory bodies of Belgium, Finland, France, Germany, Italy, Netherlands, Spain, Sweden, Switzerland and the United Kingdom. Mr André-Claude Lacoste was the first Chair for a period of four years. Mrs Judith Melin (Sweden), who was chair from 2003 to 2006, has been succeeded by Mrs Dana Drabova from the Czech Republic.

Since 2003, the Heads of the regulatory bodies of the seven "nuclear" countries (operating at least one nuclear reactor to generate electricity) who were candidates for accession to the European Union, that is Bulgaria, the Czech Republic, Hungary, Lithuania, Romania, Slovakia and Slovenia have become members of the association.

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:
– after being run by the British regulatory body, the nuclear power generating reactors group (see chapter 12) is now chaired by a deputy Director General of ASN;
– the other group, dealing with management of spent fuel and radioactive waste, as well as decommissioning operations (see chapter 16), is chaired by the Swiss regulatory body.

In each of these fields, the groups began by defining the reference levels for each technical topic, based on the IAEA most recent standards and on the most demanding approaches employed within the European Union (and therefore, for all practical purposes, in the world).

After an initial pilot study into harmonisation of nuclear reactor safety in the founding countries and having demonstrated the pertinence and effectiveness of the methodology chosen, a process to assess national practices against these reference levels was then developed. This process revealed that for nuclear power generating reactors, the harmonisation work under way for the past 3 years has achieved significant progress. For spent fuel and radioactive waste management, this work is less well advanced and is continuing.

In 2006, the members of WENRA developed national action plans for power generating reactors, designed to ensure that for all technical areas in which differences had been identified, national practices were brought into line with the reference levels defined in 2005. The objective is to harmonise national practices by the year 2010.

In 2007, in addition to continuing with the work already under way, the association turned its attention to determining subjects for priority investigation in the coming years. The subject of harmonisation of new reactors was mentioned by the members as being a top priority. For the longer term, the reactors group could also prepare

for the possible harmonisation of safety objectives for the generation IV reactors.

ASN considers that all this work confirms the ability of WENRA to carry out a bottom-up process of nuclear safety harmonisation, in addition to any more general and wide-ranging top-down community initiatives (see points 2|1|1. and 2|1|2 above).

Furthermore, both WENRA and INRA (see point 2|5), created at the initiative of Mr André-Claude Lacoste, are unique and irreplaceable forums for open and informal discussions between the Heads of the regulatory bodies.

2|1|5 The meeting of the Heads of the European radiation protection regulatory authorities

The national regulations constituting practical implementation of European radiation protection directives comprise significant differences for the same uses of ionising radiation sources, or in the vicinity of the same nuclear installations. This is for example the case with regard to the distribution of iodine tablets for populations living near a nuclear installation.

In order to take harmonisation forward in Europe, ASN is therefore convinced of the need for close collaboration between the Heads of the European radiation protection regulatory authorities, in the same way as with nuclear safety.

ASN organised a first meeting of the Heads of the European radiation protection regulatory authorities in Paris on 29 May 2007. Most of the member States were represented. The decision was taken to create working groups to discuss the main issues of radiation protection in Europe. These are: the radiation protection of roaming workers, intracommunity transfers of radioactive sources and the justification for their use, radiation protection diploma equivalences, the position of the regulatory authorities with regard to the development of new medical techniques involving ionising radiation, the harmonisation of reference levels for response to a nuclear emergency and the involvement of society as a whole in the regulation of radiation protection.

The European Commission (DG TREN) was kept abreast of this initiative and will be invited to the next meeting of this group in one year's time.

2|1|6 Assistance to the Eastern European Countries

The July 1992 G7 summit in Munich defined three priority areas for nuclear safety assistance to the eastern European countries:
– contribute to improving the operating safety of existing reactors;
– provide funding for short-term improvements to the least safe reactors;
– improve safety oversight organisation, making a clear distinction between the responsibilities of the different entities concerned and reinforcing the role and scope of local regulatory bodies.

Assistance programmes were set up by the European Commission to achieve these goals. They constitute the nuclear part of the two programmes, PHARE (Poland Hungary Assistance for Restructuring of the Economy), which is more particularly targeted at the candidates for accession to the European Union, and TACIS (Technical Assistance for the Commonwealth of Independent States), intended for the countries of the former Soviet Union. These two programmes were in 2007 replaced respectively by IPA (Instrument for Pre-accession Assistance) and by the Instrument for Nuclear Safety Cooperation (INSC) which covers countries other than those of the former Soviet block.

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.

ASN is the coordinator for the programmes conducted in Ukraine and Kazakhstan and took part in regulatory assistance projects for the Russian Federation, Ukraine and Kazakhstan.

Within the context of IAEA programmes, ASN hosted a one-week visit in early 2007 by Bulgarian experts on the subject of licensing of new projects (EPR).

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.

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:
– delicensing of nuclear reactors in Bulgaria (Kozloduy 1 to 4), Lithuania (Ignalina 1 & 2), and Slovakia (Bohunice V1 1 & 2);
– construction of a new sarcophagus for Chernobyl Unit 4, the origin of the April 1986 disaster and construction of interim storage and reprocessing installations

respectively, for the fuel and waste still present on the site;
– dismantling of decommissioned Russian nuclear submarines and radiological clean-out of the White sea military bases.

Finally, with regard to nuclear safety, 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 meetings of this group in Bonn in February, April and October 2007.

ASN observes that 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 regulatory bodies have been reinforced and clarified in the European Union accession States.

The regulatory bodies of the States which joined the Union on 1 May 2004 have thus reached a level which, with a few exceptions, means that they no longer require assistance.

However, in the States of the ex-USSR, the 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 regulatory bodies and thus underpin their credibility, reinforcement of their status and the resources at their disposal.

2 | 2 The International Atomic Energy Agency (IAEA)

The IAEA is a United Nations organisation which, in October 2007, counted 144 member States. With regard to ASN areas of competence, IAEA activities consist primarily in organising working groups at various levels and in drafting texts, called Safety Standards, describing safety principles and practices. The member States can use these texts as a basis for their own national regulations.

Since the beginning of 1996, this activity has been regulated 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 a deputy Director General of ASN, while the ASN Chairman has chaired the commission since the beginning of 2005. This commission coordinates the activities of four committees entrusted with supervising the drafting of documents in four areas: NUSSC (NUclear Safety Standards Committee) for installations 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, represented by ASN, is present on each of these committees. Representatives of the various French organisations concerned also take 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. In 2006, a single document laying out the fundamental principles for the four areas of safety was published after being approved by the CSS and adopted by the Board of Governors. The CSS then expressed its desire to see the lessons learned from this publication being applied to the lower level documents, specifications and safety guides, which should be developed in a more integrated manner in order to produce a whole that is complete, coherent and avoids redundancy. It asked the Agency's Secretariat to submit proposals concerning the structure of the safety standards for a ten-year time-frame and the main steps which will enable this to be achieved, in particular taking account of the current ongoing revision of the "Basic Safety Standards", the radiation protection requirements document.

– Setting up "services" made available to member States and designed to give them opinions on specific aspects related to safety and radiation protection.

This category includes the OSART (Operational SAfety Review Team), IRRS (Integrated Regulatory Review Service), PROSPER (Peer Review of the effectiveness of the Operational Safety Performance Experience Review), TRANSAS (TRANsport Safety Appraisal Service) and RaSSIA (Radiation Safety and Security Infrastructure Appraisal) missions.

In November 2006, ASN hosted an IRRS peer review coordinated by IAEA, whose report is available on the ASN website in English (the language in which it was written). In March 2007, ASN organised a joint seminar in Paris with IAEA to draw the conclusions of this first review, covering all areas of safety (nuclear installations, radiation protection, waste and transports) and all disciplines of the regulatory body (specification, evaluation inspection, information of the public) in a major nuclear country. ASN in particular wanted to promote this review request among its counterparts in other countries, in

order to encourage exchanges concerning best practices. Since then, a number of countries have requested a review of this type. In February and June in particular, the ASN Chairman headed an IRRS review in Japan. In 2008, ASN will take part in an IRRS review in Spain. ASN believes that widespread and systematic use of these reviews should lead to the creation of a network of experts from the regulatory bodies and help harmonise practices.

From 28 November to 14 December, the Chinon nuclear power plant hosted an OSART team. Like all the other reports concerning OSART missions in France, the corresponding report will be published on ASN website in English. A preparatory meeting for the OSART mission scheduled for the Cruas nuclear power plant in 2008 was also held in November.

Finally, ASN takes part in the RaSSIA missions and in the regional radiation protection classes organised by IAEA, ASN main targets being those countries with a French-speaking tradition. In 2007, two inspectors took part in classes aimed at training staff from the Algerian regulatory body. Four inspectors took part in RaSSIA missions to audit the radiation protection regulatory authorities in Algeria, Gabon, Cameroon and Niger.

– Harmonisation of communication tools.

Since 2002, 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 made a considerable contribution to revitalizing the international consultation process in order to add a radiation protection criterion to the INES scale, enabling the radiation exposure dose to be linked to the severity rating of a radiation protection incident or accident.

The French proposal led to adoption by 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.

In 2007, the radiation protection part was integrated into the new version of the INES scale user's guide, to create a new classification criterion based on the proven consequences of a nuclear event. This criterion will apply in the same way, regardless of the type of installation concerned,

The ASN Chairman and Mr T. Taniguchi, Deputy Director General in charge of IAEA Nuclear Safety and Security Department during a seminar dedicated to the feedback experience of the IRRS organised at ASN, jointly organised jointly by ASN and IAEA in Paris in March 2007

André-Claude Lacoste ASN Chairman during a international seminar dedicated to the feedback experience of the IRRS organised at ASN headquarters (IAEA-ASN) on 22 and 23 March 2007 in Paris

once a dose of radiation has been received in circumstances that were not planned. The end of 2008 should mark the conclusion of the experimental period and the beginning of routine implementation of the new INES scale.

ASN hopes that this scale will eventually also include radiation protection of patients, in particular with a system for rating radiotherapy events. The ASN/SFRO scale, produced jointly with the French Oncology Radiotherapy Society (SFRO) (see chapter 1 concerning ionising radiation and health risks) was officially transmitted to IAEA for international assessment by the working group on the rating of events involving patients, set up at the request of France. This working group comprises the IAEA member States conscious of the stakes involved in radiation protection of patients: Belgium, Finland, France, Germany, Hungary, Japan, Spain, Ukraine and United States. The next meeting of this working group is scheduled for March 2008.

2|3 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 aim is "to assist its Member countries in maintaining and further developing, through international co-operation, the scientific, technological and legal bases required for the safe, environmentally friendly and economical use of nuclear energy for peaceful purposes".

On 8 June, the ASN Commission and the NEA Steering Committee met for the first time in order to present their respective missions and envisage future collaboration.

Within the NEA, ASN takes part in the work of the Committee on Nuclear Regulatory Activities (CNRA). This year, CNRA contributed to drafting the NEA strategic plan for the coming years. CNRA also began work on revising its operation plan which gives a more detailed description of its organisation, the planned activities and the priorities, as well as the operating procedures it will be using to carry out its duties in conformity with the strategic plan.

ASN also takes part in the work of the Radioactive Waste Management Committee (RWMC) which brings together the regulatory bodies and organisations responsible for waste management.

In the field of radiation protection, ASN continued its participation in the Committee on Radiation Protection and Public Health (CRPPH). The ASN Chairman

addressed this committee on the occasion of the 50th anniversary of the CRPPH concerning the issues of radiation protection from the viewpoint of the regulatory or radiation protection authorities. The importance that ASN attaches to radiation protection of patients was underlined, as was the distorted public perception of the risks involved in the medical uses of ionising radiation when compared with other nuclear activities.

Multinational Design Evaluation Program (MDEP)

NEA also handles the secretarial services for phase 2 of the MDEP (Multinational Design Evaluation Program). This programme is a multinational initiative to develop innovative approaches to pooling the resources and know-how of the regulatory bodies who will have responsibility for regulatory assessment of new reactors.

This MDEP programme, which is built around safety, is a multinational cooperative forum working within the framework of power reactor safety cases and aimed at ensuring the convergence and the implementation of safety standards. The ultimate goal of this programme is to improve protection of the public and the environment.

This programme comprises three phases:

– phase 1: this phase concerns reactors whose design requires certification by the American regulatory body (NRC) and which are currently being examined by other regulatory bodies. For the time being, only the EPR is concerned and is the subject of a cooperative agreement between ASN and the Finnish regulatory body (STUK) on the one hand, and the NRC on the other;
– phase 2: conducted in parallel with phase 1. The purpose of this phase is to facilitate the safety analysis of the generation III and III + reactors. This is designed to achieve convergence of the safety objectives, criteria, codes and standards associated with analysis of the safety of a new reactor. This will also make it possible for one regulatory body to rely on another regulatory body to regulate manufacture of the reactor components.
  In this context, the second meeting of the steering committee was held at NEA in Paris on 26 and 27 March.
– phase 3: this aims to implement the materials of phase 2 for analysis of the safety of the generation IV reactors.

2 | 4 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. This activity is supervised by the annual meeting of the national representations of the Member States, comprising high-level experts, and at which ASN is represented. 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. The report on the Chernobyl accident, which was due to be published in 2005, has progressed no further than the draft stage.

During the 62nd session of the UN General Assembly, the rapporteur of this committee presented the resolutions arising from the 55th session of UNSCEAR, which underlined the lack of resources available to the committee's secretariat, preventing it from publishing in good time the reports on the sources of exposure to ionising radiation in the member States.

2 | 5 The International Nuclear Regulators' Association (INRA)

The INRA association, which comprises the Heads of the regulatory bodies of Canada, France (in 2006, the ASN Chairman chaired INRA), Germany, Japan, South Korea, Spain, Sweden, United Kingdom and the United States of America, met in 2007, first of all under the co-chairmanship of the ASN Chairman and the new Chair of the Spanish "Consejo de Seguridad Nuclear" and then, a second time, under the Spanish Chairmanship alone. Following on from the fruitful exchanges in 2006 between the Chairman of ICRP, Lars Erik HOLM (Sweden), and the members of the association, which give good reason to hope for greater integration of the issues of nuclear safety and radiation protection, 2007 was an opportunity to begin to look at strengthening the leadership of the association and envisage possible new areas for common investigation and work. Thus the safety/security interface and the question of the regulatory infrastructure needed for the development of nuclear energy in emerging countries were discussed by the members for the first time.

The earthquake that occurred in Japan in July 2007, which affected the Kashiwasaki-Kariwa plant, was also discussed at the October meeting. In 2008, INRA will meet under the chairmanship of the NRC of the United States.

2 | 6 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 regulatory body. It comprises the regulatory bodies of Belgium, France, the People's Republic of China, South Africa and South Korea.

Its mandate is to facilitate transfer of experience gained from regulation of the reactors designed and/or built by the same supplier and to enable the regulatory bodies to compare the methods they use to handle generic problems and evaluate the level of safety of the Framatome type reactors they regulate.

From 18 to 19 October 2007, the association held its 5th meeting. It was organised at the initiative of the Chinese regulatory body, NNSA, and brought together the delegations from the other 4 member countries, including France, represented by ASN and IRSN. The debates primarily covered analysis of incidents and examination of the issue of installation ageing.

3 BILATERAL RELATIONS

ASN works with many countries within the framework of bilateral agreements signed at various levels:
– governmental agreements (Belgium, Germany, Luxembourg, Switzerland);
– administrative arrangements between ASN and its counterparts (about twenty).

3|1 Staff exchanges between ASN and its foreign counterparts

One of the means used to improve knowledge of how foreign nuclear safety and radiation protection authorities actually work, given that their areas of competence are not necessarily all the same (see table 1), to learn lessons for the working of ASN and to supplement personnel training, is to develop staff exchanges.

At present, the nuclear safety and radiation protection authorities concerned are those of Austria, Belgium, Germany, Japan, the People's Republic of China, South Africa, Spain, Switzerland, United Kingdom and the United States of America.

Provision is made for several types of exchange:

– Very short term actions (one to two days) are a means of offering our counterparts cross-inspections and joint emergency exercises. In 2007, about twenty joint inspections in the field of nuclear safety and radiation protection were organised. They took place either in France, or in the countries inviting the ASN inspectors. They were held in nuclear power plants in Germany, China, Switzerland and France, in waste treatment laboratories and units in Belgium and Great Britain, and at a pressure vessel manufacturer, with American inspectors. A large number of these joint inspections also concerned radiotherapy activities in Germany and Belgium, environmental monitoring in Great Britain and the transport of radioactive materials in Belgium and in France.

– Short-term assignments (3 weeks to 6 months), aimed at studying a specific technical topic. In 2007, the ASN Lyon division welcomed two employees from JNES (Japanese Nuclear Energy Safety Organization), the technical support body for the regulatory body. JNES is currently looking at ways of improving the nuclear power plant inspection process and wished to observe how the system actually worked in France. A civil servant from the Austrian ministry responsible for the environment has been at ASN since 15 October 2007 for a 6-month training course. He is involved in ASN work in the field of regulating radiotherapy and radioactive sources.

– 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. Whenever possible, this type of exchange must naturally be reciprocal.

Since the end of 2006, a French inspector from the Lyon department has been seconded to the British nuclear safety regulator, where he is working on the fuel cycle plants, while a British inspector has been seconded to ASN and is working in the Nuclear Power Plants Department on the evaluation and licensing of the EPR in Flamanville. Another inspector from the Lyon department is at IAEA where he is working on the team responsible for organising the IRRS (Integrated Regulatory Review Service) reviews. Finally, another ASN engineer, today hired by IAEA, is also working at the Agency on safety standards and acts as the scientific secretary for the CSS (Commission on Safety Standards).

These exchanges will continue to enhance ASN practices, using proven methods and good practices employed by our counterparts. Furthermore, the experience acquired by ASN and its counterparts for nearly ten years now, shows that inspector exchange programmes are an important factor in energising bilateral relations between nuclear safety and radiation protection authorities.

3 | 2 Bilateral relations between ASN and its foreign counterparts

In the field of bilateral relations, it became apparent that the two-fold nuclear safety and radiation protection approach, which took account of the recent incorporation of radiation protection into the scope of competence of ASN and which had led to the definition of separate priorities for the two topics, was today no longer necessary. It is now possible to envisage an integrated nuclear safety and radiation protection approach for each of the countries with which ASN maintains priority relations. The following can be offered as examples.

South Africa

The bilateral cooperation agreement between the National Nuclear Regulator (NNR) and ASN was renewed and extended to take in subjects linked to radiation protection. It was signed by the ASN Chairman and the Director General of NNR in Vienna on 17 September 2007.

Bilateral exchanges continued as part of the actions decided on during the first meeting of the steering committee in 2006. Of the many meetings between the experts from these two authorities, it is worth noting the discussion week during which three NNR representatives were received by ASN, with the support of IRSN. From 12 to 16 March 2007, technical subjects covering the safety of power reactors, in particular periodic safety reviews and sump modifications, were dealt with.

The NNR-ASN steering committee met in Paris on 1 and 2 October 2007 and this in particular was the opportunity for a comparison of nuclear safety practices. The South African delegation went to CEA's Saclay site to visit the installations of the LECI and PELECI spent fuel testing laboratory.

Following on from the steering committee meeting, the research reactors working group arranged a meeting of a few representatives from ASN's research installations department and three representatives from NNR. A visit to several installations at Cadarache (the MASURCA reactor, the CEDRA installation) was also possible on 4 October.

Finally, the emergency situations working group met from 8 to 12 October 2007.

Germany

In 2007, the Franco-German Commission on nuclear installation safety questions (Deutsch-Französische Kommission für Fragen der Sicherheit kerntechnischer Einrichtungen – DFK) met on 14 and 15 March in Salzgitter, Germany. The two delegations visited the Konrad iron mine, which should become the short-lived low and intermediate level waste disposal facility. The three DFK working groups also continued their activities in 2007.

Belgium

Relations with the Belgian federal nuclear regulatory agency (AFCN) cover all ASN's areas of competence: safety, waste management, transports and radiation protection. On 12 January 2007, the ASN chairman met his recently appointed Belgium counterpart, to discuss the ongoing subjects of cooperation. The steering committee comprising ASN and AFCN met on 25 January in Brussels and identified a number of common actions, particularly in the field of radiation protection. The Franco-Belgian safety working group met on 31 May in Paris and 4 December in Brussels.

Spain

In September 2007, a bilateral chair-level meeting took place, as provided for in the administrative arrangement signed by ASN with the Consejo de Seguridad Nuclear. Radiation protection, in particular that of patients, was at the heart of the discussions. In October 2007, the ASN Chairman was offered the opportunity to give a talk to the Spanish Parliament as part of the work to modify Spanish legislation on nuclear safety regulation in this country.

USA

The intensity of the ties between ASN and the American Nuclear Regulatory Commission (NRC) reflects the close and trust-based cooperation between the two authorities. In order to review the topical issues of interest to ASN and NRC, regular meetings are held between the ASN Chairman and the Chairman of the American NRC. The latest meetings took place on 11 June and 17 September.

Finland

In 2007, the members of the ASN Commission went to Finland on 27 and 28 September, for meetings with senior management at the Finnish regulatory body (STUK) and to visit Olkiluoto, the construction site for the Finnish EPR (OL3), as well as the construction site for the future spent fuel repository in an underground granite formation.

Tableau 1 : table of areas of competence of the main civil nuclear activity regulating authorities*

Country / Safety authority	Status			Activities						
	Adminis-tration	Government agency	Independent agency	Safety of civil installations	Radiation protection			Safety (protection against vandalism and malicious acts)		Transport safety
					BNI	Other installations	Patients	Sources	Nuclear materials	
France/ ASN			•	•	•	•	•			•
Germany/ BMU + Länder	•			•	•	•	•	•	•	•
Belgium/ AFCN		•		•	•	•	•	•	•	•
Spain/ CSN			•	•	•	•		•	•	•
Finland/ STUK		•		•	•	•	•	•		•
United Kingdom/ NII			•	•	•			•	•	
Sweden/ SKI + SSI		•		•	•	•	•	•	•	•
United States/ NRC			•	•	•	•	•	•	•	•**
Canada/ CCSN			•	•	•	•	•	•	•	•
China/ NNSA	•			•	•	•		•	•	•
Korea/ MOST	•			•	•	•			•	•
Japan/ NISA + NSC + MEXT	•			•	•	•	•	•	•	
Russia/ Rostekhnadzor		•		•	•			•	•	•
India/ AERB		•		•	•	•	•	•	•	•

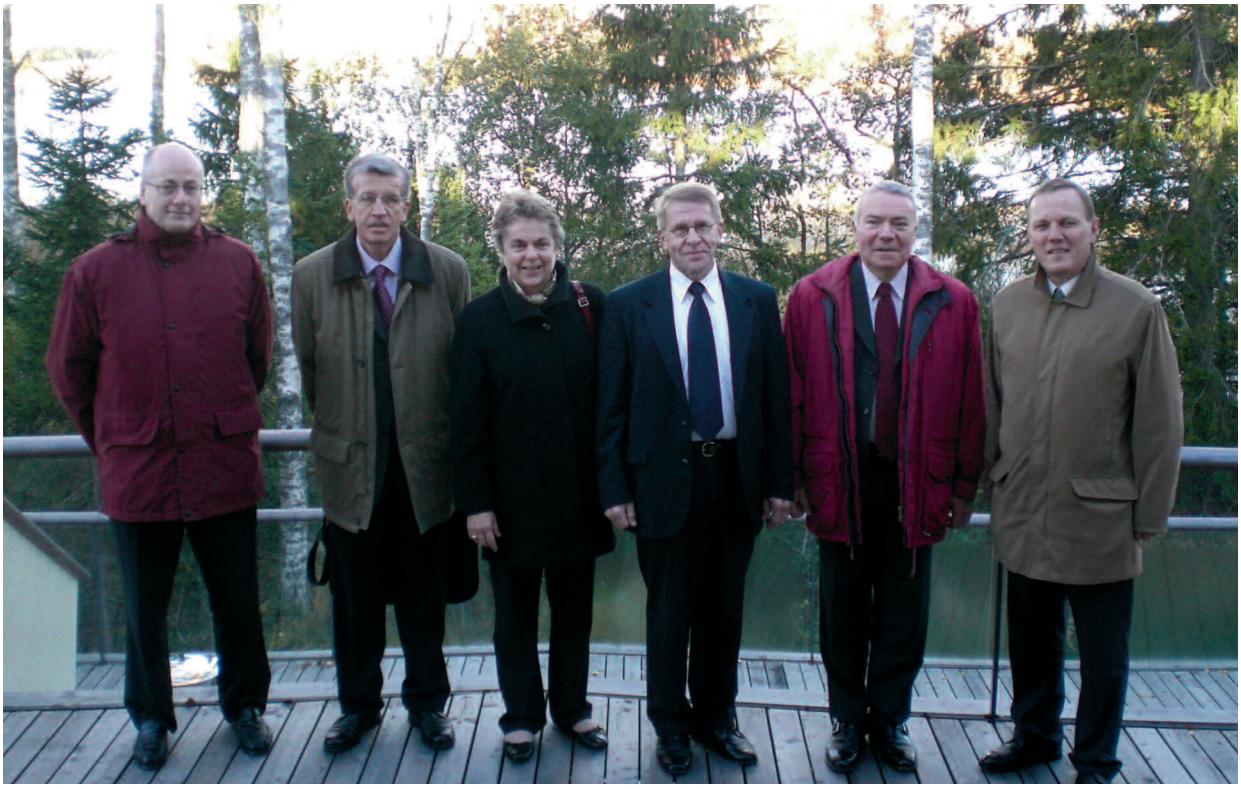
*This table gives a schematic, simplified representation of ASN's current knowledge of the main areas of competence of the entities (administration, government agency or independent agency) responsible for regulating nuclear activities in the world's leading nuclear countries.

**Domestic transport only.

Japan

In 2007, as in previous years, information exchanges with Japan continued at a sustained rate, with a number of technical visits. The demand for cooperation with France is strong and the Japanese authorities want to cooperate with ASN and their technical support organisation with IRSN.

A significant event this year was the earthquake which struck the Niigata peninsular and affected the Kashiwazaki-Kariwa power plant. ASN was in regular contact with its counterpart, NISA (Nuclear and Industrial Safety Agency) and was informed of the observed consequences on the power plant along with the measures taken by NISA. Exchanges will continue in



The ASN Commission during its mission to Finland in September 2007 accompanied by Mr Laaksonen, Director General of STUK (from left to right: Mrs Sanson, F. Barthélemy, M.-P. Comets, M. Laaksonen, A.-C. Lacoste and M. Bourguignon).

order to discuss the lessons to be learned from this event.

Finally, contacts were established between the Japanese nuclear safety commission and the ASN Commission: two Japanese commissioners met their counterparts from ASN for an exchange of views on the problems of radiation protection in the medical field on the one hand, and on reactor safety, in particular seismic protection, on the other.

United Kingdom

The annual meeting of the Heads of the French and British (Nuclear Directorate, ND) regulatory bodies took place in Paris on 18 June 2007. In April 2007, the body responsible for the control of nuclear security (OCNS) and that responsible for the safeguard of nuclear materials (UKSO) were linked to the directorate responsible for the regulation of nuclear safety and radiation protection in the installations: the British party presented this change and the benefits it sees from having these problems, which are in many respects complementary, dealt with coherently.

The Franco-British ASN-IRSN/ND steering committee met twice, in January and October, to review cooperative work in the various technical areas. In particular, with a view to the construction of new power generating reactors in the United Kingdom, and the consequent examination of the EPR by ND, a summary of the various actions under way or envisaged and how they are to be implemented (dedicated working groups, cross-inspections) was drawn up.

Finally, a British inspector from ND has been working at ASN for a year now in the team responsible for regulating and licensing the EPR, while a French inspector has been working for ND in the team in charge of checking the MOX fuel fabrication and fuel reprocessing installations.

Russian Federation

ASN offered its support to its Russian counterpart (Rostekhnadzor) for the IRRS review which is to be held in Russia in 2008. In May 2007, it therefore went to Moscow and in October 2007 it received a Russian delegation in Paris.

Switzerland

The 18th meeting of the Franco-Swiss Commission was held in Zurich on 6 and 7 July. The delegations discussed recent developments in the fields of radiation protec-

tion and safety in large industrial nuclear installations and issues concerning the organisation of their respective regulatory processes. With regard to nuclear reactor safety, the transport of nuclear materials and radioactive waste, the delegates reviewed the year's significant events. The French party in particular presented the state of progress of the EPR project. The delegates discussed practical issues which arise during the "cross inspections" and envisaged exchanges in the field of inspector training. The Chairmen recalled the importance of cross-inspections, whether in radiation protection or in nuclear installation safety.

The Franco-Swiss Commission's expert group on nuclear emergency management continued its exchanges in 2007.

South Korea

From 10 to 13 April, an ASN delegation, headed by the ASN Chairman, went to South Korea and met the leading nuclear stakeholders in the country, particularly the Director of nuclear safety, with whom a cooperation agreement was signed, the Korea Institute of Nuclear Safety (KINS), IRSN's counterpart, and the Korea Atomic Energy Research Institute (KAERI), the counterpart of CEA. This trip ended with a visit to the KORI power plant and the SHIN-KORI construction site.

India

A Franco-Indian seminar on light water reactor safety was held from 8 to 10 May. ASN presented the framework of its technical review of the EPR reactor. France and India expressed their common desire to continue with this type of exchange as of the beginning of 2008.

3|3 Assistance to emerging countries

At a time when new nuclear power generating programmes are being announced and developed, ASN is receiving increasing numbers of requests for assistance, with a view to creating a safety infrastructure compliant with the leading international principles such as those expressed in the Convention on Nuclear Safety. These requests come primarily from countries which have as yet never resorted to nuclear energy, particularly in Asia and the Middle East.

ASN will be attentive to nuclear installation projects in the emerging countries, for which it sees lead times of no less than ten years. These countries will have to create a legislative framework and an independent and competent regulatory body, as well as develop capability in terms of safety and a safety and regulatory culture.

In 2007, ASN undertook to establish a realistic and effective system for answering the requests it receives. Implementation of this system, with the corresponding human resources, will enable ASN to conduct this new mission, with the aim of maintaining a high level of nuclear safety, worldwide. ASN will thus make efforts, on a case by case basis, to verify that safety conditions are met when assessing the suitability of any particular cooperation in the nuclear field.

When examining this assistance with the creation of safety infrastructures at its main counterparts, particularly within the context of INRA (see point 2|5), ASN concern once again is to develop harmonised approaches taking account of the experience of all parties involved.

4 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 2|2) is the depositary of these conventions and provides the relevant secretarial services.

4|1 The Convention on Nuclear Safety

The Convention on Nuclear Safety concerns civil nuclear power reactors. It was adopted in June 1994 and France signed it in September 1994 with ratification in September 1995. The convention came into force on 24 October 1996. On 4 April 2007, it was ratified by 60 States, including all countries equipped with nuclear power generating 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 of the others.

The first three contracting parties review meetings were held in April 1999, April 2002 and April 2005.

The next meeting is scheduled for April 2008. With ratification of the Convention by India, this will be the first time that all the countries operating nuclear power reactors compare their safety practices.

This meeting was prepared during an organisation meeting held in Vienna on 24 and 25 September 2007: the contracting parties elected the Chair of the review meeting, Mr Magugumela, Head of the South African regulatory body, and two Vice-Chairs, Mrs McGarry and Mr Eibenschutz, Heads of the Irish and Mexican authorities respectively. The countries were split into six groups which will first of all discuss the reports presented by the countries in the group; the debates of one of the groups will be chaired by Mr. Saint-Raymond from France, a former deputy Director General of ASN.

France's report is available in French on the ASN website under the heading "*L'ASN à l'international (textes de référence internationaux)*".

It concerns not only power reactors, but also research reactors which, in France, are subject to the same regulations and the same checks. In the same way as for the previous reports, drafting was coordinated by ASN and IRSN, with the licensees making their contributions on pertinent points. It was validated by the ASN Commission and French and English versions were sent to IAEA, which handles the secretarial services for the review meetings.

4|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.

During the second review meeting in Vienna from 15 to 24 May 2006, the contracting parties had concluded that it would be a good idea to ask the IAEA secretariat to identify the IAEA safety standards relating to particular articles of the Joint Convention, thereby constituting a guide to help the member States prepare their reports as required by the Convention.

A technical meeting took place from 18 to 21 June, in order to organise this information into a working document for distribution to the member States.

4|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 2007, it had been ratified by 45 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 IAEA and regular emergency exercises are held among the contracting parties. ASN is the competent national authority for France.

4|4 The 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 2007, it had been ratified by 99 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. ASN is the competent national authority for France.

4|5 The other conventions linked to nuclear safety and radiation protection

Other international conventions, the scope of which does not fall within the remit of ASN, may be linked to nuclear safety.

This is in particular the case of the Convention on the Physical Protection of Nuclear Material, the purpose of which is to reinforce protection against malicious acts and against misappropriation of nuclear materials. This convention, which came into force in February 1987 had, by 17 September 2007, been ratified by 130 States, including France.

Additional information on these conventions may be obtained from the IAEA's website: http://www-ns.iaea.org/conventions/.

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.

Of these events, the following in particular should be mentioned:

Main ASN participations at international conferences in 2007

DATE	PLACE	OBJECT
13 – 15 March	Washington	RIC (Regulatory Information Conference)
22 – 23 March	Paris	IRRS operating experience feedback seminar
23 – 27 April	Aix en Provence	TSO Conference
14 – 16 May	Nice	ICAPP Conference (Intl Conf on advances in NPPs)
22 – 24 May	Tokyo	Seminar held by the WGPC, NEA working group on communications with the public
18 – 21 June	Vienna	International Conference on Knowledge Management in Nuclear Facilities
17 September	Vienna	IAEA General Conference
20 September	Vienna	Senior Regulators Meeting
15 –17 October	Bern	ICGR'07: International Conference on Geological Repositories
15 – 18 October	Shanghai	International symposium on management of nuclear power plant lifetimes
5 December	Paris	Seminar: Role of Research in a regulatory Context
6 – 7 December	Paris	Seminar held by CODIRPA Post-accident situations Steering Committee

6 OUTLOOK

International relations are important activities for ASN and are an efficient way of taking nuclear safety and radiation protection forward both in France and abroad.

They enable ASN and its counterparts to gain a clearer knowledge and understanding of how they each work, along with the problems these authorities face. They also enable assistance to be given to countries that wish to develop or improve their nuclear safety and radiation protection authorities. Furthermore, the bilateral relations ASN maintains with a large number of its counterparts now take place within the framework of an integrated nuclear safety and radiation protection approach.

International relations are also the driving force behind the move towards the necessary harmonisation of nuclear safety and radiation protection principles and standards.

The ultimate goal of ASN actions in this field is to develop a common approach to nuclear safety, one that considers nuclear safety to be the priority.

Thus, in 2007, ASN initiated a series of priority actions (participation in the revision of IAEA's safety standards, contribution to harmonisation as part of the MDEP, preparation for the fourth review meeting of the Convention on Nuclear Safety, development and enhancement of bilateral relations with our counterparts in the leading nuclear countries and in those where there are still important safety and radiation protection issues) which will be continued in 2008.

At a European level, ASN took part in the first meeting of the HLG and intends to make a strong contribution to the work of this group, with the aim of developing a European Community legal framework such as to ensure a high level of long-term nuclear safety in Europe.

In the field of radiation protection, and after the meeting of the Heads of the European radiation protection regulatory authorities in Paris in May, ASN will be continuing its efforts to ensure real harmonisation of practices in Europe. The working groups that are to meet in 2008 should be able to provide concrete solutions to the questions as yet unanswered, in particular concerning radiation protection of roaming workers, transfers of radioactive sources within the EU, radiation protection diploma equivalences, new medical techniques and the harmonisation of nuclear emergency reference levels.

After the numerous events that occurred in 2007, radiotherapy will be the focus of constant attention. ASN will be increasing its exchanges with its foreign counterparts in order to draw on their experience and encourage them to exercise greater vigilance in this sensitive area.

After the IRRS in 2006, ASN is firmly convinced of the importance of the peer review process and in 2007 held an operating experience feedback meeting which laid the foundations for the creation of a network of experts for evaluating the organisation and operation of the regulatory bodies. An IRRS "follow-up mission" will take place in 2009.

Finally, at a time when many new nuclear power generating programmes are being announced and developed, ASN in 2007 began to look at how to provide an adequate response to the requests for assistance made by countries wishing to develop a nuclear power programme. In this context, ASN will aim to guarantee the principle whereby nuclear safety has to remain the number one priority.

CHAPTER 8

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4 **OUTLOOK**

Nuclear activities are carried out with the two-fold aim of preventing accidents, but also of mitigating any consequences should they occur. In accordance with the principles of defence in depth, the necessary steps must therefore be taken to deal with a radiological emergency, no matter how improbable. A "radiological emergency" is understood to mean a situation arising from an incident or accident which is liable to lead to the emission of radioactive material or a level of radioactivity liable to jeopardise public health. The term "nuclear emergency" is reserved for events which could lead to a radiological emergency in a basic nuclear installation (BNI) or during 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. This emergency organisation, which is regularly tested and evaluated, is also regularly revised to take account of experience feedback from exercises and from management of real situations.

Radiological accidents can also occur in non-BNI nuclear activities:
– in an establishment carrying out a nuclear activity (hospital, research laboratory, etc.),
– owing to the loss of a radioactive source, or
– by inadvertent or intentional dissemination of radioactive substances into the environment.

ASN takes part in managing the radiation protection aspects of these emergency situations. ASN has thus divided its duties into four main areas:
– checking and ensuring that the licensee is in control of the risk and mitigates any consequences;
– providing the Government with assistance;
– informing the public;
– international actions.

Other situations can also trigger a response by the public authorities, for example situations arising from nuclear activities or industrial activities which handled materials containing natural radionuclides (uranium or thorium) in the recent or more distant past.

1 ANTICIPATING

1|1 Ensuring licensee accountability

1|1|1 On-site and off-site emergency plans

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 purpose of the off-site emergency plan (PPI or ORSEC plan), drafted by the *préfet**, is to protect populations in the short term in the event of potential danger and provide the licensee or the party in charge of transport with outside intervention assistance. It defines the tasks assigned to the various services concerned, the warning system utilisation instructions and material and human resources.

1|1|2 Role of ASN in the preparation and monitoring of emergency plans

Approval and monitoring of implementation of on-site emergency plans (PUI)

Since January 1990, 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

* In a *département*, representative of the State appointed by thhe President.

to ASN by the licensee at least six months before the installation of radioactive materials in a BNI.

ASN ensures that on-site emergency plans are correctly implemented, in particular by means of inspections.

Participation in drafting the off-site emergency plans
Pursuant to the 13 September 2005 orders concerning the PPI and the ORSEC plan, the *préfet* is responsible for preparing and approving the PPI. ASN assists the *préfet* in analysing the technical data to be provided by the licensees, in order to determine the nature and scope of the consequences. This analysis is conducted jointly with its technical support organisation IRSN, which takes account of the most recent available data on serious accidents and radioactive material dispersal phenomena. ASN makes sure that the PPI and PUI are consistent.

Definition of the response levels is based on the most recent international recommendations and, since 2003, has been stipulated in regulatory requirements.

Following on from the action carried out in 2004, in collaboration with the Ministry for the Interior, ASN is taking part in drafting ORSEC plans (PSS-TMR part) initiated by circular NOR/INT/E/00008/C of 23 January 2004 issued to the *préfets* and revising the PSS-TMR.

Population protection actions
Based on the above-mentioned response levels, the off-site emergency plans identify the population protection actions that will limit the consequences of a possible accident. For example, the off-site emergency plans defined for the vicinity of a PWR reactor stipulate sheltering of the population and the absorption of stable iodine within a 10 kilometre radius, plus evacuation of the population within a 5 kilometre radius.

1 | 2 Organising a collective response

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.

Act 2004-811 of 13 August 2004 on the modernisation of civil security, makes provision for an updated inventory of risks, an overhaul of operational planning, performance of exercises involving the population, information and training of the population, an operational watching brief and alert procedures. A number of decrees implementing this Act were passed during the course of 2005, in particular:

– decree 2005-1158 of 13 September 2005 concerning off-site emergency plans (PPIs);
– 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 *préfecture* level);
– decree 2005-1156 of 13 September 2005 concerning the local safeguard plan.

The scope of a nuclear emergency and of radiological emergencies in general, is specified in the government directive of 7 April 2005. The response organisation of the authorities and that of the licensee are presented in diagram 1. This is specific to an accident affecting a PWR 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.

1 | 2 | 1 Local provisions

In an emergency situation, only two parties are authorised to take operational decisions:
– the licensee of the affected nuclear installation, who must implement the organisational provisions and the means to bring the accident under control, to assess and mitigate its consequences, to protect the individuals on the site and alert and regularly inform the authorities. This arrangement is defined beforehand in the licensee's mandatory PUI;
– the *préfet* 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. Through its regional divisions, ASN assists the *préfet* in drafting the plans and managing the situation.

1 | 2 | 2 National provisions

The relevant ministries and the ASN jointly advise the *préfet* with regard to the protective measures to be taken. They offer the *préfet* information and advice to enable him to assess the condition of the installation, the scale of the incident or accident and any potential developments.

* Administrative region headed by a *Préfet*.

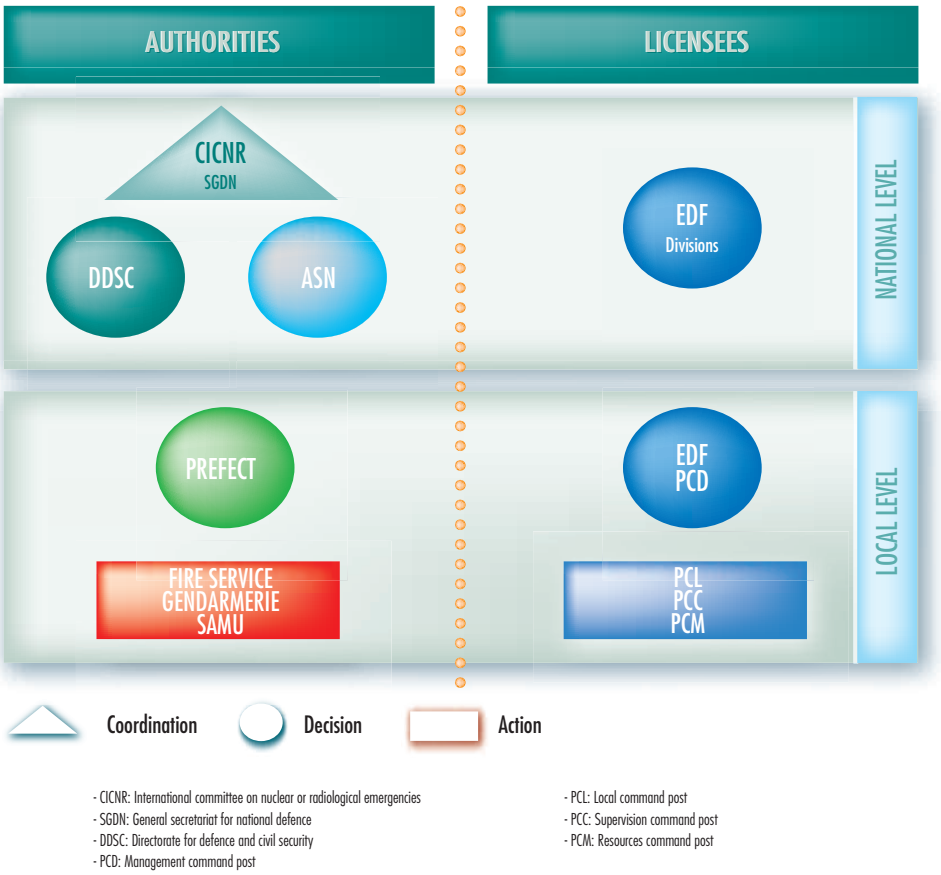


Diagram 1: emergency response to an accident affecting a nuclear reactor operated by EDF

The main bodies concerned are as follows:

– Ministry of the Interior, Overseas France and Territorial Communities: the Directorate for Civil Security and Defence (DDSC) can call on an inter-ministerial emergency management operations centre (COGIC) and the Nuclear Risk Management Aid Committee (MARN). It provides the *préfet* with material and human resources for the protection of individuals and property;

– Ministry for Health, Youth and Sport: responsible for protecting human health against the effects of ionising radiation;

– Ministry for the Economy, Finance and Employment and the Ministry for Ecology, Sustainable Development and Spatial Planning: it plays an active role in the State's nuclear safety and radiation protection duties, jointly with the other competent government departments, in particular those in charge of civil security;

– Ministry of Defence: the Defence Nuclear Safety and Radiation Protection Delegate (DSND) is the competent authority for regulating the safety of secret basic nuclear installations, military nuclear systems (SNM) and defence-related transport. A protocol was signed by ASN and the DSND on 26 January 2005 to ensure coordination between these two entities in the event of an accident affecting an activity under the supervision of the DSND, to facilitate the transition from the emergency phase managed by the DSND to the post-accident phase for which 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.

– pursuant to Act 2006-686 of 13 June 2006 on Transparency and Security in the Nuclear Field, ASN is involved in managing radiological emergency situations. It assists the Government with all questions

under its responsibility and informs the public about the safety of the installation in which the emergency situation originated. ASN's duties in an emergency were not modified by the above-mentioned Act and are detailed in point 2|1|1 of this chapter. The organisation of the ASN is based primarily on its regional divisions.

1|3 Protecting the public

1|3|1 General protection actions

The population protection actions that can be taken during the emergency phase are described in the emergency plan, which for a BNI is the off-site emergency plan (PPI). The steps taken are designed to protect the population and prevent hazards attributable to exposure to ionising radiation and to any toxic chemical substances present in the releases.

In the event of a serious accident, a number of preventive measures can be envisaged by the *préfet* in order to protect the population:
– sheltering and listening: the individuals concerned, alerted by a siren, take shelter in a building, with all openings carefully closed, and wait for instructions from the *préfet* broadcast by radio;
– administration of stable iodine tablets: when ordered by the *préfet*, the individuals liable to be affected by the releases of radioactive iodine take the prescribed dose of potassium iodide tablets;
– evacuation: in the event of an imminent threat of large-scale radioactive releases, the *préfet* may order evacuation. The population is then asked to prepare a bag, secure the home, leave it and go to the nearest muster point.

Furthermore, in order to minimise contamination by ingestion, a ban on the consumption of contaminated foodstuffs may be ordered as a precaution during the emergency phase. Maximum allowable radioactive levels have been set for this purpose on foodstuffs. The *préfet* ensures that the population is regularly informed of developments in the situation and concerning its consequences. He may remind people that they must not pick vegetables from their gardens or farms for consumption during the sheltering period.

1|3|2 Iodine tablets

The third preventive distribution campaign took place on all nuclear power plant sites in 2005 and 2006 (circulars of 8 February 2005 and 11 August 2005 concerning preventive distribution of stable iodine tablets). During the course of this campaign, ASN sent out a brochure to about 500,000 homes, presenting nuclear safety and radiation protection regulation.

The Government also asked the *préfets* to make plans for stockpiling in each *département* in order to cover the entire country. A circular dated 23 December 2002 provides the *préfets* with a guide for drawing up stable iodine tablet stock management plans.

The Ministry for Health asked ASN in June 2006 to draft, on the basis of past experience, a "new iodine policy" targeted at the most susceptible populations and harmonised with the policies of neighbouring countries. In response to this request, ASN set up two national and

Summary of the proposals by the national and international working groups concerning protection of the population against releases of radioactive iodine

The existing provisions applicable to young people and, by extension, to pregnant women, need to be strengthened. It was therefore proposed that the response level in a radiological emergency concerning the thyroid be lowered. In the event of releases of radioactive iodine involving several countries, it was proposed that in the first few hours following an accident, and until such time as official international coordination is in place, there be common reference points and compatible population protection actions, alongside coordinated preventive information efforts. With regard to the distribution of iodine tablets, it was proposed that the system in place be harmonised, strengthened and simplified. Outside the scope of the off-site emergency plans applicable to the area around nuclear installations, it was proposed that a graduated approach be adopted, with free distribution to those under 18 years of age, on request, through pharmacies. In addition to protection based primarily on the administration of stable iodine tablets, a coherent range of population protection measures is now proposed, in order to prevent the appearance of radiation induced cancers. This system includes sheltering and listening, consumption restrictions and evacuation. It implies adequate information of the populations and stakeholders concerned, in particular the emergency response teams.

international working groups. The national working group brought together the government departments concerned, nuclear licensees, representatives of the local information committees and of various associations. The international group comprised five neighbouring countries: Belgium, France, Germany, Luxembourg and Switzerland. The goal was cross-frontier harmonisation of preventive action to be taken in the first few hours following an accident, in order to deal with releases of radioactive iodine into the atmosphere.

Following the work initiated by these two groups, the ASN Commission decided on further guidelines and proposed implementation of them in a letter dated 27 November 2007, sent to the Minister for Health, Youth and Sport. These guidelines are detailed in the box on the previous page.

1 | 3 | 3 Care and treatment of radiation victims

In the event of a nuclear or radiological accident, a significant percentage of the injured could be contaminated by radionuclides. This contamination could pose problems for care and treatment by 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. These provisions are designed to act as guidelines for the services and organisations in charge of planning for and handling emergency situations. This circular is currently being revised.

Together with the Directorate for Hospitalisation and Health Care Organisation (DHOS) of the Ministry for Health, Youth and Sport, the departments of the Defence High Official (HFD) of said ministry, the specialists from the Paris SAMU (emergency medical service), the French Army Radiological Protection Service (SPRA), IRSN, CEA, EDF and universities, ASN drafted and in 2007 updated a collection of Response information sheets entitled "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, Youth and Sport and the French SAMU emergency medical service.

Caring for contaminated victims

The "Medical response to a nuclear or radiological event" sheets come in addition to circular DHOS/HFD/DGSNR 2002/277 of 2 May 2002 concerning the organisation of medical care in the case of a nuclear or radiological accident. This circular is supplemented by circular DHOS/HFD 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.

Within the framework of the response to a nuclear, radiological, biological and chemical (NRBC) threat, ASN in 2006 and 2007 organised a theory and practical training module for professionals and sent out teaching tools to the nuclear physicians in the relevant departments. To do this, ASN obtained the help of the Paris SAMU, the Assistance publique des Hôpitaux de Paris, the Defence High Official at the Ministry for Health and Solidarity, CEA and a private company. These awareness/training days are a means of maximising the knowledge available to the intervention personnel.

1 | 4 Understanding the long-term consequences

Hitherto, the organisational efforts made by the authorities mainly concerned the emergency phase, in other words the period during which radioactive discharges are liable to occur or actually occur. A policy for protection of the populations in the emergency phase already exists and is regularly tested during national exercises involving the installation licensee, the local administrative services (under the authority of the *préfet* of the *département*) and national authorities, as well as associations and various expert assessment organisations.

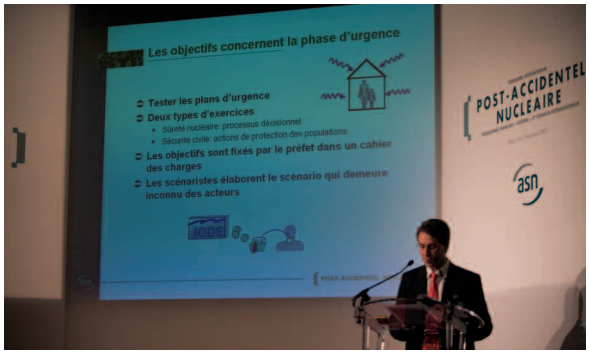
The post-accident phase concerns how to deal with the consequences of the event, which are of widely differing natures (economic, health, social) and which have to be resolved in the short, medium and indeed long term if a situation felt to be acceptable is to be restored. Pursuant

to the government directive of 7 April 2005, 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, ASN first of all focused on developing the post-accident aspect when carrying out national and international exercises (such as INEX3) and initiated a more general debate by bringing together all the stakeholders in a steering committee (CODIR-PA) in charge of the post-accident aspect. In addition to ASN, which acts as Chair, this committee comprises representatives from the various ministerial departments concerned by the subject, health agencies, associations, representatives of the local information committees and IRSN.

Once it was set up, CODIR-PA decided to give priority to work on two scenarios involving an accident of medium-level importance affecting a PWR reactor. These scenarios, drafted by IRSN, constitute the basis for the work being done by the various working groups set up.

On 6 and 7 December 2007, ASN organised an international seminar to review the work in progress and the findings and problems concerning this topic. The main conclusions of the twelve working groups making up the CODIR-PA were presented during these two review days. Numerous presentations also concerned European and international work in progress. The aim is to obtain enough data to allow definition of the means of resolving the complex problems that would arise during a nuclear accident. In 2008, ASN will continue this work in order to determine a policy, which could then be tested during nuclear and radiological emergency exercises.



CODIR-PA symposium organised by ASN on 6 and 7 December 2007

2 MANGING EMERGENCY SITUATIONS

2|1 Assisting the Government

2|1|1 ASN's emergency role

In an emergency situation, ASN – with the support of IRSN – has a four-fold duty:
1) to ensure that judicious provisions are made by the licensee;
2) to advise the Government;
3) to contribute to the circulation of information;
4) to act as competent authority within the framework of the international conventions.

Oversight of action taken by the licensee
In the same way as in normal operating conditions, licensee actions are regulated by ASN in an emergency situation. In this particular context, ASN ensures that the licensee exercises in full its responsibility for keeping the accident under control, minimising the consequences, and rapidly and regularly informing the authorities. It does not take the place of the licensee in the technical steps taken to deal with the accident.

Advising the Government
The decision by the *préfet* concerning the population protection measures to be taken depends on the actual or foreseeable consequences of the accident around the site. It is up to ASN to inform the *préfet* of its position on this subject, taking account of the analysis conducted by 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.

Circulation of information
ASN is involved in information circulation in a number of ways:
– provision of information to the media and the general public: ASN contributes to informing both the media and the general public in different ways (press releases, press conference). It is important that this should be done in close collaboration with the other organisations who are themselves involved in communication (*préfet*, local and national licensee, etc.);

– institutional information: ASN keeps the Government informed, along with the SGDN responsible for informing the President of the Republic and the Prime Minister;

– information of foreign safety organisations: ASN informs the foreign safety organisations with which it has concluded agreements (neighbouring countries).

Function of competent authority as defined by international conventions

Since the publication of decree 2003-865 of 8 September 2003, 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).

2|1|2 The role of ASN

Nuclear safety organisation

In the event of an incident or accident occurring in a BNI, ASN, with the help of its technical support organisation IRSN, sets up the following organisation:

– at the national level, an emergency response centre comprising:

• a decision-making level or command centre (called PCD), located in ASN's emergency management centre in Paris. This centre is headed by the ASN Chairman or his representative. Its role is to adopt a stance or make decisions to advise the *préfet* in charge of running the emergency operations;

• a communication level supported by an information unit located close to ASN's PCD, run by an ASN representative. The ASN Chairman or his representative acts as the spokesperson, a role that is distinct from that of the head of the PCD.

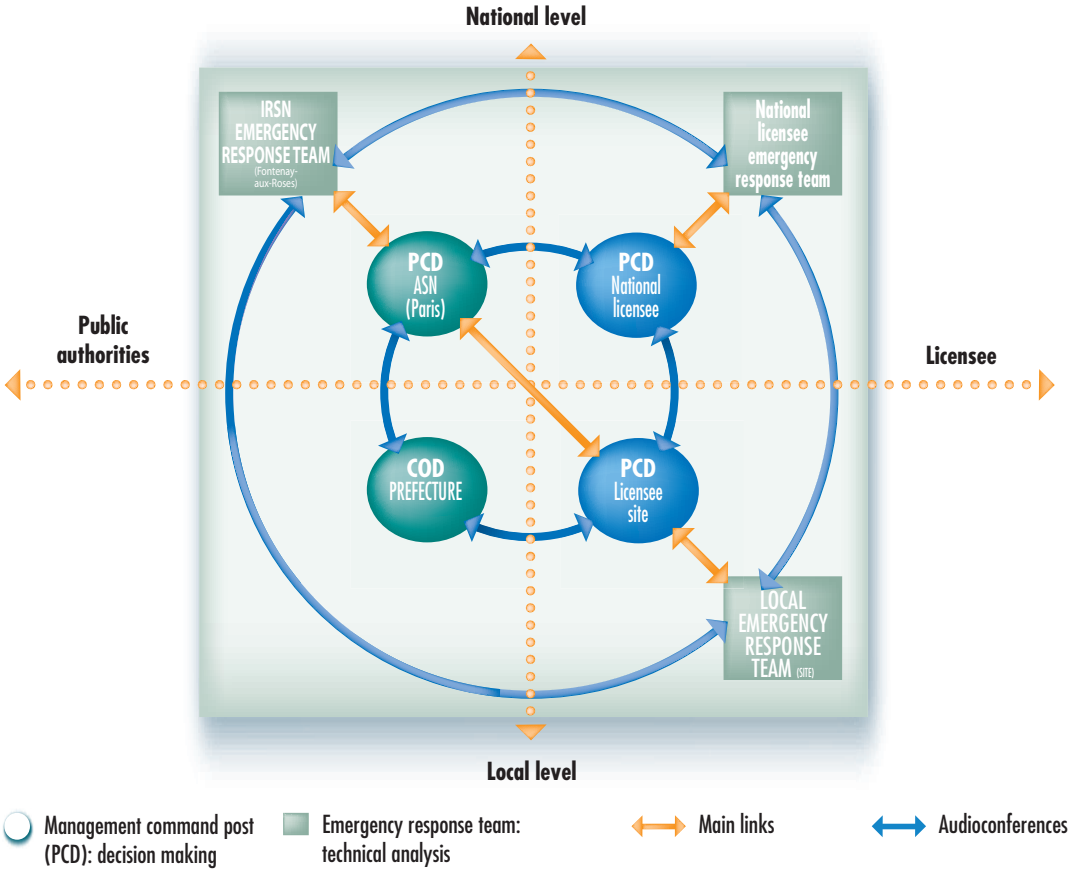


Diagram 2: planned safety response

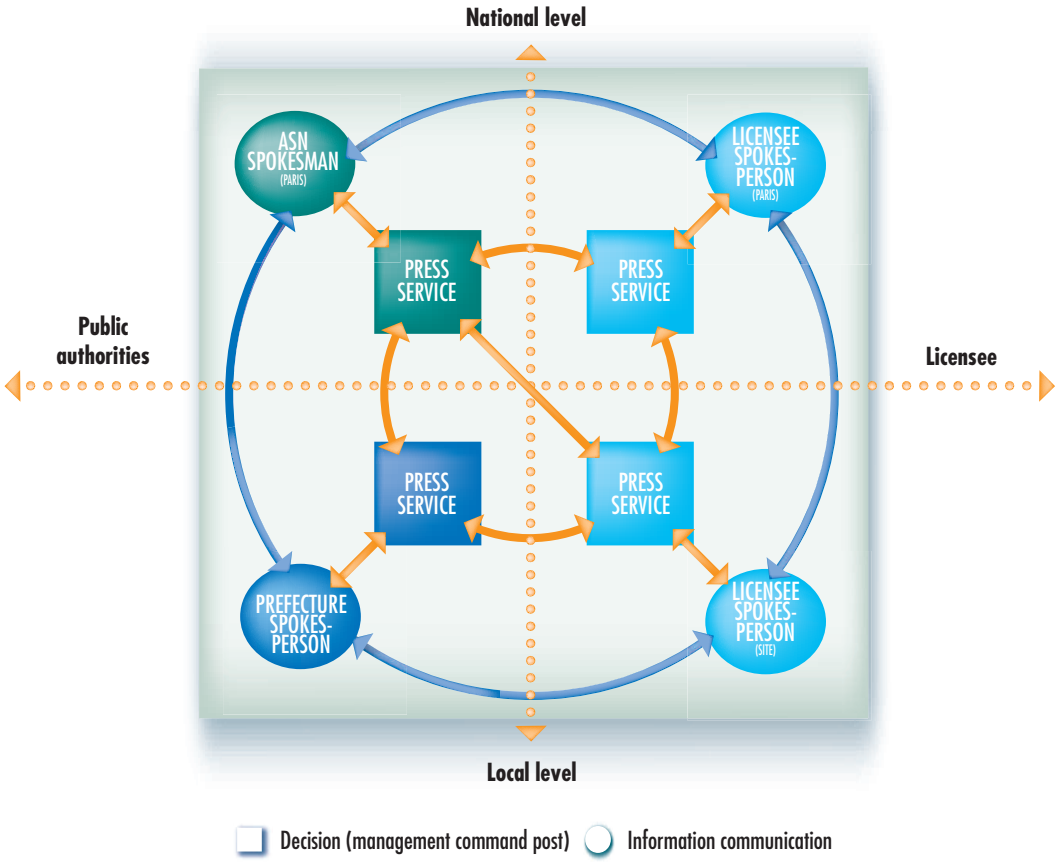


Diagram 3: planned communication response

– at local level, one delegation sent to work with the *préfet* and one sent to the site on which the accident happened, with the respective roles of helping the *préfet* reach his decisions and carry out communication, and ensure that the decisions taken by the licensee are justified.

ASN is supported by an analysis team led by IRSN's Director General or his representative. This team is resident at IRSN's technical emergency centre, located in the nuclear research centre at Fontenay-aux-Roses. ASN, its technical support organisation 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.

Diagram 2 presents the overall safety organisation set up, in collaboration with the *préfet* and the licensee.

Diagram 3 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.

Responding to any radiological emergency situation

Apart from incidents affecting nuclear installations which have an emergency plan, radiological emergencies can also occur:

– during performance of a nuclear activity, whether for medical, research or industrial purposes;
– in the case of intentional or inadvertent dispersal of radioactive substances into the environment;
– 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.

ASN together with the ministers and stakeholders concerned, drafted circular DGSNR/DHOS/DDSC 2005/1390 of 23 December 2005. This circular defines how the government departments are organised in the case of an event liable to lead to a radiological emergency other than those situations covered by an existing emergency plan.

With the support of IRSN, ASN is responsible for overseeing the actions of the facility heads or site owners, for advising the competent police authority with regard to the steps to be taken to prevent or mitigate the direct or indirect effects of ionising radiation on human health, including through environmental hazards, and for taking part in dissemination of information.

Faced with the number of possible sources of alerts and the corresponding alert channels, 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.

ASN opened a telephone hotline in 2003 (toll-free radiological emergency number 0 800 804 135). The purpose of this hotline is to receive calls from the one-stop shop 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 official who will act accordingly. Depending on the seriousness of the accident, ASN may decide to activate its emergency response centre in Paris.

Once the authorities have been alerted, the response generally consists of four main phases: care for the individuals involved, confirmation of the radiological nature of the event, securing the zone and reducing the emission and, finally, clean-out.

The Mayor or the *préfet* coordinates the intervention teams and decides on the protection measures for the public.

In these situations, responsibility for the decision and for implementing protective measures lies with:
– the head of the facility performing a nuclear activity (hospital, research laboratory, etc.) who implements an on-site emergency plan (PUI) 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 *préfet* concerning public safety outside nuclear installations.

2|1|3 ASN's emergency response centre

In order to be able to carry out these assignments, ASN has its own emergency response centre, equipped with communication and data processing tools enabling:
– swift mobilisation of ASN staff;
– reliable exchange of information between the many partners concerned.

The fact of activating the emergency response centre in no way constitutes a judgement of the gravity of the situation. In the event of an alert, triggering of the centre offers ASN technical management and communication resources that are easily accessible to all parties involved.

ASN emergency centre during an emergency exercice at Chinon in November 2006

La Fère Champenoise

A traffic accident took place on Thursday 5 April 2007, at about 6 h 25 on main road RN4 at La Fère Champenoise between two utility vehicles, a truck-trailer and a van. The two vehicles caught fire on impact and both drivers were killed. The van, registered in Germany, was carrying a source of Caesium 137 with an activity level of 81.4 TBq.

The emergency services dispatched to the site initially identified the van's contents as an electrical transformer. It was only at about 8 h 30 that measurements taken by a specialist fire and emergency services team, the mobile radiological intervention unit (CMIR), identified the presence of radioactivity. All safety steps were taken, in particular with a 50-metre safety perimeter being set up around the radioactive source, plus installation of a decontamination airlock for all individuals present and all members of the response teams. Road traffic on main road RN4 was also interrupted.

Once informed of this accident, ASN activated its emergency response centre. At the same time, the ASN Chalons en Champagne division was alerted and sent two radiation protection inspectors to the site, where they took radioactivity measurements confirming those taken by the CMIR. All the steps taken enabled the Sous-Préfet *of Épernay, who was present on the site, to ensure effective communication with the journalists dispatched to cover the event. IRSN intervened to recover the damaged package and ensure that it was stored in complete safety.*

Subsequent investigations confirmed the integrity of the exposed package. This lack of any ionising radiation consequences for the response teams, the public and the environment is due to the continued integrity of the package in an accident situation involving violent impact and fire. This confirms – were it necessary - the sound basis of the strict regulatory requirements surrounding package design. The fire destroyed at least one of the hazard warning signs affixed to the vehicle, which contributed to the delay in precise identification of the material transported. Stricter requirements concerning the fire-resistance of these signs could be envisaged on the occasion of a revision of the regulatory texts.

This emergency response centre was activated in a real situation on 28 and 29 December 1999 on the occasion of the incident that occurred in Le Blayais nuclear power plant following the 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-site emergency plan and alert ASN.

In 2005, the emergency response centre was activated twice, on the occasion of incidents that occurred on the Nogent-sur-Seine and Blayais nuclear power plants. In 2007, the emergency centre was triggered during the night of 9 April 2007 when there was a loss of electrical power on the Dampierre nuclear power plant, and 5 April 2007 when a transport accident occurred in Fère-Champenoise (51) (see box).

As demonstrated by these events, ASN's alert system allows swift mobilisation of ASN staff and the IRSN engineer on call. This automatic system sends out an alert signal to all staff carrying radiopagers 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 exercises or when actual emergencies arise.

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. ASN's PCD also has a video-conferencing system which is the preferred means of contact with 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 IRSN's Téléray network of probes.

2|2 Ensuring efficient coordination with international authorities

In the light of the potential repercussions of an accident abroad, it is important for the various countries to be informed and to intervene in as coordinated a way as possible. This is why IAEA and the European Commission offer the member countries tools to help with notification, intervention and assistance. ASN plays an active role in the preparation of these tools.

Independently of any bilateral agreements on the exchange of information in the event of an incident or

accident with possible radiological consequences, France is committed to applying the Convention on Early Notification of a Nuclear Accident adopted on 26 September 1986 by IAEA and the decision of the Council of European Communities of 14 December 1987 concerning community procedures for an early exchange of information in the event of a radiological emergency. On 26 September 1986, France also signed the convention adopted by IAEA concerning assistance in the event of a nuclear accident or a radiological emergency.

Two government directives of 30 May 2005 and 30 November 2005 specify the procedures for application of these texts in France and instate ASN as the competent national authority. It is up to the competent national authority to notify the event without delay to the international institutions and to the States concerned, to supply relevant information quickly in order to limit the radiological consequences and finally to provide the Ministers concerned with a copy of the notifications and information transmitted.

Within IAEA's National Competent Authority Coordinating Group (NCACG), ASN was designated to chair the competent authorities for western Europe. In 2007, the work of this group focused on the concepts and tools needed to ensure effective international coordination in the fields of assistance and communication between authorities.

2|2|1 Bilateral relations

Within the framework of the bilateral relations, particularly with neighbouring countries, ASN in 2007 initiated and continued with drafting of a protocol for the exchange of information and assistance in order to deal with radiological emergencies. These drafts aim to structure the exchanges which have existed for many years. They differentiate between the nature of the information exchanged, on the one hand with regard to planning and on the other in response to an emergency. They aim at precisely identifying the various stakeholders and entities responsible for and to whom the information is to be sent. The protocol is currently being finalised with the German authorities.

2|2|2 Multilateral relations

Population protection measures differ from State to State in terms of regulations and recommendations. The simple recommendations for absorption of iodine tablets vary on

Fère Champenoise accident on 5 April 2007 (Marne)

either side of the border. Some nuclear power plants are however located in the immediate vicinity of the border (Gravelines, Chooz, Cattenom, Fessenheim, Bugey plants).

In the various international meetings at which France regularly participates, it became apparent that the States needed to make efforts whenever possible to harmonise the population protection recommendations. A working group was therefore set up by Belgium, Luxembourg, Germany, Switzerland and France, in order to harmonise the recommendations for population protection against releases of radioactive iodine. In 2006 and 2007, five meetings led to a consensus on subjects such as the individuals requiring priority protection and tablet dosage. This work, which is detailed in point 1|3|2, will lead to changes in French policy.

ASN took part in 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, ASN is helping to define the strategy concerning international assistance requirements and resources and to set up the emergency assistance response network (ERNET). ASN is also working with NEA to define a strategy for carrying out international exercises.

2|2|3 International assistance

The above-mentioned government directive of 30 November 2005 defines the procedures for international assistance when France is called on or when it requires assistance itself. For each Ministry, it contains an obligation to keep an up-to-date inventory of its intervention capability in terms of experts, equipment, materials and medical resources, which must be forwarded to ASN.

SGDN and ASN thus asked all stakeholders concerned to forward the data needed for compilation of a database of national competences for assistance in the event of a nuclear accident or radiological emergency.

2|3 Dealing with emergencies

In 2007, ASN was called via its radiological hotline, via its duty staff, or directly via those in charge of the various dossiers, to deal with a number of radiological emergencies, such as triggering of the radiation portal monitors (customs checkpoints, technical landfills) or the discovery of unidentified sources during the course of inventories. Even if they entail no health risk, these events warrant verification and radioactivity measurements.

3 LEARNING FROM EXPERIENCE

3|1 Carrying out exercises

If it is to be fully operational, the entire response system and organisation must be regularly tested. This is the purpose of the nuclear and radiological emergency exercises. These exercises, which are defined by an annual circular, involve the licensee, the local and national public authorities – particularly the *préfectures* - ASN and 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 condition, 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.

3|1|1 Nuclear alert tests and mobilisation exercises

ASN periodically carries out tests to check the correct functioning of the system for alerting its staff. The system is also used for the exercises described below and undergoes unannounced tests.

3|1|2 Exercises

As in previous years, ASN prepared a programme of national nuclear emergency exercises for 2007, announced by the *préfets* in a circular signed jointly by ASN, the DSND, DDSC and SGDN. This circular of 11 January 2007 in particular makes provision for two 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 and large-scale application of population protection measures as specified in the PPIs (alert, sheltering, evacuation), based on a scenario built around the role to be played by the population.

During most of these exercises, simulated media pressure is placed on the main parties concerned, in order to test their ability to communicate. Table 1 describes the key characteristics of the national exercises conducted in 2007.

ASN maintains international relations to exchange good practices observed during exercises carried out abroad. During the course of 2007, ASN thus organised the Gravelines exercise together with the Belgian and British authorities. ASN also received a foreign delegation of observers for the radioactive materials transport exercise organised by France.

In 2007, France in particular took part in the international exercises organised by the European Community and IAEA. These tests were an opportunity for checking the alert, transmission and information exchange procedures between the competent national authority (ASN) and the emergency centres of the European Community and IAEA.

Apart from the national exercises, the *préfets* are asked to conduct local exercises with the sites concerning them, in order to improve preparations for a nuclear or radiological emergency situation and in particular test the time needed to mobilise all the parties concerned. In 2007, in conjunction with the *préfecture* of the Pas-de-Calais *département*, ASN organised a radiological safety exercise.

In addition to the exercises organised by the licensees to test their in-house organisation, a national nuclear and radiological emergency exercise held every three years on each site with a BNI would seem to be a fair compromise between staff training and the time needed to effect organisational changes. Since 1985 therefore, the number of national exercises has risen and in 2007 there were 9, as shown on graph 1.

Table 1: National civil nuclear and radiological emergency exercises conducted in 2007

NUCLEAR SITE	DATE OF EXERCISE	TARGET OF THE EXERCISE	PARTICULAR CHARACTERISTICS
Radiological safety exercise carried out in the Pas-de-Calais *département*	16 February 2007		Verification of alert circuits and health aspect
Dampierre (EDF)	16 February 2007	Civil defence	Moving some of the personnel away from the nuclear power plant
Gravelines (EDF)	13 March 2007	Nuclear safety	Impact on the Dunkerque independent port authority and on cross-Channel maritime traffic
Piratome	04 April 2007	Civil defence	Exercise organised by SGDN
Saint-Alban (EDF)	22 June 2007	Civil defence	Test of satisfactory inter-*département* coordination
Pierrelatte	27 September 2007	Nuclear safety	Health aspect and coordination of licensees
Radioactive material transport (Nantes port)	9 October 2007	Nuclear safety	Victims emergency care test. South African observers
Blayais (EDF)	21 November 2007	Nuclear safety	Inter-*département* exercise involving senior management of EDF
Flamanville (EDF)	27 November 2007	Civil defence	International alert test. Alert of British authorities and IAEA

Visit by a South African delegation

In October 2007, ASN received a South African delegation comprising a number of members mainly from the South African nuclear safety authority (NNR). They in particular wished to attend an emergency exercise simulating a radioactive material transport accident, which was held in the Nantes independent port authority on 9 October 2007. To be able to observe the actions of the various parties involved in the emergency, they were spread among the various emergency centres (ASN, IRSN and préfecture*).*

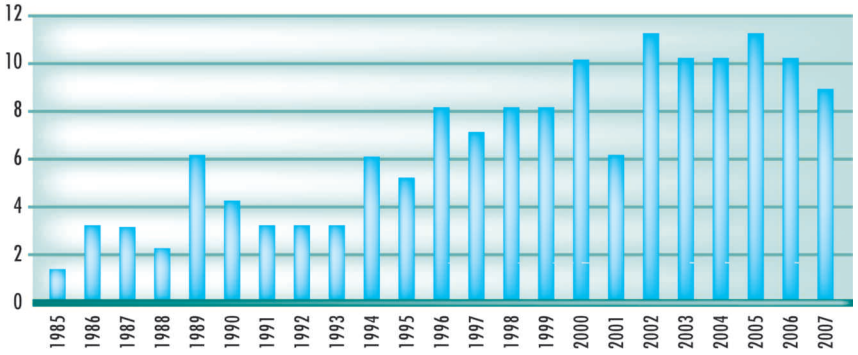
A report containing their remarks was sent to ASN, which will take them into account in order to improve its nuclear and radiological emergency management methods.

PIRATOME exercice

ASN took part in the PIRATOME exercise organised by SGDN on 4 April 2007. This exercise simulated an attempt to hijack a transport of enriched uranium hexafluoride (UF6) in the Yonne département *and, in the afternoon, simulated a situation involving a terrorist dirty bomb in the Loiret* département.

This exercise, which mobilised ASN for the entire day, was on the whole well understood. ASN gave the authorities recommendations concerning the medical and health related measures to be taken, or concerning civil security. ASN's internal response organisation for managing radiological emergencies also proved to be appropriate to this type of situation.

Certain areas for improvement of the system were identified during the feedback meeting organised by SGDN, in particular the problem of establishing the decision-making level until such time as the PIRATOME plan was triggered. Furthermore, the problems with identifying the radioactive products involved at the beginning of the exercise made it hard to conduct a precise technical assessment of the situation and take the right decision for protection of the population. The areas of improvement identified were taken into account in order to improve the response by the authorities that could find themselves faced with such a situation. Circular 800 concerning national policy for the use of emergency and care resources in the face of a terrorist act involving radioactive materials is currently being revised.



Graph 1: number of national emergency exercices 1985-2007

The number and scope of the national exercises are considered to be considerably greater than is the case abroad. The international review conducted in 2006 (IRRS mission) underlined the importance of this programme of exercises. They enable ASN staff and national stakeholders to accumulate a wealth of knowledge and experience in managing emergency situations. These exercises are also an opportunity to train field personnel, with about 300 staff being involved in each exercise.

3 | 2 Assessing with a view to improvement

Review meetings are organised in each emergency command post immediately after each exercise. Along with the other participants in the emergency exercise, 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. These same feedback meetings are organised in order to learn the lessons from any real situations that have occurred.

The real situations that occurred in 2006 and 2007 thus demonstrated the importance of communication in an emergency, in particular to inform the public sufficiently in advance and avoid the spread of rumours that could lead to panic among the population. The draft international protocols were modified and aim to inform foreign authorities as early as possible. In certain cases, the licensee is required to send information about an incident directly to the foreign authorities. Specific alert criteria will also be sent out to the air quality monitoring associations.

The events occurring in nuclear power plants highlighted the importance of defining criteria for lifting the emergency measures. These aspects were incorporated into the draft order concerning risk management.

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 or other means of telephone-based alert.

In 2007, the systematic use of decision-making audioconferences led to greater consistency in the steps taken to protect workers and the population as decided on by the licensee and the public authorities.

The purpose of the emergency response organisation is to prevent, inform and protect the public. During the exercises, it became clear that the siren system triggered by the licensees to alert the populations did not cover the entire intervention perimeter in all cases. In these conditions, EDF undertook to complement the existing siren system with a system of telephone alerts. This new additional procedure automatically calls the landlines of the individuals concerned. This experimental system was tested on numerous occasions during the national exercises conducted in 2007. It will be gradually extended to all the *départements* concerned.

The exercise scenarios generally involve a simulated emission of radioactivity outside the installation in which the accident occurred. 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 only reaching the experts and decision-makers after a lengthy delay. 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 government 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. In 2007, ASN took part in a number of meetings to develop a programme of measures aimed at improving integration and dissemination of the radioactivity measurements taken by the various stakeholders (licensees, CMIR, IRSN, etc.).

Each nuclear installation is required periodically to take part in a national nuclear and radiological emergency exercise involving the entire national emergency response organisation. The various *préfectures* 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 scenarios increasingly frequently include a health component, involving treatment of the injured (sometimes contaminated), who have to be given care and be

Protection of participants

Communication during a TMR exercice in Nantes (Loire-Atlantique)

evacuated in a potentially or actually hazardous environment;
– testing of the information procedures between the *départements* or even the States adjoining an installation help broaden the scope of mutual communication.

Experience feedback from nuclear or radiological 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, ASN calls all participants together twice a year to review good practices and identify areas for improvement. ASN thus brought together the heads of the communication units of the various public and private stakeholders to examine the communication aspects of an emergency situation, in order to identify areas for improvement. It became clear that it was important to strengthen the links between the local and national levels and provide the *préfectures* with greater assistance in organising the exercises involving simulated media pressure.

4 OUTLOOK

Act 2006-686 of 13 June 2006 on Transparency and Security in the Nuclear Field, confirmed ASN's duties in an emergency. During the course of 2007, ASN set itself the goal of better informing, regulating and progressing in the management of emergencies. This year also saw a number of situations that could be described as radiological emergencies and for which ASN was called on (transport accident at La Fère Champenoise, incident in the Dampierre power plant) and activated its emergency command centre.

In 2008, in the light of these events, ASN wishes to continue to look at ways of improving its organisation. Jointly with the Ministry of the Interior, Overseas France and Territorial Communities, this review will look at the various components of civil security as applied to nuclear matters, risk prevention, information and alerting of the populations, protection of individuals, property and the environment. As an independent administrative authority, ASN will develop its organisation within the framework of its new status. Finally, in 2008, ASN will be conducting a series of visits of French and foreign emergency management centres, in order to compare practices.

ASN feels that it is important to maintain and pursue relations with countries along France's borders, in order to improve exchanges liable to lead to harmonisation of the population protection provisions. These exchanges in particular led to the following work being started in 2006 and finalised in 2007:
– work on cross-border harmonisation for drafting of a common iodine policy;

– definition of a protocol for information exchanges between the safety authorities and technical support organisations, in particular identifying the parties involved and the type and nature of the information exchanged in an emergency.

In order to make it easier to respond to any requests for assistance from foreign countries, ASN started work on creating a database of national nuclear accident or radiological emergency assistance skills. ASN will continue this work in 2008.

Following on from the work begun in 2006, ASN aims in 2008 to finalise an order on risk management by the licensees. This order will clarify the objectives of the on-site emergency plan. It takes account of acquired experience and transcribes into French law the reference levels recommended by the WENRA association. ASN considers that this regulatory work will further improve internal management of emergencies by the licensees.

2007 was devoted to intense work by the steering committee for management of the post-accident phase of a nuclear accident or radiological emergency (CODIR-PA) set up by ASN in 2005. The aim is to define general principles which would clarify the measures aimed at resolving the complex problems that would arise in the event of a nuclear accident. The scenarios examined in particular concern the health management of the populations, economic consequences and rehabilitation of the contaminated areas. In 2008, ASN intends to continue this work in order to determine a policy that could be tested during nuclear and radiological emergency exercises.

Together with the government departments and public institutions concerned, ASN drafted the circular of 11 December 2007 concerning exercises for 2008. It ensures that precise and factual objectives can be defined sufficiently early on. Defining these goals, which take account of experience feedback, should allow better preparation and a better appreciation of how well the exercise was performed. ASN intends in 2008 to conduct an unannounced exercise to test the implementation of an emergency response organisation appropriate to radiological emergency situations.

CHAPTER 9

1 **MEDICAL AND DENTAL RADIODIAGNOSIS INSTALLATIONS**

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1|2 **Technical and administrative rules**
1|2|1 Technical rules for fitting out radiology and tomography installations
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2|1|2 In-vitro diagnosis
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6 OUTLOOK

For more than a century now, and for both diagnostic and therapeutic purposes, medicine has made use of a variety of ionising radiation sources, produced either by electric generators, or by artificial radionuclides. Even if their benefits and usefulness have long been medically proven, these techniques do however make a significant contribution to exposing the population to ionising radiation. Behind exposure to natural radiation (NORM), they represent the second source of exposure for the population and the leading source of artificial exposure (see chapter 1).

Protection of the staff working in installations using ionising radiation for medical purposes is regulated by the provisions of the Labour Code. These regulations were updated in November 2007 (see chapter 3).

The installations themselves are required to comply with specific technical rules, while the use of radioactive sources is subject to specific management rules contained in the Public Health Code, also updated in November 2007 (see chapter 3).

In recent years, the technical regulations have been considerably strengthened with the creation of a new body of regulations dedicated to patient radiation protection (see point 3|1|3). The principles of justification of procedures and optimisation of the doses delivered are the foundation of these new regulations. However, unlike the other applications of ionising radiation, the principle of limitation of the dose delivered to the patient does not apply, owing to the health benefits derived by the patient, because a certain dose is required either to obtain a diagnostic quality image, or to obtain the desired therapeutic effect.

Since 2005, ASN has recorded a number of radiotherapy event notifications, some of which have so far had no known health consequences, while others have entailed serious complications for the patients, in a few cases even leading to death. In this context, ASN in 2007 carried out an inspection of all radiotherapy centres, focusing on organisational and human factors. At the same time, in addition to publishing criteria for the notification of significant radiation protection events, ASN in conjunction with SFRO, developed a scale for rating the severity of events affecting patients undergoing a medical radiotherapy procedure.

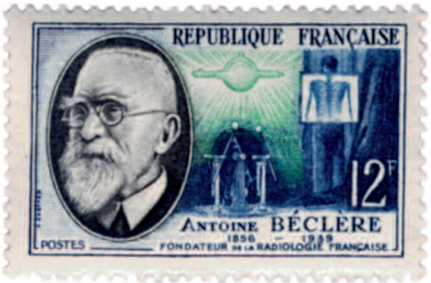
1 MEDICAL AND DENTAL RADIODIAGNOSIS INSTALLATIONS

1|1 Summary of the different types of installations

Radiology is based on the principle of differential attenuation of X-rays by the organs and tissues of the human body. The information is gathered either on radiological film or more and more often on digital media allowing computer processing, transfer and storage of the images obtained.

Radiodiagnosis, which is the oldest of the medical applications of radiation, is a discipline containing all the techniques for morphological exploration of the human body using X-rays produced by electric generators. It enjoys pride of place in the medical imaging field and comprises various specialities (conventional or interventional radiology, computed tomography, angiography and mammography) and a wide variety of examinations (radiography of the thorax, the abdomen, and so on).

W. Roentgen



Stamp representing A. Béclère, the founding father of French radiology

The request for a radiological examination by the physician must be part of a diagnostic strategy taking account of the relevance of the information to be looked for, the expected benefit for the patient, the anticipated exposure level and the possibility of using other non-irradiating investigative techniques (see medical imaging good practices guide, chapter 3).

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. The main subjects are the skeleton, thorax and abdomen. Conventional radiology can be split into three main families:

– radiodiagnosis performed in fixed installations specifically built for the purpose;
– radiodiagnosis carried out using mobile appliances, especially by the patient's bedside. This practice is however restricted to those patients who cannot be transported;
– radiodiagnosis in the operating theatre as a tool contributing to the satisfactory performance of interventional procedures. In this case mobile X-ray generators fitted with a light intensifier are used, outputting images on a screen (radioscopy) that can be used in real time to guide the surgeon's hand.

Interventional radiology

These techniques use radioscopy with image intensification and radiography and require special equipment for the performance of operations which are either diagnostic (examination of coronary arteries, etc.) or therapeutic (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 interventional 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, interventional radiology must be justified by a clearly determined medical need and its practice must be optimised in order to improve the radiation protection of both operators and patients.

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.

Conventional radiology room

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

Operating theatre radiology equipment

Computed tomography

Using a closely collimated X-ray 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.

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 (MRI) for certain investigations. However, the new generation of appliances (multi-slice scanners) enable the scope of investigation of computer tomography to be expanded, with easier and faster investigation.

Computed tomography appliance

The counterpart can be a greater number of images being taken, which runs contrary to the principle of optimisation, thus leading to a significant rise in the doses of radiation delivered to the patients.

1|1|2 Dental radiodiagnosis

Dental radiodiagnosis equipment is among the most common of radiological installations. Three techniques are used:

Intra-oral radiography

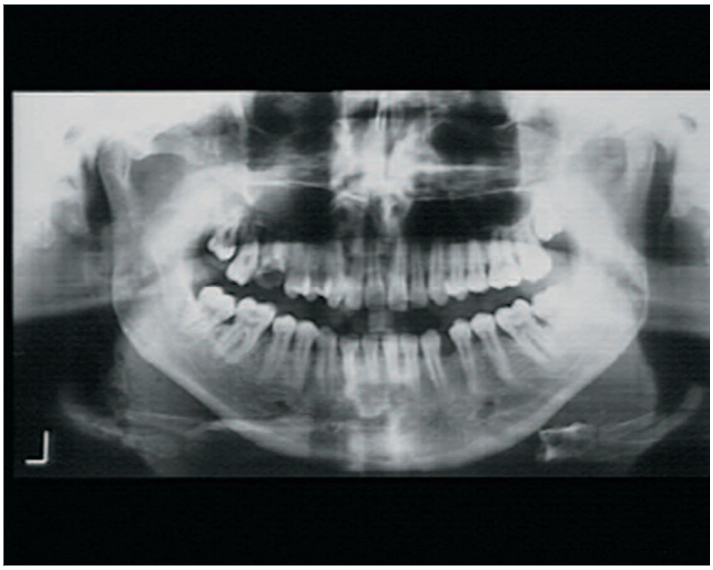
Intra-oral type radiography generators are generally mounted on an articulated arm, to provide localised images of the teeth. They operate with relatively low voltage and current and a very short exposure time, of about a few hundredths of a second. This technique is increasingly frequently combined 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.

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.



Dental panoramic X-ray appliance and dental panoramic X-ray picture

In the dental field, 2007 confirmed the development of volumetric 3D tomography, a technique derived from conventional computed tomography, as well as the use of portable radiodiagnosis appliances. ASN will be defining the practical means of guaranteeing operator protection, based on the conclusions of the IRSN assessment of the risks of external exposure linked to the use of this new equipment.

1 | 2 Technical and administrative rules

1 | 2 | 1 Technical rules for fitting out radiology and tomography installations

Radiology installations

A conventional radiological installation comprises a generator (high-voltage unit, radiation generating tube and control unit), 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). These standards stipulate that 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. This work, in which ASN is participating, together with IRSN and representatives of the professions concerned, has advanced although it has not yet been possible to develop a new method for calculating the opacity of the walls of radiology rooms that would be able to replace the analytical method contained in standard NFC 15-160. The aim of the new method is to be more operational and easier to use, particularly for the practitioners. Work will continue in 2008.

In addition to complying with the above-mentioned standards, the installations must be equipped with a generator less than 25 years old (medical appliances used for medical care) and carrying the CE marking that has been mandatory since June 1998. This certifies that the appliance is in conformity with the main health and safety requirements mentioned in articles R. 5-211-21 to 24 of the Public Health Code.

Tomography installations

Tomography installations must be fitted out in accordance with the requirements of special standard NFC 15-161, which sets rules primarily for the dimensions of the examination room and for the radiological safety measures to be taken. A tomography appliance cannot therefore be installed in a room with a surface area of less than 20 m^2 and in which no linear dimension is less than 4 metres. The opacity of the walls (including floor and ceiling) of the room must correspond to an equivalent thickness of 0.2 to 1.5 mm of lead, depending on the purposes for which the adjoining rooms are used. In addition, tomography equipment more than 25 years old must not be used.

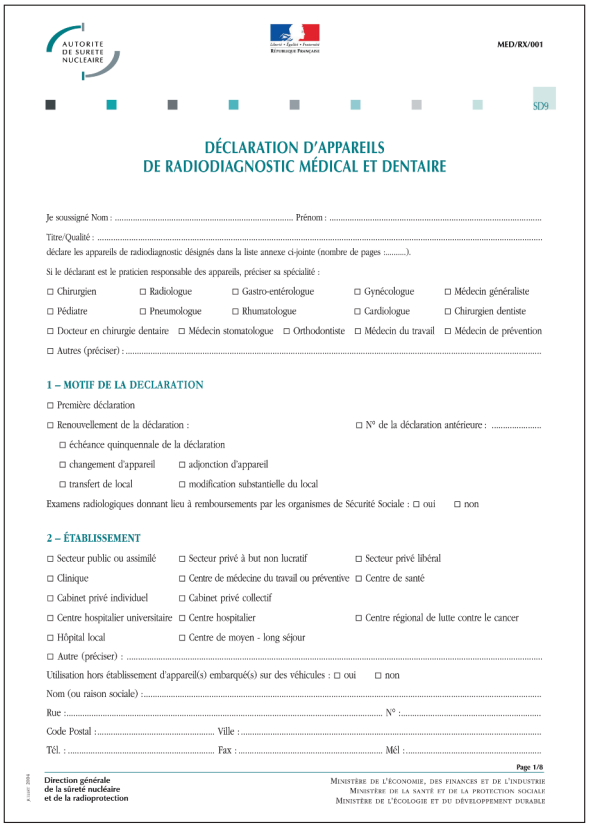
Table 1: number of appliances notified to ASN in 2007, per type of use

Conventional radiology	Interventional radiology	Mammography	Dental radiodiagnosis
4182	86	790	6530

1 | 2 | 2 Notification of medical or dental diagnostic appliances

The use of electrical appliances generating X-rays for medical or dental diagnosis purposes – other than installations classified as heavy – is subject to notification to ASN. Notification is by means of a form (that can be downloaded from www.asn.fr or obtained from the ASN regional divisions) plus the backup items specified in the regulations. For each establishment, a single notification mentioning all the radiological installations needs to be presented. When the dossier is considered by the ASN competent regional division to be complete, an acknowledgement of receipt of notification of a radiodiagnosis installation is sent by ASN to the declaring party.

As the maximum 5-year validity of the notification has been abolished, a new notification becomes necessary only if significant changes have been made to the installation (change in or addition of an appliance, transfer of substantial modification of the room or change in the practitioner in charge).



AUTORITE DE SURETE NUCLEAIRE

MED/RX/001

SD9

DÉCLARATION D'APPAREILS
DE RADIODIAGNOSTIC MÉDICAL ET DENTAIRE

Je soussigné Nom : ..... Prénom : .....

Titre/Qualité : .....

déclare les appareils de radiodiagnostic désignés dans la liste annexe ci-jointe (nombre de pages : .....).

Si le déclarant est le praticien responsable des appareils, préciser sa spécialité :

☐ Chirurgien ☐ Radiologue ☐ Gastro-entérologue ☐ Gynécologue ☐ Médecin généraliste
☐ Pédiatre ☐ Pneumologue ☐ Rhumatologue ☐ Cardiologue ☐ Chirurgien dentiste
☐ Docteur en chirurgie dentaire ☐ Médecin stomatologue ☐ Orthodontiste ☐ Médecin du travail ☐ Médecin de prévention
☐ Autres (préciser) : .....

1 – MOTIF DE LA DECLARATION

☐ Première déclaration
☐ Renouvellement de la déclaration : ☐ N° de la déclaration antérieure : .....
☐ échéance quinquennale de la déclaration
☐ changement d'appareil ☐ adjonction d'appareil
☐ transfert de local ☐ modification substantielle du local

Examens radiologiques donnant lieu à remboursements par les organismes de Sécurité Sociale : ☐ oui ☐ non

2 – ÉTABLISSEMENT

☐ Secteur public ou assimilé ☐ Secteur privé à but non lucratif ☐ Secteur privé libéral
☐ Clinique ☐ Centre de médecine du travail ou préventive ☐ Centre de santé
☐ Cabinet privé individuel ☐ Cabinet privé collectif
☐ Centre hospitalier universitaire ☐ Centre hospitalier ☐ Centre régional de lutte contre le cancer
☐ Hôpital local ☐ Centre de moyen - long séjour
☐ Autre (préciser) : .....

Utilisation hors établissement d'appareil(s) embarqué(s) sur des véhicules : ☐ oui ☐ non

Nom (ou raison sociale) : .....

Rue : ..... N° : .....

Code Postal : ..... Ville : .....

Tél. : ..... Fax : ..... Mél : .....

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Direction générale de la sûreté nucléaire et de la radioprotection

MINISTÈRE DE L'ÉCONOMIE, DES FINANCES ET DE L'INDUSTRIE
MINISTÈRE DE LA SANTÉ ET DE LA PROTECTION SOCIALE
MINISTÈRE DE L'ÉCOLOGIE ET DU DÉVELOPPEMENT DURABLE

Notification form for medical and dental radiodiagnostic equipments

1 | 2 | 3 Tomography installation operating license

Tomography installations require prior authorisation from ASN, with the licence lasting a maximum of 10 years before renewal (the maximum 5-year validity was increased to 10 years by decree 2007-1582 of 7 November 2007); it is issued to the practitioners in charge.

The licence application is made with a form (that can be downloaded from www.asn.fr or obtained from the ASN regional divisions). The application dossiers, plus the backup items requested, are to be returned to the respective regional divisions with responsibility for examination.

The licence is granted on the basis of criteria concerning necessity as applicable to heavy equipment, pursuant to articles L.6122-1 and R.6122-26 of the Public Health Code, the competence of the practitioner in charge, conformity with the installation technical arrangement and layout rules and the radiation protection organisation.

In 2007, ASN issued 227 decisions concerning the use of scanners (commissioning or renewal licences, licence revocation notices).

The French radiological inventory comprises 855 tomography installations (2007 figures). It should be noted that this figure includes appliances intended for radiotherapy simulation purposes.

Overall, in the field of radiodiagnosis, it should be pointed out that in 2007, the profession gives greater importance to radiation protection in daily practices, taking greater account of the safety of workers (person with competence for radiation protection, dosimetry

monitoring of staff liable to be exposed, marking out of regulated areas, etc.), but also of the patient (optimisation, justification). ASN supports them in this move, in particular the radiologists, by placing a number of aids at their disposal (regulations interpretation guides, etc.) and promoting good practices (good practice guides for medical imaging, radiology procedures, and so on), drafted under the supervision of the French Radiology Society.

2 NUCLEAR MEDICINE

2|1 Presentation of nuclear medicine activities

Nuclear medicine includes all uses of unsealed source radionuclides for diagnostic or therapeutic purposes. Diagnostic uses can be divided into in-vivo techniques, based on administration of radionuclides to a patient, and exclusively in-vitro applications.

2|1|1 In-vivo diagnosis

This technique consists in examining the metabolism of an organ with a specific radioactive material - called a radiopharmaceutical - administered to a patient. The nature of the radiopharmaceutical, which is classified as a drug, depends on the organ being examined. The radionuclide can be used directly, or fixed to a carrier (molecule, hormone, antibody, etc.). For example, table 2 presents some of the main radionuclides used in the various investigations.

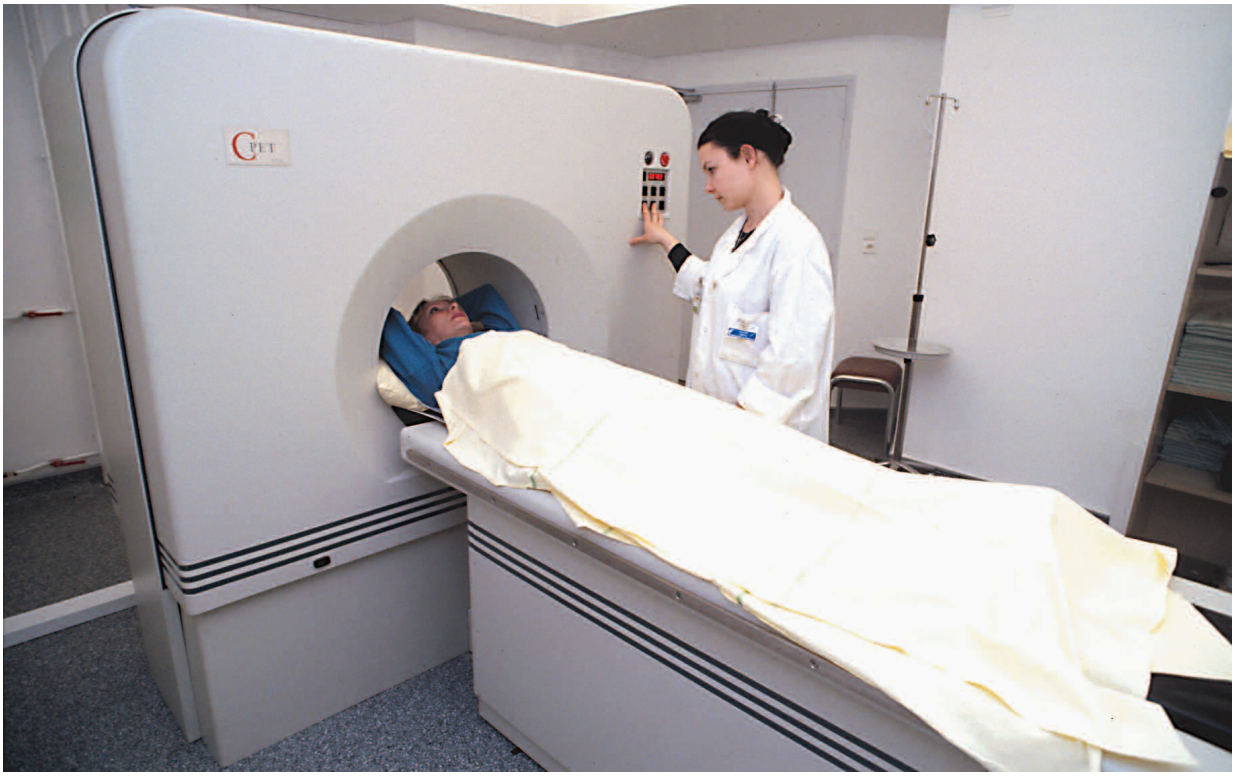
Technetium 99m, delivered to nuclear medicine departments in the form of a generator, is by far the most commonly used radionuclide. Its short radioactive half-life (6 hours) and the low level of its gamma radiation enable the dose received by the patient to be optimised. The activity administered to a patient for an examination is a few hundred megabecquerels (MBq). The radioactive material administered is located in the organism by a specific detector - a scintillation camera or gamma-camera - which consists of a crystal of sodium iodide coupled with a computer-controlled acquisition and analysis system. This equipment is used to obtain images of how the investigated organs are functioning (scintigraphy). As these images are digitised, the physiological processes can be quantified, along with a three-dimensional reconstruction of the organs, using the same principle as for the X-ray scanner.

Fluorine 18, a radionuclide that emits positrons with a half-life of 110 minutes, is today commonly used in the form of a sugar, fluorodeoxyglucose (FDG), for examinations in cancer treatment. It requires the use of a scintillation camera able to detect positron emitters, called a positron emission tomography (PET) machine.

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). In order to make it easier to merge functional and morphological images, hybrid appliances have been developed: PET machines are now systematically coupled with a scanner (PET-SCAN) and more and more nuclear medicine departments are acquiring gamma-cameras coupled with a scanner (SPECT-CT).

Table 2: some of the main radionuclides used in the various nuclear medicine explorations

Type of exploration	Radionuclides used
Thyroid metabolism	Iodine 123, technetium 99m
Myocardial perfusion	Thallium 201, technetium 99m
Pulmonary perfusion	Technetium 99m
Pulmonary ventilation	Krypton 81m, technetium 99m
Osteo-articular process	Technetium 99m
Oncology - search for metastasis	Fluorine 18



Positron Emission Tomography machine in Tenon hospital, Paris

2|1|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 in blood samples taken from the patient: 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.

2|1|3 Targeted internal radiotherapy

Targeted internal radiotherapy aims to administer a radiopharmaceutical emitting ionising radiation, which will deliver a high dose to a target organ for curative or palliative purposes.

Certain therapies require hospitalisation of the patients for several days in specially fitted out rooms in the nuclear medicine department, until most of the radionuclide administered has been eliminated through the urinary tract. The radiological protection of these rooms must be appropriate to the type of radiation emitted by the radionuclides. This is in particular the case with treatment of certain thyroid cancers after surgery, involving the administration of about 4,000 MBq of iodine 131.

Other treatments can be on an out-patient basis. 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. Finally, radioimmunotherapy, which has appeared more recently, can be used to treat certain lymphomas using antibodies marked by yttrium 90.

2|1|4 The new nuclear medicine tracers

In recent years, research has been under way in France and around the world, to develop new radioactive tracers. This primarily concerns positron emission tomography (PET) and targeted internal radiotherapy.

Source with sealed syringe ready for administration to the patient

The installation of numerous PET cameras has opened the door to research on the advantages of new positron emitting radiopharmaceuticals. Considerable research is being carried out into molecules marked with fluorine 18 (FLT, F-DOPA, F-MISO, FES, FET, F-choline, etc.), which could supplement FDG, so far the only tracer commonly used in PET. Future research should also look at new positron-emitting radionuclides. A clinical trial with gallium 68 (which has the advantage of being produced by a generator, in the same way as technetium 99m) should be starting soon.

In the field of targeted internal radiotherapy, most research in progress concerns radio-immunotherapy (use of antibodies marked with a radionuclide) involving yttrium 90. Research in the near future could concern new beta-emitter radionuclides (such as lutetium 177) or alpha-emitters. Radium 223, the first alpha-emitter to have been tested in France as of 2006 for palliative treatment of bone metastases, is currently undergoing a second trial to assess its effectiveness in curative treatment.

The use of new radiopharmaceuticals in nuclear medicine means that the radiation protection requirements associated with their use must be taken into account as early as possible in the process. Given the activity levels involved, the characteristics of the radionuclides and the known preparation and administration protocols, exposure of the operators, particularly their hands, could reach or even exceed the dose limits set by the regulations. In addition to issuing a reminder of regulatory requirements, ASN has also initiated awareness raising programmes, in particular by encouraging the development of automated systems for preparation and/or injection of these radioactive products.

2|2 Key figures: a stable number of nuclear medicine departments

This sector comprises a total of 239 operational nuclear medicine units, containing both in vivo and in vitro installations (2007 figures).

The number of nuclear medicine units practicing in-vivo diagnosis and therapy has been on the whole stable over the last two years. 60% of them are located in public or comparable structures and 40% are in private structures. After a period in which a number of the units acquired PET machines (2003-2006), the PET inventory is stabilising: in 2007, 74 are in service. The drop in in-vitro diagnostic activity using radionuclides is continuing and in certain cases entails closure or merging of laboratories, or these laboratories being absorbed into nuclear medicine units.

Nuclear medicine involves about 500 specialist practitioners in this field, to which must be added 1,000 physicians working in the nuclear medicine units (interns, cardiologists, endocrinologists, etc.).

2|3 Techical and administrative rules

2|3|1 Nuclear medicine department organisation and operating rules

Given the radiation protection constraints involved in the use of unsealed source radionuclides, nuclear medicine departments must be designed and laid out so that they can receive, store, prepare and then administer unsealed

radioactive sources to patients or handle them in laboratories (radioimmunology for instance). Arrangements also need to be made for collection, interim storage and disposal of radioactive waste and effluents produced in the installation.

From the radiological viewpoint, the personnel are subjected to an external exposure hazard, in particular on the fingers, owing to handling of sometimes highly active solutions (the case with fluorine 18, iodine 131 or yttrium 90 in radio-immunotherapy), along with an internal exposure hazard through accidental intake of radioactive materials. As the patients eliminate the administered radioactivity through their urine, special treatment of it is required in order to limit discharges into the public domain. In these conditions, the nuclear medicine departments have to comply with specific layout rules, the main provisions of which are described below.

Location and layout of premises

The premises of a nuclear medicine unit must be located away from the general circulation areas, clearly separated from premises intended for ordinary use, grouped so that they form a single unit allowing easy marking out of controlled areas, categorised in descending order of radioactive activity levels. They comprise at least:

– a changing area airlock for the staff, separating normal clothing from work clothing;
– examination and measurement rooms and waiting rooms for the patients prior to examination;
– areas for storage and preparation of unsealed sources (hot laboratory);
– an injection room adjoining the hot laboratory;
– installations for reception of the radionuclides delivered and storage of radioactive waste and effluent.

Shielded enclosure for handling unsealed sources

Layout of premises

The walls are sized to ensure protection of the workers and the public in their vicinity. The floors, walls and worktop surfaces must be made of smooth, impermeable, seamless and easily decontaminable materials. The washbasin taps must not be hand-operated. The changing area airlock must be equipped with washbasins and a shower and the sanitary facilities for the patients who have received an injection must be connected to a septic tank, itself directly connected to the establishment's main sewer. The hot laboratory must be fitted with one or more shielded chambers for storing and handling radioactive sources, offering protection against the risks of internal exposure and dispersal of radioactive materials.

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 materials in the hot laboratory must be connected to independent extraction ducts fitted with filters.

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 effluents must be sent from a small number of dedicated drainage points to buffer tanks which operate alternately as filling tanks and decay storage tanks. These tanks, of which there must be at least two, must be positioned above a safety leak tank.

The management of radioactive sources in nuclear medicine units must comply with the rules stipulated by the Public Health Code (chapter 3|1).

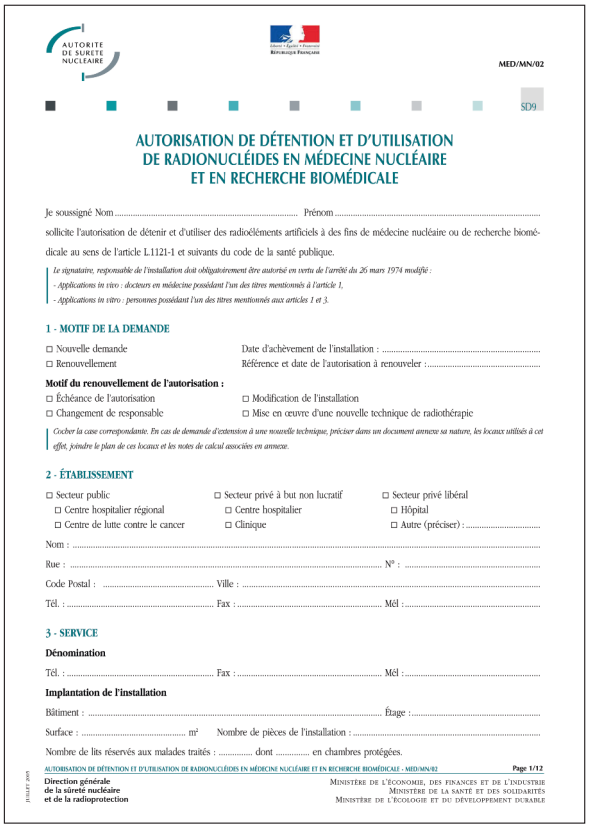
ASN is currently working on updating the layout rules for nuclear medicine installations, most of which date from the 1980s, in order to take account of recent changes in nuclear medicine (PET, etc) and in the general radiation protection regulations, as well as of the experience feedback concerning the existing regulations from the ASN inspectors and the nuclear medicine professionals themselves. The professionals will be involved in this work.

2 | 3 | 2 Nuclear medicine licences

The use of radioactive sources in nuclear medicine is subject to prior licensing by ASN (article R. 1333-24 of the Public Health Code), for a maximum renewable period of 10 years. The licence is issued to the practitioner, who is then responsible.

The licence application dossiers are based on a form that can be downloaded from www.asn.fr plus backup items as listed in the regulations. Particular attention must be paid to the procedures for collecting and disposing of the radioactive waste and effluents produced. The dossier must therefore comprise a waste and effluent management plan for the entire establishment within which the nuclear medicine unit is located.

In 2007, ASN issued 79 decisions concerning nuclear medicine (commissioning and renewal licences, licence revocation notices, etc.).



AUTORITE DE SURETE NUCLEAIRE

MED/MN/02

SD9

AUTORISATION DE DÉTENTION ET D'UTILISATION DE RADIONUCLÉIDES EN MÉDECINE NUCLÉAIRE ET EN RECHERCHE BIOMÉDICALE

Je soussigné Nom ..... Prénom .....

sollicite l'autorisation de détenir et d'utiliser des radioéléments artificiels à des fins de médecine nucléaire ou de recherche biomédicale au sens de l'article L1121-1 et suivants du code de la santé publique.

Le signataire, responsable de l'installation doit obligatoirement être autorisé en vertu de l'arrêté du 26 mars 1974 modifié :
- Applications in vivo : docteurs en médecine possédant l'un des titres mentionnés à l'article 1,
- Applications in vitro : personnes possédant l'un des titres mentionnés aux articles 1 et 3.

1 - MOTIF DE LA DEMANDE

☐ Nouvelle demande — Date d'achèvement de l'installation : .....
☐ Renouvellement — Référence et date de l'autorisation à renouveler : .....

Motif du renouvellement de l'autorisation :
☐ Échéance de l'autorisation — ☐ Modification de l'installation
☐ Changement de responsable — ☐ Mise en œuvre d'une nouvelle technique de radiothérapie

Cocher la case correspondante. En cas de demande d'extension à une nouvelle technique, préciser dans un document annexe sa nature, les locaux utilisés à cet effet, joindre le plan de ces locaux et les notes de calcul associées en annexe.

2 - ÉTABLISSEMENT

☐ Secteur public — ☐ Secteur privé à but non lucratif — ☐ Secteur privé libéral
☐ Centre hospitalier régional — ☐ Centre hospitalier — ☐ Hôpital
☐ Centre de lutte contre le cancer — ☐ Clinique — ☐ Autre (préciser) : .....

Nom : .....
Rue : ..... N° : .....
Code Postal : ..... Ville : .....
Tél. : ..... Fax : ..... Mél : .....

3 - SERVICE

Dénomination
Tél. : ..... Fax : ..... Mél : .....

Implantation de l'installation
Bâtiment : ..... Étage : .....
Surface : ..... m² Nombre de pièces de l'installation : .....
Nombre de lits réservés aux malades traités : ..... dont ..... en chambres protégées.

AUTORISATION DE DÉTENTION ET D'UTILISATION DE RADIONUCLÉIDES EN MÉDECINE NUCLÉAIRE ET EN RECHERCHE BIOMÉDICALE - MED/MN/02 — Page 1/12

JUILLET 2005

Direction générale de la sûreté nucléaire et de la radioprotection

MINISTÈRE DE L'ÉCONOMIE, DES FINANCES ET DE L'INDUSTRIE
MINISTÈRE DE LA SANTÉ ET DES SOLIDARITÉS
MINISTÈRE DE L'ÉCOLOGIE ET DU DÉVELOPPEMENT DURABLE

Radionuclides possession and utilisation license application form for nuclear medicine and biomedical research

3 RADIOTHERAPY

3 | 1 Presentation of radiotherapy techiques

With surgery and chemotherapy, radiotherapy is one of the key techniques employed to treat cancerous tumours. 200,000 patients are treated every year. Radiotherapy uses ionising radiation to destroy malignant cells. The ionising radiation necessary for treatment is either produced by an electric generator, or emitted by radionuclides in the form of a sealed source. A distinction must be made between external (or transcutaneous) radiotherapy, in which the radiation source is placed outside the patient and brachytherapy, in which the source is positioned in direct contact with the patient, either in or close to the area to be treated.

3 | 1 | 1 External radiotherapy

Before the irradiation sessions take place, a treatment plan is always drawn up. For each patient, and in addition to the dose to be delivered, this plan defines the target volume to be treated, the ballistics of the irradiation beams and the dose distribution (dosimetry), as well as the duration of each treatment session. 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 carried out using either particle accelerators producing beams of photons or electronics with an energy level of between 4 and 25 MeV and delivering dose rates of between 2 and 6 Gy/min, or telegammatherapy devices equipped with a source of cobalt 60 whose activity level is about 200 terabecquerels (TBq), although the number of these devices is declining in France. They are gradually being replaced by particle accelerators, whose superior performance offers a more complete range of treatments.

Particle accelerator for radiotherapy

3|1|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. Brachytherapy techniques involve three types of applications:

– low dose rate brachytherapy, which requires hospitalisation of the patient for several days, delivers dose rates of from 0.4 to 2 Gy/h. The iridium 192 sources positioned inside the tissues generally come in the form of wires 0.3 to 0.5 mm in diameter, with a maximum length of 14 cm and whose linear activity is between 30 MBq/cm and 370 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.

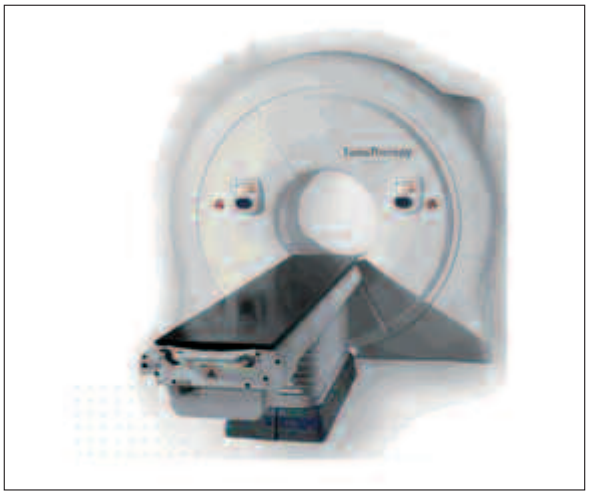
  In recent years, low dose rate brachytherapy techniques have been supplemented by the use of sealed sources of iodine 125 (half-life of 60 days) to treat prostate cancers. The iodine 125 sources, just a few millimetres long are permanently installed in the patient's prostate. Their unit activity is between 10 and 30 MBq and treatment requires about one hundred grains representing a total activity of 1500 MBq, delivering a prescribed dose of 145 Gy to the prostate.

– medium dose rate pulsed brachytherapy uses dose rates of 2 to 12 Gy/h delivered by a small-dimension iridium 192 source (a few millimetres), with maximum activity limited to 18.5 GBq. This source is applied with a specific source applicator. This technique delivers doses identical to those of low dose rate brachytherapy, and over the same period, but given the higher dose rates, irradiation is split up into several sequences (pulses). The patient does not therefore carry the sources permanently, which is more comfortable and enables him to receive visitors. This technique, which is likely to be increasingly used, significantly improves the radiation protection of the personnel, who can now work with the patient without being exposed, once the source has been returned to the applicator's storage container;

– high dose rate brachytherapy uses a small-dimension iridium 192 source (a few millimetres) and a maximum activity of 370 GBq, delivering dose rates higher than 12 Gy/h. A source applicator comparable to that used in pulsed brachytherapy is used. The treatment times are very short (no more than a few minutes), unlike the previous techniques. High dose rate brachytherapy is primarily used to treat cancers of the oesophagus and bronchus.

3|1|3 The new radiotherapy techniques

New techniques called tomotherapy and extra-cranial radiosurgery (accelerator on robot arm) have been used in France since the beginning of 2007, in addition to conventional tumour irradiation methods.



Tomotherapy installation

Tomotherapy performs irradiation by combining the continuous rotation of an electron accelerator with the longitudinal displacement of the patient during irradiation. The technique employed is similar to the principle of helical acquisitions obtained with computer tomography. A photon beam of 6 MV at 8 Gy/min formed by a multi-leaf collimator enabling the intensity of the radiation to be modulated will allow irradiation of large volumes of complex shape as well as extremely localised damage which may be in anatomically independent regions. It is also possible to acquire images in treatment conditions and compare them with reference computer tomography images, in order to improve the quality of patient positioning. This technique is currently being used in nearly a hundred centres in the United States and Europe. Three devices of this type have been installed in France since the end of 2006 and have been used to treat patients since the first quarter of 2007.

Extra-cranial radiotherapy in stereotaxic conditions with a robot arm, also called "robotic radiosurgery" consists in using a small particle accelerator producing 6 MV photons, placed on an industrial type 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. This allows irradiation in stereotaxic conditions that can also be slaved to the patient's breathing.

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.

At present, a number of European centres (Germany, Netherlands, Spain and Italy) are using this technique. In France, two installations of this type were commissioned at the end of 2006 and a third during the first quarter of 2007.

3|2 Key figures: rising numbers of accelerators

External radiotherapy installations
The number of radiotherapy installations is rising and now comprises 388 appliances located in 182 radiotherapy centres, half of which are public, while the other half are private (2007 figures). 667 radiotherapists are listed in the ADELI directory, of whom 42% are independent practitioners and 56% are salaried.

Brachytherapy units
This inventory comprises 109 brachytherapy units (2007 figures).

3|3 Technical and administrative rules

The rules for radioactive source management in radiotherapy are comparable to those defined for all sealed sources, regardless of their use.

3|3|1 Technical rules applicable to external radiotherapy installations

These machines must be installed in rooms specially designed to guarantee radiation protection of the personnel, turning them into true bunkers (the thickness of the ordinary concrete walls can vary from 1 m to 2.5 m). A radiotherapy installation comprises a treatment room including a technical area containing the appliance, a control station outside the room and, in the case of some accelerators, auxiliary technical premises.

The protection of the premises, in particular the treatment room, must be determined 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 person specialising in medical radiophysics (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 safety case defines the thicknesses and nature of the various protections required, which are 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

Radio-surgery installation

below. This safety case should be included in the file presented to support the application for a licence to use a radiotherapy installation, examined by 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.

3|3|2 Technical rules appicable to brachytherapy installations

Low dose rate brachytherapy

CThis technique requires the following premises:

– an application room, where the source carrier tubes (non-radioactive) are positioned on the patient and their correct positioning is checked by radiological imaging;
– hospitalisation rooms specially reinforced for radiation protection reasons (on the basis of 8,100 MBq of caesium 137 or 5,550 MBq of iridium 192), where the radioactive sources are put in place and where the patient remains for the duration of the treatment;
– an area for radioactive source storage and preparation.

For certain applications (use of caesium 137 in gynaecology), a source applicator can be used to optimise staff protection.

Pulsed dose rate brachytherapy

This technique can only be used in units which already employ low dose rate brachytherapy. The rooms set aside for hospitalisation of patients receiving this treatment must have radiological protection appropriate to the maximum activity of the radioactive source used (generally 18.5 GBq of iridium 192).

High dose rate brachytherapy

The maximum activity used is 370 GBq of iridium 192, so irradiation may only take place in a room with a configuration comparable to that of an external radiotherapy room and fitted with the same safety systems.

3|3|3 Radiotherapy licensing

Use of radiotherapy installations requires prior licensing from ASN. The renewable 10-year licence is issued to the practitioners, who are then responsible for it.

The licence application dossiers are based on a form that can be downloaded from the ASN website (www.asn.fr). These dossiers, accompanied by the required backup items, are to be returned to ASN (locally competent division) for examination.

In 2007, ASN issued 126 decisions concerning radiotherapy installations and 24 decisions concerning brachytherapy activities (commissioning or renewal licences, licence revocation notices).

4 BLOOD PRODUCT IRRADIATORS

4|1 Description

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 radiological 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.

4|2 Blood product irradiator statistics

In 2007, the inventory of installations of this type, most of which were in operation in blood transfusion centres, remained stable at 36 units. However, the clear trend towards replacement of irradiators by X-ray machines, in particular to eliminate the constraints involved in managing radioactive sources, was confirmed during the course of 2007.

4|3 Technical and administrative rules

The room in which the labile blood products irradiator is installed must be specifically dedicated to this appliance and be as isolated as possible, protected from all risk of flooding, short-circuit, explosion or traffic accident. It must be designed to prevent any possibility of break-in or any spread of fire.

Access must be via a solid door equipped with an effective system automatically closing the door after it has been opened and only allowing access by authorised persons. If in a regulated area, the outside of the door must carry the appropriate radiation hazard sign for the type of regulated area.

The irradiator control console must be fitted with a control key which is to be removed from the device and stored in a safe place under the responsibility of an individually designated person.

These installations are subject to licensing, in the same way as for nuclear medicine and radiotherapy. Source management rules also apply. In 2007, ASN notified 2 decisions concerning blood product irradiators.

Blood product irradiator

5 IMPACT OF MEDICAL INSTALLATIONS

The potential dosimetric impact from medical installations concerns patients receiving treatment or undergoing examination, the health professionals (doctors, radiophysicians, electroradiology operators, nurses, etc.) using ionising radiation or participating in their use, but also the population, for example people living near the installations or population groups who could be exposed to waste or effluents from nuclear medicine departments.

5|1 Medical exposure of patients

Patient exposure to ionising radiation is differentiated from the other types of exposure (workers, population) because it is not subject to any limitations. This is also the only case in which exposure is delivered for the direct benefit of the exposed persons, i.e. the patients. The situation is different whether the patient is being exposed for diagnostic reasons (radiology or diagnostic nuclear medicine) or is receiving external or internal radiotherapy treatment. In the first case, optimisation is necessary by delivering the minimum dose necessary to obtain relevant diagnostic data, while in the second, the dose needed to sterilise the tumour must be delivered, while maximising preservation of the surrounding healthy tissue.

Guide of good practice for medical imaging examinations published by the French Radiology Society

Optimisation of the dose received by the patient depends on the quality of the equipment used, which for example 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 that used for this exposure (if a radiological film viewer is defective, this could lead to an increase in doses delivered in order to produce the films). On the whole, inspections carried out in 2007 showed that about 70% of the units exercised quality control of their appliances, while 12% have undertaken to set up a process of this type. 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 (see point 1|3|4).

Table 3 below presents the breakdown of the number of procedures and associated doses for conventional radiography, computed tomography, nuclear medicine and interventional radiology.

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

ASN survey

To assess the whether the PSRPM staffing levels are appropriate to the activity of a radiotherapy department, ASN considered the criteria defined by the DHOS in 2002 and the guideline values published by EFOMP (European Federation of Organisations for Medical Physics) - in 1997.

The main conclusions of the survey conducted by ASN show that 60 of the 160 centres who answered, or 40% of the radiotherapy centres, were unable to comply with the requirement of PSRPM presence throughout the patient treatment period.

Overall, this survey showed the need for about 100 full-time equivalent PSRPM and about 100 full-time equivalent associated technicians (dosimetrists and electro-radiology operators).

In nuclear medicine, the activities administered vary widely from one department to another, from one country 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.

The optimisation process can be improved if a person specialising in medical radiophysics (PSRPM) is present in the department to determine and guarantee the doses delivered. Overall, according to ASN sources, only 64% of the departments for which the indicators were recorded currently employ a PSRPM, all departments included (radiotherapy, radiology, nuclear medicine). This overall figure indicates a shortage of staff with this qualification, in particular in radiology departments.

In radiotherapy departments, the presence of the PSRPM during treatment is mandatory. An ASN survey was carried out at the beginning of 2007 to identify PSRPM needs in radiotherapy departments. The conclusions are presented below.

Drafting of a medical radiophysics plan, which is required for all types of ionising radiation applications, as specified in the order of 19 November 2004, should enable the establishment heads and practitioners to identify the resources needed to develop medical radiophysics. Progress is certainly still needed in this area because only 27% of the establishments inspected in 2007 possessed such a plan and 22% of them are in the process of preparing one.

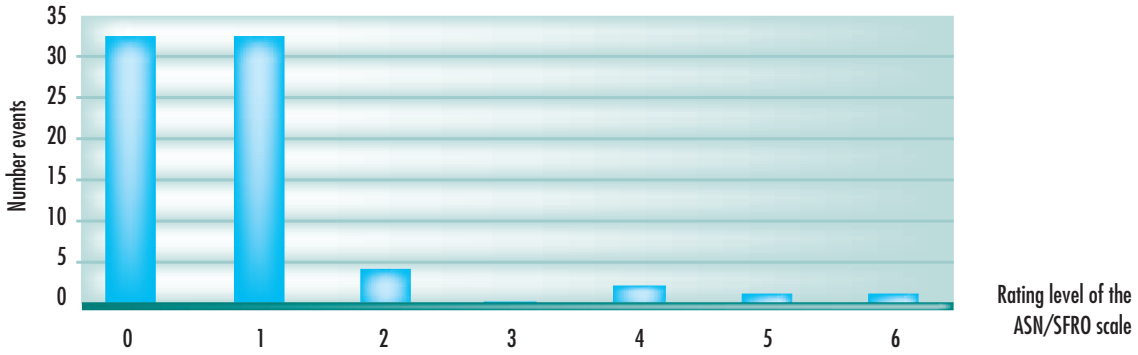
With regard to radiology and nuclear medicine, diagnostic reference levels (NRD) give a clearer picture of the doses delivered and thus allow better management of them. However, only 65% of the nuclear medicine departments, 8% of conventional radiology departments and 17% of computer tomography departments have transmitted NRD data at least once during the course of the past three years (source IRSN).

ASN attaches particular importance to the drafting of medical radiophysics plans and the implementation of diagnostic reference levels, owing to their key role in optimising the doses delivered to the patients.

Table 3: contribution to the individual dose from radiological and nuclear medicine procedures (source: IRSN)

Type of procedure	Approximate percentage of number of procedures	Contribution to individual mean dose
Conventional radiology	90%	36%
Interventional radiology	1%	17%
Tomography	8%	40%
Nuclear medicine	1%	7%

Rating of events notified to ASN since 2005 and affecting patients during a radiotherapy medical procedure, according to severity (using the ASN/SFRO scale)



5|2 Patient exposure accidents

Since 2005, ASN has been notified of 76 events which led to or could have led to patient exposure; 51 were notified after publication of the ASN/DEU/03 guide for the notification of significant events in June 2007. Most of these events occurred during radiotherapy treatments, while one event concerned an irradiation overdose during interventional radiology.

Their consequences for the health of the patients vary considerably:
– they usually affect a single isolated patient but can also concern cohorts (Épinal hospital: 4500+409+24, Toulouse University Hospital: 145);
– they can lead to death (Épinal hospital, Lyon Sud University Hospital) or to serious or severe complications (Tours Hospital, Grenoble University Hospital (see 2006 annual report));
– generally they do not become immediately apparent, requiring medical surveillance;
– they can sometimes be compensated for during the course of the subsequent treatment.

Once notified by the heads of the establishments concerned, through application of the radiation protection events notification guide (www.asn.fr), ASN:
– organises a reactive inspection, when necessary with the technical support of experts (IRSN, SFPM, SFRO, etc);
– disseminates experience feedback to the professionals;
– informs the health agencies (DGS, DHOS, Afssaps, InVS, INCa);
– informs the public after prior (mandatory) information of the patients by their radiotherapist, using the severity scale published in July 2007 (www.asn.fr).

An examination of the causes of these events shows frequent errors in patient identification, but also errors in the use of software, technical errors (e.g. poor optimisation of the use of portal imaging when checking the positioning of the patients, poor beam calibration), inadequate staff training in the use of new software or new technologies, or deficient organisation (lack of quality assurance, communication error between operators). The origin of these events is usually human and organisational, but may sometimes also be linked to equipment anomalies.

ASN played an active role in preparing and implementing the national programme of action defined by the Minister for Health, Youth and Sport, taking charge of actions to develop the events notification system (ASN/DEU/03 guide available on www.asn.fr) and the rating system (ASN/SFRO experimental scale available on www.asn.fr) as well as preparing the quality assurance reference system.

At an international level, ASN focused on disseminating the experience acquired:
– through meetings both bilateral (Belgium, Switzerland, Ireland and Spain) and multilateral (Euratom and IAEA committees);
– by taking part in the working group set up by IAEA to prepare a scale for rating events concerning patients radiation protection. The principle of an international conference organised by ASN in partnership with IAEA has now been accepted.

5|2|1 Radiotherapy accidents at the Rangueil University Hospital (CHU) in Toulouse

On 20 April 2007, ASN was informed by the Rangueil hospital in Toulouse of a discrepancy between the prescribed dose and the dose delivered to 145 patients treated in the regional stereotaxic radio-surgery centre, between 6 April 2006 and 17 April 2007.

National programme of action to reinforce the safety of radiotherapy treatment

1. Quality and Safety of practices – Quality Assurance

Publish an ISO 9000 type radiotherapy quality assurance reference system (ASN action).
Draft, distribute and assess the implementation of radiotherapy certification criteria, including in-vivo dosimetry (INCa action completed).
Draft clinical recommendations for cancerology incorporating radiotherapy indications and their place in patient care strategies (INCa action).
Draw up a procedures guide for external radiotherapy of tumours (SFRO action completed).
Include criteria on the radiotherapy quality approach in the establishment certification process (HAS action completed).
Support radiotherapy centres with implementing the quality and safety approach (INCa/Meah action in progress).

2. Set up a system of radiation protection

Establish procedures guaranteeing the coherence of all radiotherapy radiation protection procedures (DGS action).
Distribute a guide intended for professionals, concerning the notification of radiation protection events (ASN action completed).
Draw up an incidents rating scale for the purpose of communication with the public (ASN action completed).
Initiate an experimental system for notification of serious side-effects linked to health care (InVS action).

3. Human resources / Training

Conduct a study into the demographics of the radiotherapy professionals (SFRO action completed).
Define a system for recognition of independent oncology radiotherapists through a status similar to that of the health institutions (DHOS action).
Publish a decree and an order aimed at enhancing the recognition of radiation physicists in public institutions (DHOS action completed).
Increase the number of radiation physicists undergoing training (DHOS/INCa action in progress).
Improve the status of the electro-radiology operators in radiotherapy (DHOS action).
Draft a programme of continuous training and a module covering analysis and management of radiotherapy risks for health professionals (IRSN action).
Update the radiation physicists initial training reference system and strengthen continuous training (DHOS action).

4. Installations safety

Improve software safety (AFSSAPS action completed).
Reinforce the checks made on irradiating devices placed on the market (appliances and software), in particular reinforcing the checks on the language used in the software and the user's guides (AFSSAPS action completed).
Reinforce external quality control (AFSSAPS action completed).
Extend internal quality control to multi-slice collimators, portal imaging, treatment planning systems, data verification and recording systems (AFSSAPS action completed).
Improve the radiotherapy installation acceptance conditions (AFSSAPS action).

5. Relations with patients and the public

Inform the public: draft an information document intended for the general public (INCa/SFRO action).
Inform general practitioners (INCa/SFRO action).
Draft recommendations for communication to the patients concerned and to the public by the establishment and the authorities (DGS action).
Organise the response to be given to patients, families and associations regarding the consequences of radiotherapy treatments (IRSN action).

6. Inspections and checks

Reinforce ASN's inspection programme (ASN action completed).

7. Knowledge of the field

Annual summary of ASN inspections (action completed).
Create a radiotherapy observatory (SFRO action).
Conduct a multi-year survey of radiotherapy practices (INCa action).
Annual review of radiation protection notifications (ASN/AFSSAPS action).

Stereotaxic radiosurgery is a therapeutic method that consists in delivering high-energy radiation to an intracranial damage in a single treatment session. Although qualified as surgical, this technique is non-invasive.

This incident notification followed detection by the manufacturer of a calibration anomaly in the treatment appliance, with the consequence being that a dose higher than that prescribed was delivered to the organs, although the proportions varied according to the location of the organs and the characteristics of the radiation beams used. As soon as the anomaly was detected, the on-site medical team shut down the installation and proceeded to analyse the files of all the patients treated, in order to determine the dose actually delivered.

The ASN Bordeaux division, together with the Haute-Garonne DDASS, AFSSAPS and IRSN, carried out an inspection on 3 May 2007 to clarify the circumstances surrounding the event. This inspection confirmed the discrepancies in the measurements taken at calibration of the radio-surgery micro-beams, linked to the measuring tool used. Once the team at the stereotaxic radio-surgery centre in the Toulouse university hospital had corrected its calibration procedures, it was authorised to resume clinical and therapeutic activities further to the inspection.

All patients received a letter inviting them to attend an individual medical interview to inform them of the dose actually received and the consequences for subsequent surveillance.

The event was provisionally rated 2 on the ASN/SFRO scale, pending the results of the ongoing medical surveillance.

5|2|2 Radiotherapy accidents at Épinal Hospital

In July 2006, ASN was informed of the over-exposure of 23 patients who had been treated for prostate cancer in the Jean Monnet hospital in Épinal, between May 2004 and May 2005.

In July 2006, Xavier Bertrand, then Minister for Health and Solidarity, had asked the General Inspectorate of Social Affairs (IGAS) and ASN to ascertain precisely where responsibility lay and draw all necessary conclusions, at both local and national levels, concerning the conditions of radiotherapy safety from the technical, organisational and human viewpoints. The final conclusions of the mission were presented in February 2007. The mission in particular revealed quality assurance shortcomings in the practices of the department and a lack of radiation protection organisation and monitoring of the iatrogenic complications of radiotherapy.

L'ASN assure, au nom de l'État, le contrôle du nucléaire pour protéger le public, les patients, les travailleurs et l'environnement. Elle informe les citoyens.

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Paris, le 23 mai 2007

NOTE D'INFORMATION

Anomalie lors de traitements de radiochirurgie stéréotaxique à Toulouse (Haute-Garonne)

Le 20 avril 2007, l'Autorité de sûreté nucléaire (ASN) a été informée par l'hôpital Rangueil de Toulouse d'un écart, sans conséquence sanitaire détectée à ce jour, entre la dose délivrée et la dose prescrite à 145 patients traités au centre régional de radiochirurgie stéréotaxique (1) entre le 6 avril 2006 et le 17 avril 2007.

Cette déclaration d'incident fait suite à la détection par le fabricant d'une anomalie de calibration de l'appareil de traitement. Il en résulte que la dose délivrée aux organes lors de l'unique séance de traitement a été plus élevée que celle prescrite, dans des proportions variables selon la localisation des organes et les caractéristiques des faisceaux de rayonnements utilisés. Dès la détection de l'anomalie, l'équipe médicale du site a arrêté l'installation et a procédé à l'analyse de l'ensemble des dossiers des patients traités, afin de déterminer la dose effectivement délivrée.

La Division de Bordeaux de l'ASN a procédé, conjointement avec la DDASS de Haute-Garonne, l'AFSSAPS et l'IRSN, à une inspection le 3 mai 2007 afin de préciser les circonstances de l'événement Cette inspection a confirmé la discordance des mesures réalisées lors de la calibration des micro-faisceaux de radio chirurgie, discordance liée à l'outil de mesure utilisé. L'équipe du Centre de Radio Chirurgie Stéréotaxique du CHU de Toulouse ayant corrigé ses procédures de calibration, a été autorisée à redémarrer son activité clinique et thérapeutique à la suite de l'inspection.

Tous les patients ont été invités par courrier à un entretien médical personnalisé afin d'être informés de la dose réelle reçue et des conséquences sur la surveillance ultérieure. Ils feront l'objet d'un suivi spécifique clinique afin de détecter l'apparition éventuelle de complications liées au traitement.

Pour une autre installation de même nature actuellement en fonctionnement à Nantes, la division territoriale de l'ASN s'est assurée de l'absence d'anomalie similaire.

(1)La radiochirurgie stéréotaxique est une méthode thérapeutique consistant à délivrer un rayonnement de haute énergie sur une lésion intracrânienne en une séance unique de traitement. Bien qu'elle soit qualifiée de chirurgicale, cette technique est non invasive.

Mentions légales

On-line incident notification on www.asn.fr concerning the radiotherapy accident in Rangueil university hospital in Toulouse

Given the apparently large number of complications in the population of patients treated by conformational radiotherapy in Épinal, the question was to find out whether this frequency was in any way significantly different from the usual rates of radiation induced damage. The Minister then entrusted IRSN with an additional mission on 8 March 2007, asking it to assess the radiotherapy practices at Jean Monnet Hospital. IRSN submitted its report on 23 March, the main conclusions being as follows:

– the dose criteria set by Jean Monnet hospital for sound organs were, barring exceptions, met with regard to exposure of the bladder, although for the rectum, these criteria were not met in 16% of cases;
– the dosimetric impact of the checks carried out by portal imaging was considered to be negligible until April 2006, whereas for prostate cancer treatments, the added dose could represent a total of about 6 grays. Subsequently, the additional dose was correctly taken into account, although by eliminating 2 to 3 irradiation sessions, whereas the dose at each session should have been reduced (which was done as of November 2006).

Finally, on 26 July 2007, ASN was informed of the discovery of another case of over-exposure of a radiotherapy patient treated in 1999. This notification came about as a result of the surveillance put into place at the request of the Minister responsible for health, following the discovery of the first accidents.

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Paris, le 29 janvier 2008

NOTE D'INFORMATION

Centre Hospitalier d'Epinal : le dispositif de surveillance médicale des anciens patients conduit à la découverte de nouveaux cas de surexposition

Le dispositif de surveillance médicale des anciens patients du service de radiothérapie du Centre hospitalier Jean Monnet d'Epinal, mis en place depuis mars 2007 par le ministre chargé de la Santé, conduit à la découverte de nouveaux cas de surexposition.

L'ASN a été ainsi informée le 16 janvier d'un cas concernant une patiente traitée en 1998 pour un cancer du sein, puis en 2003 pour une métastase osseuse dorsale. La superposition des champs d'irradiation lors des deux traitements aurait conduit à une surexposition de la zone traitée. Un deuxième cas concerne huit patientes traitées en 1993 pour un cancer du sein. Ces patientes auraient été surexposées à la suite d'une erreur de paramétrage des faisceaux faisant suite à l'installation d'un nouvel accélérateur.

Ces nouveaux cas s'ajoutent à une série d'événements déjà mis en évidence dans ce service de radiothérapie :

- 24 patients traités pour un cancer de la prostate entre mai 2004 et août 2005 ont été surexposés d'environ 20 % à la suite d'une mauvaise utilisation du logiciel de planification du traitement ;
- 400 patients traités pour un cancer de la prostate entre 2001 et 2006 ont été surexposés d'environ 8 % par une utilisation excessive de l'imagerie contrôlant leur positionnement pendant le traitement ;
- parmi 4 500 patients traités pour divers cancers entre septembre 1987 et juillet 2000, et concernés par une erreur de programmation d'un logiciel interne, 312 patients ont reçu une surexposition maximale de l'ordre de 7 %.

Le suivi médical par les équipes médicales du Centre hospitalier d'Epinal de l'ensemble de ces patients est en cours. Dès réception du bilan médical, l'ASN procèdera au classement sur l'échelle ASN/SFRO de ces événements.

A chaque événement déclaré, l'ASN procède en effet à l'identification de leurs causes précises. L'ASN engagera la même démarche pour tout nouvel événement qui lui serait déclaré.

L'ASN s'assurera également, au cours de ses inspections, que les enseignements tirés de ces incidents sont bien pris en compte par l'ensemble de la profession dans tous les centres de radiothérapie.

L'ASN confirme qu'elle procédera en 2008, comme en 2007, à l'inspection de l'ensemble des centres de radiothérapie en France.

Mentions légales

On-line information notice on asn.fr summarising the over-exposure incidents that occured in Epinal hospital and the medical supervision put in place for former patients

The technical file analysis carried out by the hospital revealed that the over-exposure stemmed from incompatibility between the software developed by the radiotherapy department when the appliance was started up in 1989 and a new patient positioning method being used. This error would seem to have been systematically reproduced until July 2000. The investigations conducted at Épinal by the ASN Strasbourg division and the Regional Hospitalisation Agency, on 9 August 2007, confirmed the initial assessment made by the hospital: of the 4500 patients potentially concerned by the error between 1989 and 2000, a maximum 7% overdose for a group of about 300 patients treated between 1999 and 2000 was identified.

ASN is continuing its actions with regard to the Épinal hospital and is remaining particularly attentive to the results of the medical surveillance put in place.

5|2|3 Stereotaxic radiotherapy equipment surveillance incident

On 8 June 2007, the BrainLAB company notified AFSSAPS of a generic malfunction in its stereotaxic radiotherapy devices. The use of these devices (Brainscan or iPlan RT Dose 3.0., 3.0.1, 3.0.2 treatment planning software used in conjunction with the Leksell stereotaxic centring frame) led to a 1.25 mm deviation in the radiation beam used to treat brain tumours and malformations.

In line with the precautionary measures taken by the Ministry for Health, Youth and Sport on 11 June 2007, ASN provisionally suspended the stereotaxic radiotherapy licences for the treatment of cerebral damage in the 4 centres which used these devices: the Alexis Vautrin Centre in Nancy, Montpellier University Hospital, Bretonneau University Hospital in Tours and Pitié-Salpétrière University Hospital in Paris.

These 4 centres were authorised to resume treatment after ASN validation of the corrective measures adopted.

5|2|4 Interventional radiology incident at the Lyon Est Hospital

On 1 August 2007, ASN was informed by the Lyon Cardiology Hospital of a higher than necessary level of X-ray exposure of a patient during installation of a cardiac defibrillator, on 16 July 2006 in the cardiac rhythm studies department.

When performing procedures of this nature, the practitioner uses imaging for guidance. In the present case, an error was made when selecting the imaging mode, leading to the choice of a mode delivering a higher dose: radiography mode was chosen instead of fluoroscopy mode.

With the assistance of IRSN, the ASN Lyon division carried out a reactive inspection on 29 August 2007 in order to precisely determine the circumstances of the incident and analyse the corrective measures taken by the establishment. This inspection was followed by an additional technical visit on 19 September 2007, in order to conduct a reconstruction of the event.

Following the 29 August inspection, ASN asked the establishment to present the preventive measures to be implemented to prevent such an incident happening again, particularly in terms of staff training, departmental organisation in the event of equipment loans, and the organisation of staff radiation protection.

An evaluation of the possible radiological consequences for the patient and the staff present in the examination room at the time of the procedure is currently ongoing.

5|3 Radiation protection of medical personnel

5|3|1 Dosimetry

According to the data collected by IRSN in 2006 (IRSN report "Worker radiation protection. Initial 2007 review of IRSN activities"), about 151,000 people working in fields using ionising radiation for medical purposes – that is 54% of all exposed workers subject to monitoring, all sectors taken together – underwent dosimetric monitoring of their exposure. Medical radiology covers about 67% of the medical personnel exposed. In total, more than 98% of the persons monitored in 2006 and working in medicine or dentistry received an annual effective dose of less than 1 mSv while the annual limit of 20 mSv was exceeded 18 times (28 in 2005). These overexposures can be broken down as follows: 15 in medical radiology, 1 in radiotherapy, 1 in dental radiology and 1 in occupational medicine. Inquiries are systematically held by ASN in conjunction with the occupational medicine department and when necessary together with the conventional safety inspectorate, to identify the individual causes of each of these overexposures.

Each overexposure must lead to notification to ASN of a significant event by the licensee of the nuclear activity and must be the subject of a specific investigation, in conjunction with the occupational physician and if necessary with the conventional safety inspectorate, in accordance with the circular of 16 November 2007 concerning the coordination of the radiation protection inspectors with the conventional safety inspectors for the prevention of hazards arising from ionising radiation.

5|3|2 Organisation of radiation protection

Apart from dosimetric surveillance, ASN defined 5 other indicators for assessing how personnel radiation protection is organised.

The presence of a person with competence for radiation protection (PCR) or a department with competence for radiation protection (SCR) is therefore essential to the radiation protection organisation within the establishment. This indicator has now reached highly satisfactory levels as 86% of the establishments assessed in 2007 have a PCR and 7% of them an SCR.

However, although the percentage of establishments visited in 2007 that had carried out the workstation studies was higher than in 2006 (37% in 2007 as opposed to 24% in 2006), progress is still needed. ASN stresses the importance of this approach, which is the starting point for a close examination of exposure optimisation.

Similarly, continuous training in radiation protection must continue to be given, as the results show that 40% of establishments train their personnel and that 40% intend to implement training programmes.

On the other hand, significant progress was observed in the performance of periodic checks by approved organisations, with 86% of the establishments inspected in 2007 carrying out these checks, as against 68% of the establishments inspected in 2006.

Thermoluminescent ring for personnel radiation protection (dose measurement at the extremities)

5|4 Medical personnel exposure incident

On 15 June 2007, ASN was informed of an irradiation incident involving a medical electro-radiology operator that had occurred that same day in the radiotherapy department of the Georges François Leclerc Centre (cancer treatment unit) in Dijon.

This event occurred during treatment of a patient using radiotherapy. Patient irradiation was started while an operator was still in the treatment room. Irradiation was interrupted by means of the emergency stop button after about ten seconds. The operator, who was close to the irradiator, was exposed to a part of the radiation delivered to the patient.

An IRSN estimate of the dose received by the operator confirmed the overexposure of the annual acceptable exposure limit for workers (20 mSv). Given the effective dose received – about 30 mSv – no health consequences are anticipated for this person.

The ASN Dijon division carried out a reactive inspection on 18 June in the Georges François Leclerc centre to understand how and why the incident happened and to examine the corrective measures taken by the centre. The incident proved to have been caused by human error and a lack of procedures. The centre immediately took corrective organisational measures and has undertaken to conduct a more detailed analysis of risk identification.

This event concerns a worker. Since the regulation limits were exceeded (effective dose higher than 20 mSv for 12 consecutive months), ASN rated this incident level 2 on the 7-tier INES experimental radiological events scale.

5|5 The impact on the environment and the population

Barring special circumstances, there is no particular surveillance of the impact of medical applications on the environment and the population owing to its extremely diffuse nature. Except in the case of incidents, the potential impact could concern:

– specific professional categories liable to be exposed to effluents or waste produced by nuclear medicine departments;
– members of the public, if the premises containing installations emitting ionising radiation are not fitted with the requisite protection;
– the entourage of patients who have received nuclear medicine treatment or examination involving radionuclides such as iodine 131.

The available information concerning radiological surveillance of the environment carried out by IRSN, in particular measurement of ambient gamma radiation, on the whole reveals no significant exposure level above the background radiation variations. However, radioactivity measurements in major rivers or wastewater treatment plants in the larger 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 indicate doses of a few microsieverts per year for the most exposed individuals, in particular the workers employed in the sewerage networks (IRSN 2005 study). However, no trace of these radionuclides has ever been measured in water intended for human consumption.

The recommendations that should be made by the physician after radionuclides are used in nuclear medicine were the subject of the work done by the "nuclear medicine" working group of the French High Public Health Council, in particular with respect to examinations and treatment using iodine 131. The aim was to harmonise the advice and lifestyle hints already dispensed by each physician. The work done was based on European recommendations but also on simulations and measurements taken in real-life situations. The recommendations, which were published by ASN in 2007, concern the residual activity after hospitalisation (in the case of therapy using high activity levels) or the activity administered if the patient receives iodine 131 without hospitalisation (exploration or treatment of hyperthyroidism).

For protection of members of the public, the recommendations will be relatively undemanding, with the exception of particular situations (flights lasting longer than 7 hours, close working contact in particular with pregnant women or children). For protection of family members, the recommendations made concern the partner and children under 10 years of age. The harmonised advice for everyday life, established according to the activity levels administered, will concern the length of time off work and the length of restrictions on contact between spouses and with children.

6 OUTLOOK

In 2007, ASN was notified of 90 radiation protection events related to the medical uses of ionising radiation. Most of them occurred during external radiotherapy treatment, but also during brachytherapy. Some of these events, of varying levels of severity can, or could eventually lead to over-exposure of patients, while others occasioned accidental exposure of personnel. 2007 was also in particular marked by the revelation of 2 further accidents in the radiotherapy unit of the Jean Monet hospital in Épinal and an accident in the stereotaxic radiosurgery department of the Toulouse University Hospital.

Most of the events notified are from university hospitals, reflecting their commitment to the notification system put into place by ASN, although the same cannot as yet be said for the private centres.

Whenever the situation demanded, the event notifications were followed by a reactive inspection, an evaluation of the causes and the transmission of recommendations to the entire community of oncology radiotherapists. ASN then informs the public by publishing an incident notification on its website www.asn.fr. These events are rated using either the INES scale, when the event concerns worker protection or, since July 2007, the ASN/SFRO scale when it concerns patients receiving radiotherapy treatment.

On the basis of initial results underlining the importance of human and organisational factors in the occurrence of these events, ASN in 2007 incorporated this new dimension into its inspection programme. All radiotherapy installations (182) were thus inspected in 2007. Summaries of these inspections will be made public early in 2008.

In addition to its own regulatory duties and powers of inspection, ASN played an active role in preparing and implementing the national action programme defined by the Minister for Health, Youth and Sport, in order to tighten up radiotherapy treatment safety. More particularly, ASN took charge of the work being done to draft a quality assurance reference system, which should be published in the 1st quarter of 2008 and is involved in the work being done to finalise the organisation of radiation protection, improve initial and continuous training of radiation physicists and develop an information strategy for the health establishments, aimed at the patients and public.

Through its regional divisions, close collaboration was set up between ASN and the organisations responsible for supervising the health care establishments (regional hospitalisation agencies) to examine the practicalities of increasing the resources allocated to radiation protection whenever necessary, and of course to alert them whenever patient safety is threatened.

At a national level, ASN also strengthened its ties with the various health safety stakeholders, coordinated by the Directorate General for Health, whether they are in charge of health policy concerning the fight against cancer (National Cancer Institute), evaluating medical practices (High Health Authority), specific inspection actions (AFSSAPS) or support for health establishments (Meah).

In 2008, together with SFRO, an evaluation will be conducted of the notification system set up and the severity scale used for rating events affecting patients as part of a medical radiotherapy procedure. ASN will use the bilateral contacts it has created with the other European countries to publicise and disseminate the French approach and the notification and rating tools developed. At international level, IAEA has already adopted the principle of a severity scale applicable to patient radiation protection, with the ASN/SFRO scale serving as the starting point for this work.

With regard to inspections, ASN will maintain its presence in the radiotherapy centres, paying particularly close attention to the increase in medical radiophysics resources announced by the Minister responsible for health, and the gradual development of quality assurance.

CHAPTER 10

1 PRESENTATION OF INDUSTRIAL AND RESEARCH ACTIVITIES USING IONISING RADIATION

1.1 Sealed radioactive sources
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1.1.2 Non-destructive testing
1.1.3 Checking of parameters
1.1.4 Other common applications
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5 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 correctly assured. This safety in particular involves satisfactory source management, supervision of the conditions in which sources are held, used and disposed of, from fabrication to the end of their lives.

It also involves increasing the oversight of the main stakeholders, the source manufacturers and suppliers, and enhancing their accountability.

1 PRESENTATION OF INDUSTRIAL AND RESEARCH ACTIVITIES USING IONISING RADIATION

Industry and research employ sources of radiation, produced either by radionuclides - primarily artificial – in sealed or unsealed sources, or by electrical generators. The main applications in these sectors are presented below.

1 | 1 Sealed radioactive sources

The following are among the main uses of sealed radioactive sources.

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.

Industrial irradiation of food products

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. This technique in particular uses iridium 192 and cobalt 60 sources, with activity not exceeding about twenty terabecquerels. Gamma radiography is usually performed using a mobile device which can be moved from one worksite to another and consists primarily of:

– a source applicator, used as a storage container when the source is not in use and for transport;
– an ejector tube and remote-control for moving the source between the projector and the object to be radiographed, while protecting the operator who can thus remain at a distance from the source; and
– a radioactive source inserted into a source-holder.

Gamma radiography device

Checks on parameters – Gammadensimeter

1 | 1 | 3 Checking of parameters

The operating principle of these appliances is the attenuation of the signal emitted: the difference between the emitted signal and the received signal can be used to assess the parameter being checked.

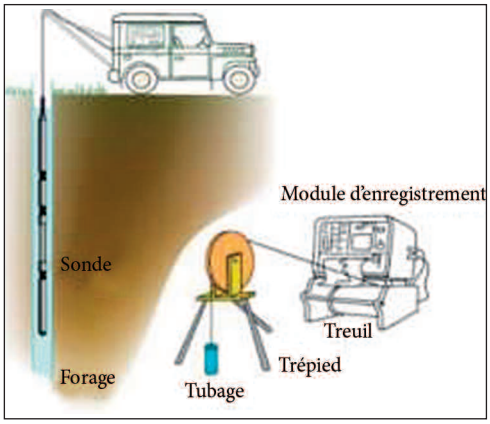
The radionuclides most frequently employed are krypton 85, caesium 137, americium 241, cobalt 60 and prometheum 147. The source activity levels are between a few kilo becquerels and a few giga becquerels.

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 level: 3.5 MBq) or prometheum 147 (activity level: 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 is then received by a detector. The signal attenuation on this detector gives 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



Logging: schematic diagram

Logging probe

attenuation on this detector provides the level of filling of the container and automatic triggering of certain operations (stop/continue filling, alarm, etc.). The radionuclides used depend on the characteristics of the container and the content. As applicable, americium 241 (activity level: 1.7 GBq), caesium 137 - barium 137m (activity level: 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 level: 2 GBq), caesium 137-barium 137m (activity level: 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; and
– 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 141-beryllium or californium 252.

1 | 1 | 4 Other common applications

Sealed sources can also be used for:
– eliminating static electricity;
– calibrating measuring instruments (radiation metrology);
– 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; and
– detection using X-ray fluorescence devices. This technique is particularly useful in detecting lead in paint (see box).

Diagram 1 specifies the number of facilities authorised to use sealed radioactive sources in the applications identified. It illustrates the diversity of these applications and how they evolved from 2004 to 2007.

It should be noted that a given facility may carry out several activities and therefore appears in diagram 1and the following diagrams.

1 | 2 Unsealed radioactive sources

The main radionucleides used in the form of 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,

Device for detecting lead in paint

Unsealed radioactive sources

searching for leaks, for friction research, for building hydrodynamic models and in hydrology.

The number of facilities authorised to use unsealed sources stands at 1,037.

Diagram 2 specifies the number of facilities authorised to use unsealed radioactive sources in the applications identified from 2004 to 2007.

1 | 3 Electrical generators of ionising radiations

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 (mainly in the aerospace sector).

These devices, which use the principle of X-ray attenuation, are mainly employed as industrial gauges (tank filling measurements, etc.) or to inspect goods containers or luggage. There are also more specific uses based on radiography for restoration of musical instruments or paintings, archaeological study of mummies or analysis of fossils.

Diagram 1: use of sealed radioactive sources

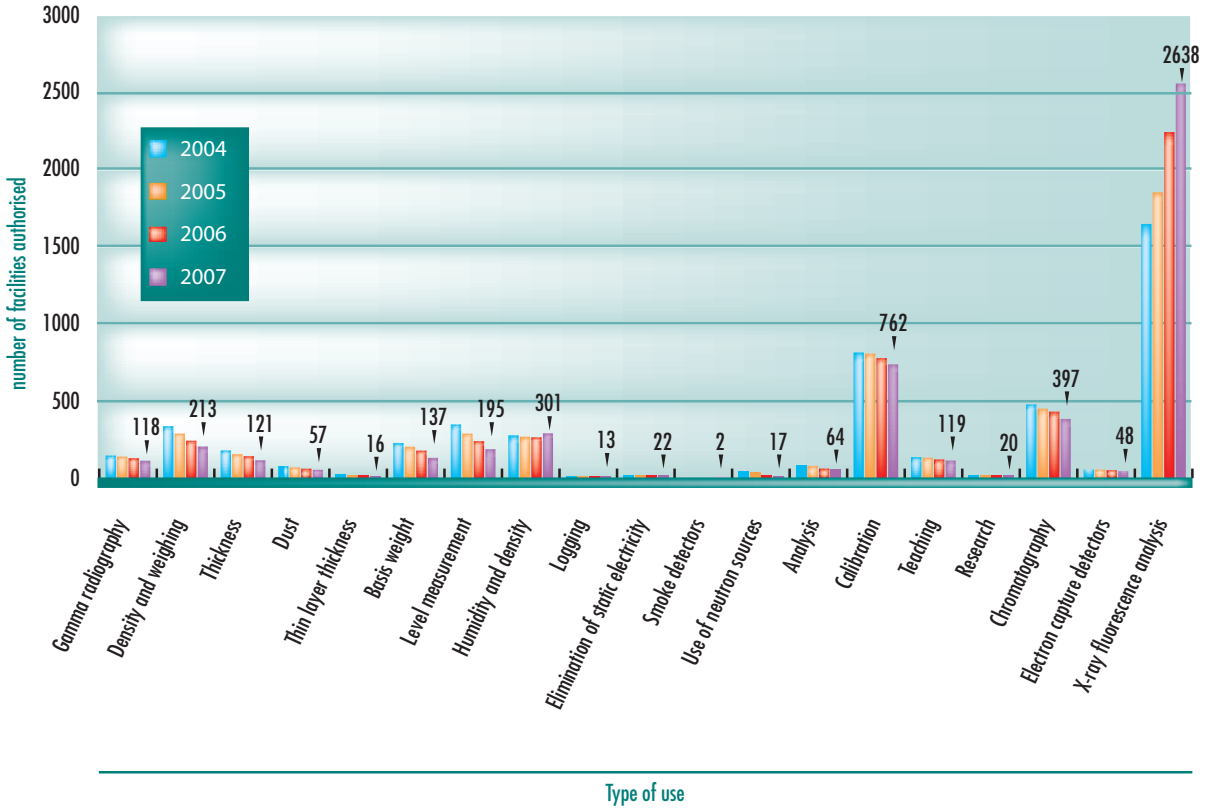


Diagram 2: use of unsealed radioactive sources

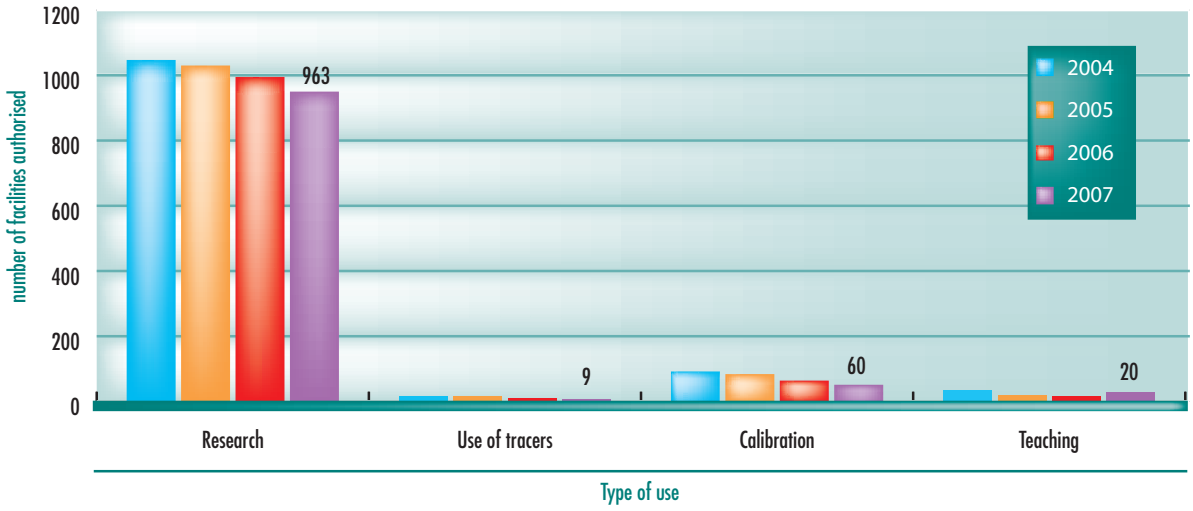
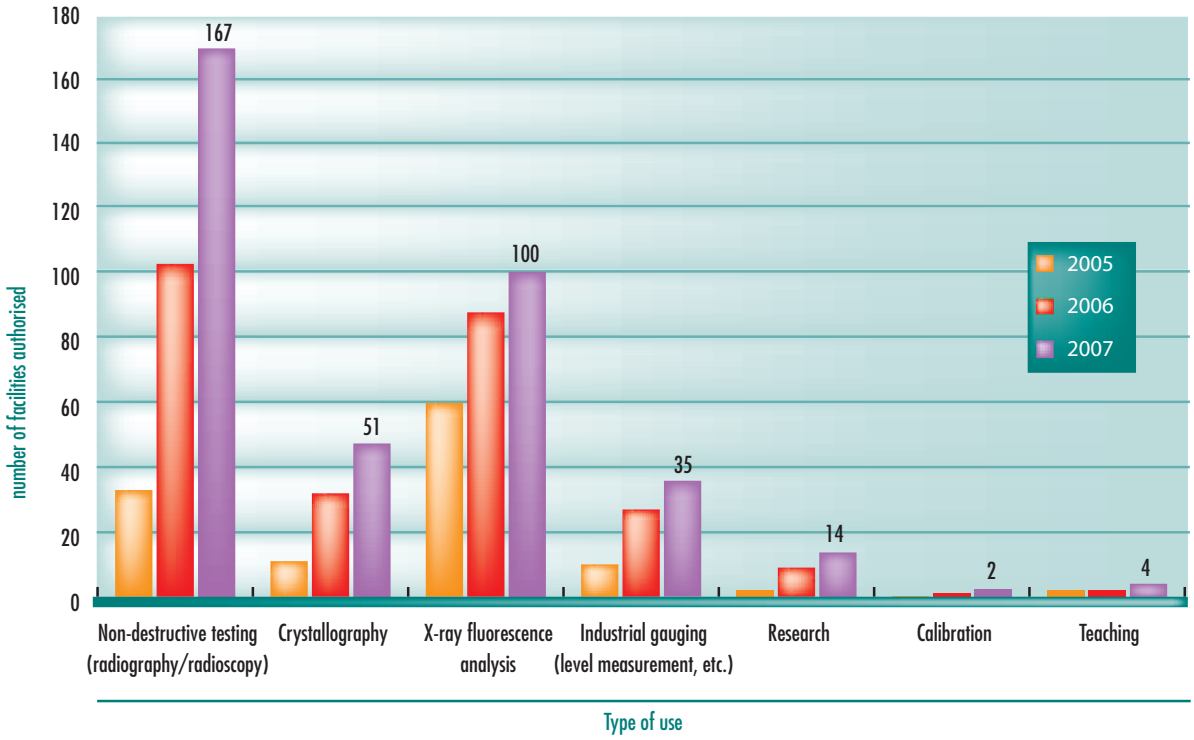


Diagram 3: use of electrical generators of ionising radiation

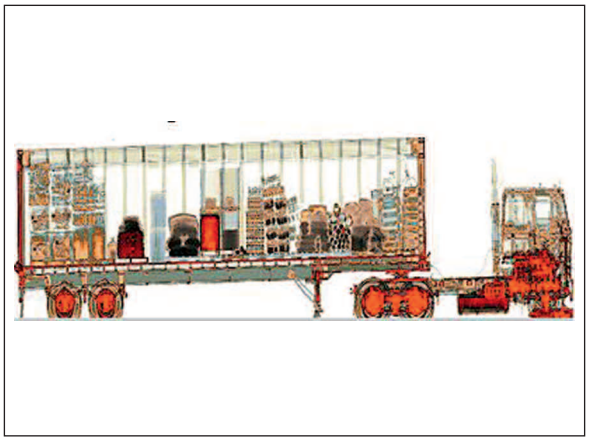


Veterinarians also use these appliances for bone radiography and other common diagnosis procedures.

Unlike the electrical generators used in the medical field, there is no CE marking obligation allowing free circulation of these appliances throughout the European Union.

Diagram 3 specifies the number of facilities authorised to use electrical generators of ionising radiation in the listed applications. It illustrates the diversity of these applications and their evolution from 2005 to 2007. In 2004, the figures available to ASN were not significant.

Accelerator



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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 identified installations which can be used in a wide variety of fields, as presented in table 1.

In the field of research, a number of synchrotron radiation production installations must be mentioned: the ESRF in Grenoble (European synchrotron radiation facility) and the SOLEIL synchrotron in Saint Aubin (91) operated by CEA.

Table 1: scope of use of particle accelerators

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 equipment, powders, drugs, membranes
Plastics Polymers	Cross-linking Manufacture of foam Thermal memory	Heat-shrink food wrapping, gymnastics apparatus, pipes and ducts, moulded packaging, flexible laminate packaging
Environment	Disinfection - Precipitation Organic detoxification Fermentation inhibition DeSOx/DeNOx	Sludges for spreading, emission of smoke, gas, solvents, water and various effluents, nutrients from sludges 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

2 REGULATORY PROVISIONS CONCERNING INDUSTRIAL AND RESEARCH APPLICATIONS

The requirements of the Public Health Code are recalled below with regard to the industrial and research applications introduced by decree 2002-460 dated 4 April 2002. These requirements were modified by decree 2007-1582 of 7 November 2007. Pursuant to these changes to the Public Health Code, modifications to the provisions described below are currently in progress.

2|1 Licensing frameworks for ionising radiation sources used for industrial and research purposes

Table 2 presents the procedures which in 2007 govern the various industrial and research applications, including for veterinary purposes.

It should be noted that, unlike for medical applications, industrial and research applications always require licensing and there is no notification system (apart from some of them which, in certain conditions, may be exempted from this licensing requirement). The changes to the Public Health Code introduced by decree 2007-1582 of 7 November 2007 will allow the creation of a system of notification for certain nuclear activities, appliances or appliance categories covered by article R.1333-19. In addition, the Public Health Code introduces a licensing exemption for nuclear activities which are already covered by a licence under the Mining Code, the BNI regime or that for installations classified on environmental protection grounds.

The licences are issued for a renewable limited period and are non-transferable. Any change to the license, concerning either its beneficiary, or the installation, or its operating conditions, must be the subject of a new application. 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.

Table 2: procedures applicable to industrial or research nuclear activities

Nature of the nuclear activity	Procedure and competent authority	Observations
Manufacture of radioactive sources or devices containing them	ASN licence(1), except if nuclear activity in licensed ICPE: authorisation by *préfet**	
Manufacture of products or devices containing radioactive sources		Exemption possible if criteria set in article R. 1333-18 of the CSP are met(2)
Use of radioactive sources		
Irradiation of products, including food products		
Use of electrical generators, including particle accelerators	ASN licence	Exemption possible if criteria set in article R. 1333-18 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. 1333-18 are met(2)

(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 materials involved do not exceed one ton);

– to electrical generators of ionising radiation. For an equivalent dose rate higher than 1µSv/h, in normal operation, an equivalent dose rate higher than 1µSv/h is created at no point located a distance of 0.1 m from their accessible surface, if they are of a type certified as conforming to the standards for which the references are set by a decision of the Nuclear Safety Authority, approved by the Ministers responsible for health, labour and industry, or in the case of equipment operating with a potential difference of 30 kV or less, in the same delivered equivalent dose rate conditions.

*In a *département*, representative of the State appointed by the President.

2|2 Licensing procedures

For each nuclear activity mentioned in table 2 and requiring a licence issued by ASN, the corresponding application must be submitted by the person in charge of the nuclear activity, jointly with the head of the facility or his/her representative. This dossier is to be drawn up on the basis of a form available from the website www.asn.fr, in the "*formulaire*" (form) section and returned to ASN, accompanied by all other documents required. This website also contains explanatory notices to help applicants prepare their dossiers.

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; and
– the precautions taken against the risks of theft or fire.

In 2007, ASN continued with its actions to promote handling of licensing by its regional divisions. The review of applications concerning the possession and use of gamma radiography equipment, gammadensimeters, appliances for detecting lead in paint, electrical generators and unsealed sources was gradually entrusted to the ASN regional divisions. With the exception of licences concerning suppliers, all other licences will eventually be examined by the regional divisions.

2|3 Radionuclide source management rules

These rules, already presented in chapter 3, 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 with IRSN;
– the obligation on the licensee to keep detailed accounts of the sources in its possession and their movements;

ASN website

Table 3: scope of the main CPEs for radiation sources

Particular conditions for use of radiation sources (the texts marked with a * are 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 radionucleides 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.*

– immediate notification to the préfet and 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.

A number of conditions for use previously determined by the Interministerial Commission for Artificial Radioelements (CIREA) also apply. CIREA, which was responsible for issues concerning artificial radioelements until 2002, had laid down special utilisation conditions (CPE) to inform the future licensee of the conditions for implementation of the regulations to 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 presents the scope of the main CPEs.

The more commonly used of these CPEs will then be transcribed into ASN orders or decisions, 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.

3 PRIORITIES IMPLEMENTED DURING THE YEAR

3|1 General actions

In 2007, and in addition to its regulatory preparation work, 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:
– meetings with research organisations;
– 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;
– meetings with professional organisations (order and union of veterinary surgeons, GESI, GIMELEC, etc.).

These actions enable 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 ASN to obtain direct feedback from the users concerning any constraints and difficulties they are experiencing.

Encouraging professionals to define guides of good practice concerning radiation protection in their daily activities is seen by ASN as a priority. In July 2005, it proposed to COFREND that an examination of the justification for gamma radiography be carried out, with production of a document detailing good practices to be observed, both by the customers and by the gamma radiography contractors. This work began in 2006 and continued in 2007. In January 2008, it will be the subject of a one-day national conference organised by SFRP and devoted to the safety of radiographic inspections, at which COFREND and SFRP will present the results of the work of nine thematic workshops on this subject. At the same time, regional approaches aimed at producing good practice charters for industrial radiography were initiated. We can for example mention the signing of the Provence Alpes Côte d'Azur and Haute-Normandie charters and the launch of the process in the Nord Pas de Calais region. Gamma radiography is an area in which the radiation protection stakes are high, as incorrect use of the appliances or loss of a gamma radiography equipment source are likely to have serious health consequences.

3|2 Suppliers

In 2007, ASN carried on with priority action initiated in 2003 concerning 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 satisfactory and that their activities be duly covered by the licence specified in article R. 1333-17 of the Public Health Code.

During the course of 2007, 56 licences were issued to suppliers and 2 licences were revoked. Several dozen dossiers are also being investigated by ASN.

It should be pointed out that it can take a long time to review this type of dossier owing to the combination of a number of negative factors (the problem of getting in touch with the right people, then of obtaining relevant information about the sources and devices, the complexity of the analyses linked to the radiation protection of appliances and radionuclide sources, the problems with obtaining precise guarantees for actual recovery of used or end of life sealed sources.

However, the extensive work currently under way on this type of dossier will ease later review when subsequently renewing licences or when licence modifications are requested.

In 2007, ASN also began a nationwide search for any unauthorised suppliers distributing products in France. It thus visited a number of trade fairs and professional forums and conducted spot checks on advertising or offers made via the internet. More than 30 companies were identified and received an information letter recalling the regulations applicable in France.

3|3 Users

Review by ASN of about 1700 application dossiers for possession and use of radionuclides led to 544 new licences being notified and 178 licences being revoked. About 1,100 dossiers dealing with an industrial or research activity are currently being reviewed by ASN. Diagram 4 presents the licences issued or revoked in 2007 and the trend in this area from 2004 to 2007.

Once the licence is obtained, the licensee may procure sources. To do this, it collects supply request forms from

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 IRSN, which notifies the interested parties that delivery may take place. In the event of any difficulty, the matter is referred to ASN.

Electrical generators of ionising radiation

ASN examines applications for a licence to possess and use electrical generators. It should be remembered that until the publication of decree 2002-460 modifying the Public Health Code, these installations simply required notification.

A number of problems were raised during these investigations. X-ray generators are in particular defined as working equipment by the Labour Code and therefore have to comply with a number of design and installation standards.

ASN has begun discussions with the Ministry for Labour and has encouraged the *Union technique de l'électricité* (UTE) to begin work on updating the above-mentioned standards. The UTE therefore initiated a revision of the NF-C 15-160 standards and the associated specific standards.

In 2007, ASN granted 240 licences for the use of electrical X-ray generators.

Sources of ionising radiation used in BNIs

Article R. 1333-17 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 as required by article L.1333-4. This simplifying arrangement only applies to sources necessary for the operation of the BNI and for activities linked to this operation. The other sources held or the other nuclear activities performed remain subject to licensing as specified in R.1333-17 of the Public Health Code.

The administrative simplification introduced by article R.1333-17 is intended to avoid the multiplication of the licences needed for the performance of a particular nuclear activity. The beneficiary is in no way exempted from the need to comply with the requirements of the Public Health Code, in particular those concerning the acquisition and transfer of sources.

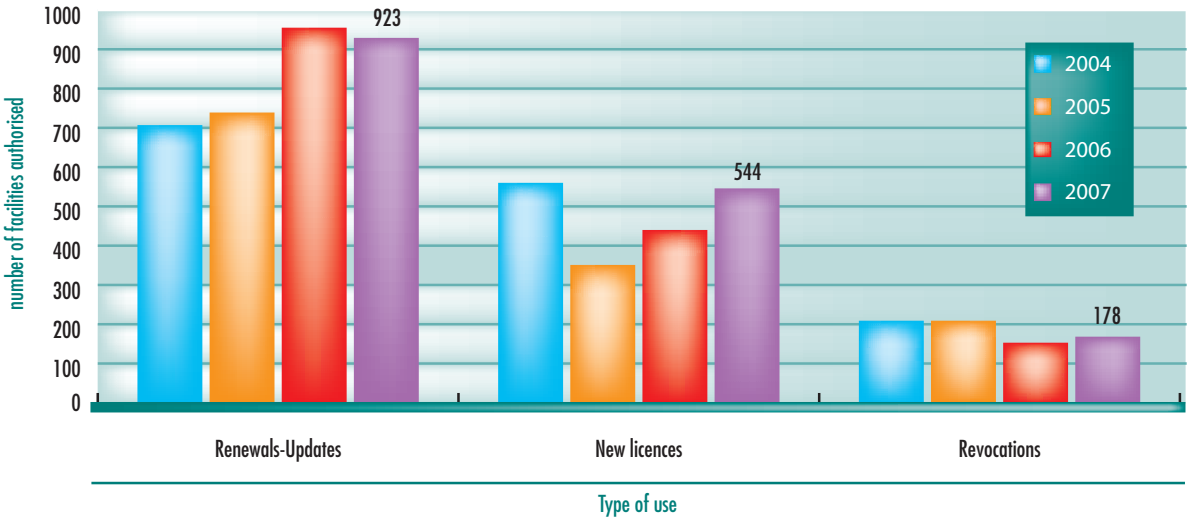
The BNI licensees draw up a list of sources in their possession, differentiating between those required for operation of the installations and other sources. ASN asked them to incorporate management of the sources required for operation into the installations safety reference frameworks.

CEA also regularised the situation with respect to the Public Health Code, by obtaining licences for its various establishments in place of the ordinary law exemptions which it had previously enjoyed. The regularisation work continued in 2007 with respect to electrical generators of ionising radiation and the registration of the sources in its possession.

3|4 Phasing out of unjustified or prohibited activities

The Public Health Code stipulates that "A nuclear activity or intervention may only be undertaken or carried out

Diagram 4: number of authorisations issued for radioactive sources users



if justified by the advantages it procures, particularly in health, social, economic or scientific terms, with respect to the risks inherent in the exposure to ionising radiation to which the individuals are likely to be subjected". It also states that "No intentional addition of radionuclides in consumer goods and construction products is authorised" (articles R. 1333-2 and 3 of the Public Health Code).

In the case of sources used for industrial and research purposes, the justification decision is entrusted to ASN by Act 2006-686 of 13 June 2006 on transparency and security in the nuclear field.

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 materials in consumer goods), or the licence required with regard to radiation protection will not be renewed.

With regard to the ban on the intentional addition of radionuclides in consumer goods and construction products (articles R. 1333-2 and 3 of the Public Health Code), the sale of irradiated precious stones, of accessories such as key-rings, hunting equipment (sights), navigation equipment (compasses), or river fishing equipment (floats), equipped with sealed tritium sources, is prohibited.

For existing activities, justification will be reassessed if current know-how and technology so warrants. This is the case with smoke detection systems (see box) and various other activities that are disappearing, in particular owing to technological changes: dew point determination, level measurement and density measurement, for which X-ray or ultrasound techniques are tending to replace those using radionuclides, or snow height measurement and cable car gondola positioning systems using a radioactive source fixed in the support cable splices.

3|5 National and international coordination

With the aim of coordinating public authorities, ASN in 2007 sought to forge new ties and maintain existing links with the State's various departments involved in radioactive source monitoring and oversight duties. ASN therefore initiated exchanges with the General Directorate of Customs and Excise (DGDDI) and the General Directorate for Competition Policy, Consumer Affairs and Fraud Control (DGCCRF), with a view to signing collaborative agreements in areas of common interest.

Exchanges also took place with the French authorities with competence for regulating nuclear activities, with the aim of reaching a joint vision and coordinating their actions: the Director for the Prevention of Pollution and Risks (DPPR) at the Ministry for Ecology, Sustainable

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 in the past several types of radionuclides were used (americium 241, plutonium 238, nickel 63, krypton 85), at present only americium is used, with an activity not exceeding 37 kBq (the most recent ones use a 10 kBq source).

However, if just a few years ago this situation could be justified owing to the human safety advantages of this technique, this is no longer the case given that new detection techniques using an optical technology have been developed and can comply with fire detection regulations and standards.

Pursuant to article L.1333-1 of the Public Health Code, this change requires that arrangements be made to retire smoke detectors containing radionuclides. To enable this to happen, a draft government order proposing gradual replacement was drawn up by ASN and proposed for consultation to various groups and bodies representing the various stakeholders involved in this retirement process (suppliers, installers, users) as well as to the ministries concerned, whether or not signatories of the text.

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 paint is to be found in older homes (built before 1 January 1949), as the use of paint as an additive was subsequently prohibited.

A legislative text concerning the fight against social exclusion requires action to prevent saturnism in children by including a check on the lead concentration of paint in the transaction for the sale of any residential real estate built before 1 January 1949 (validity of one year except if absence of lead: permanent validity) and when significant work is carried out on the coverings and coatings of communal parts of residential buildings built before 1 January 1949 (renewal for all work unless absence of lead: permanent validity). 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 (CSP), 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 lines 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 one or more X-ray photons (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.

As the decree and supplementary orders concerning the fight against saturnism and published in the Official Gazette of 26 April 2006 (decree 2006-474 of 25 April and 4 orders of 25 April) laid down the use of detection appliances "capable of analysing the K line of the fluorescence response spectrum emitted by lead" (article 2 and appendix 2 of the order of 25 April 2006 concerning the determination of the risk of exposure to lead (CREP)), the licences for use of electrical X-ray generators for this application were not renewed as they are unable to comply with the objective set by the regulations.

The portable devices used today contain sources of cadmium 109 (half-life 464 days) or cobalt 57 (half-life of 270 days). The activity of these sources can range from 400 MBq to 1500 MBq.

Development and Spatial Planning (MEDAD) and the Delegate for Nuclear Safety and Radiation Protection for National Defence Installations and Activities (DSND).

Finally, with respect to international coordination, ASN initiated or replied to bilateral or multilateral consultations and took part in conferences, mainly aimed at strengthening international and European Community harmonisation. It also continued to take part in the periodic exchanges between States organised by IAEA through implementation of the code of conduct on the safety of radioactive sources and the associated import and export guidelines.

In this field, it drew the Government's attention to the measures needed to reinforce how the State handles source safety and in particular to comply with the requirements of the code of conduct on the safety of radioactive sources and the associated import and export guidelines issued by IAEA.

4 REGULATION OF RADIATION SOURCES AND INSTALLATIONS

4|1 Regulation by ASN

Regulation of radiation sources depends on the nature of the source and the stage of production and use reached. It is presented in chapter 4.

ASN pays particularly close attention to the use of gamma radiography appliances. Following the discovery of numerous shortcomings in the implementation of radiation protection good practices, and even serious breaches of the regulations set by the Public Health, Labour and Environment Codes, ASN sent out a circular letter to the industrial firms concerned on 26 April 2004, urging them to comply with the main regulatory requirements in force. A reminder was sent out in a circular letter dated 29 December 2005, following the loss of a gamma radiography source in Chile, which resulted in serious irradiation of a worker. These circular letters were presented in an information note published on ASN's website (www.asn.fr). ASN has made inspection of establishments using gamma radiography appliances one of its priority inspection topics since 2004. In 2007, this topic was once again a priority, with particular attention focused on implementation of the "zoning" order of 15 May 2006 to industrial radiography activities. The main inadequacies identified concern prior evaluation and optimisation of doses, as well as the conditions for carrying out gamma radiography operations on the worksites.

At the same time as organising inspections, ASN also checks the handling of the incidents of which it receives notification. These 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.

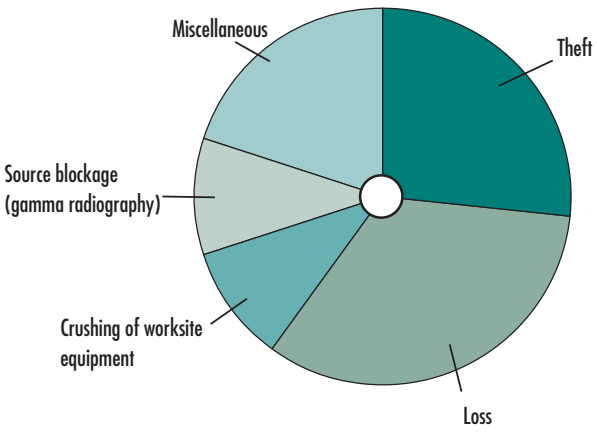
About thirty such events occurred in 2007, some of which are recurring:
– 9 source thefts (mainly contained in lead detection devices);
– 11 source losses from the site on which they were being used;
– 3 gammadensimeters crushed on worksites;
– 3 source blockages in the ejector tube during gamma radiography inspections;
– 6 miscellaneous incidents (lightning arrester found in a dump, fire with no consequences for the source, and so on).

4|2 Sealed source recovery and replacement requirements

According to the Public Health Code (articles L. 1333-7 and R. 1333-52 and 53), 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 financial security deposit to cover the consequences should it default and should another party or the French National Agency for Radioactive Waste Management (ANDRA) be required to step in to take its place. Finally, in accor-

Diagram 5: typology of the most frequent incidents



Inspection of a radioactive sources interim storage

Inspection of a gamma-radiography site

dance with article R. 1333-52, the supplier is required to declare any source not returned to it within the specified time.

The collecting organisation must issue the user with a confirmation of recovery, certifying that the user is no longer responsible 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 IRSN, but a trace of it is kept in the Institute's "archives" file.

When renewal applications are reviewed, in the event of closure of the company or during occasional periodic inspections, ASN with the assistance of IRSN systematically checks the situation and the future of the sealed sources.

In 1996, the source suppliers set up a non-profit association called Ressources, which in particular set itself the goal of creating a guarantee fund to reimburse ANDRA or any other approved organisation for the costs involved in recovering the sources from the user, either owing to defaulting by the supplier normally responsible for recovery, or owing to the absence of any such supplier in the case of stray sources.

Under the national plan for management of radioactive materials and waste (see chapter 16), used source disposal solutions are being examined. ASN has authorised the disposal in the Aube repository of sealed radioactive sources with a half-life shorter than that of caesium 137, or about 30 years, setting activity limits per source and per source package. This technology, which concerns about 10% of used sources, will not however address the problem of long-term management of all sources.

In order to manage and limit the number of sealed radioactive sources needing to be recovered, a life extension for certain sources is being envisaged. A draft ASN technical decision specifying the conditions in which a source can benefit from such an extension is being prepared.

Furthermore, with regard to the disposal or recycling of certain sealed radioactive sources, the creation of an administrative delicensing process is being envisaged. This process would enable the sources concerned to be withdrawn from the individual supervision and oversight applicable to sealed sources. They would however need to be disposed of in authorised channels or installations.

5 OUTLOOK

In the field of regulating applications of ionising radiation in industry and research, ASN's aim is to work to ensure that the operators take full account of the risks involved in the use of ionising radiation. This problem is accentuated by the diversity and numbers of the parties involved. The serious accidents that have occurred abroad, for example in gamma radiography, offer clear evidence, were such evidence necessary, of the need for scrupulous implementation of the regulations and stringent operating procedures. ASN has therefore continued with definition of its priority actions, while optimising use of its resources:

– the central level continued with supplier regulation, both through examination of the licensing dossiers and through inspections within the organisations concerned;
– the regional levels gradually took charge of examining a certain number of licensing applications (gamma radiography equipment, gammadensimeters, paint lead detectors, unsealed sources) and continued to carry out checks on the users.

At the same time, the gradual increase in ASN's resources continued, with the nomination of radiation protection inspectors.

During the course of its regulatory activities, ASN must remain vigilant and determined concerning any deviations that could lead to events with serious consequences for workers or for the public. Following the gamma radiography equipment source incidents, it reminded the gamma radiography profession on two occasions of the importance of abiding by radiation protection rules.

The action initiated in previous years will also be carried on and supplemented by:
– continuation of the work to revise 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;
– the inspections performed, in particular at the users and holders of gamma radiography equipment and gammadensimeters;
– rationalisation of licences within the establishments whenever possible, with continuation of this particular objective being made easier by the recent changes to the Public Health Code.

ASN aims to maintain closer ties with all industrial and research stakeholders and organisations. ASN will in particular be reinforcing its checks on the extent to which opting to use radioactivity when issuing its licences is justified.

It should be noted that an update of the requirements of the Public Health Code was published in the Official Gazette of 9 November 2007, with the following objectives:
– to transpose Council Directive 2003/122/Euratom of 22 December 2003 on the control of high-activity sealed radioactive sources and stray 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 regulation of radiation protection;
– to provide clarifications and additional data in the wording of a number of provisions already in force.

These changes to the Public Health Code (three systems: exemption, notification and licensing, instead of two; corporate body instead of the physical individual alone; possibility of setting a licence period other than the current five years) should bring ASN's regulatory work more in line with the needs, making it more efficient and effective.

CHAPTER 11

1 GENERAL INTRODUCTION

1 | 1 Packages

1 | 2 Annual traffic

1 | 3 The various industrial players

1 | 4 Regulation of the safe transport of radioactive materials

2 PACKAGE MODEL APPROVAL

2 | 1 Issue of package designs approval certificates

2 | 2 Inventory of approved containers

3 INSPECTION AND FIELD CHECKS

4 INCIDENTS AND ACCIDENTS

4 | 1 Package handling events

4 | 2 Incidents and accidents during actual transport

4 | 3 Nonconformity of container or content

5 INTERNATIONAL ACTIVITY

6 OUTLOOK

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 enforcement. Its role in this field was confirmed by Act 2006-686 of 13 June 2006 on Transparency and Security in the Nuclear Field (TSN Act) which instituted the Nuclear Safety Authority as an independent administrative authority.

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 minimising the irradiation, contamination and criticality hazards involved in radioactive and fissile material transport, ensuring that man and the environment experience no ill effects. Monitoring safety is the responsibility of ASN.

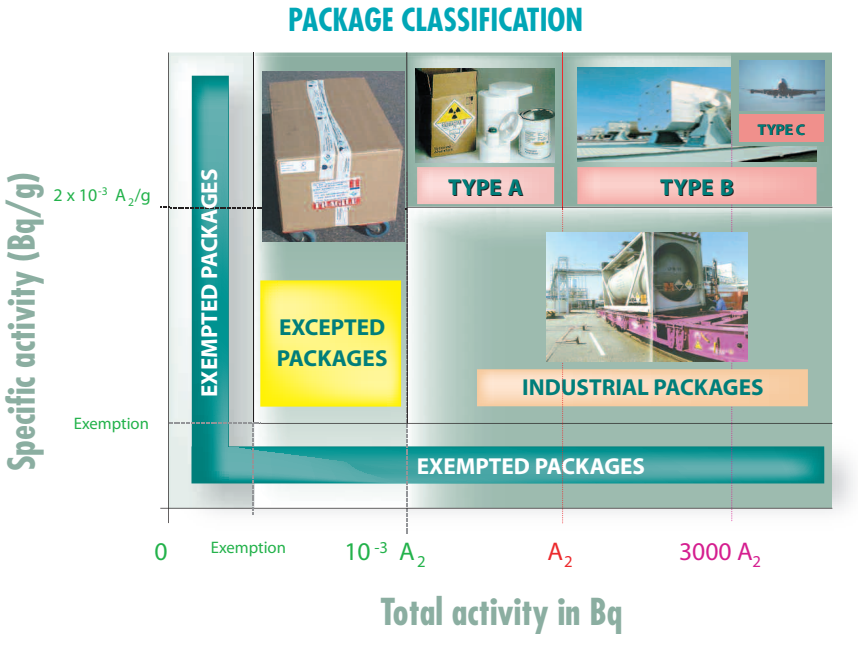
Pursuant to decree 2001-592 of 5 July 2001, regulation of the transport of radioactive and fissile materials for national security purposes falls to the Defence Nuclear Safety and Radiation Protection Delegate (DSND).

1 GENERAL INTRODUCTION

1|1 Packages

The term package designates the container with its radioactive contents ready for transport. 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 physical and 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 following diagram shows the different types of packages defined by the regulations.



Type of package according to total and specific activity

Type A packaging example – radiopharmaceuticals package

Type B packaging example – Gammagraph containing an iridium source

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 2.10^{-3} A2;
– type A packages: activity of contents below A1 or A2;
– type B packages: activity of contents above A1 or A2; and
– type C packages (air transport): activity of contents above 3000 A1 or 3000 A2.

Characteristics of the various types of packages

Excepted packages undergo no qualification testing. They must however meet a certain number of general specifications such as a maximum surface dose rate of less than 0.005 mSv/h. Non-fissile industrial packages (type A) are not designed to withstand accident situations, although they are required to withstand certain incidents encountered during handling and disposal 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; and
– 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 remain below 20%.

Fissile or type B packages must be designed so that they continue to fulfil 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; and
• immersion in 15 m deep water (200 m water depth for spent fuel) for 8 h.

Type C packages must be designed so that they continue to fulfil 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;
– 90 m/s impact on a rock target; and
– immersion in 200 m deep water for 1 hour.

This package classification only applies to the transport 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.

Each type of package has its own safety requirements and the corresponding testing criteria designed to prove its ability to withstand normal transport and transport accident conditions (see box).

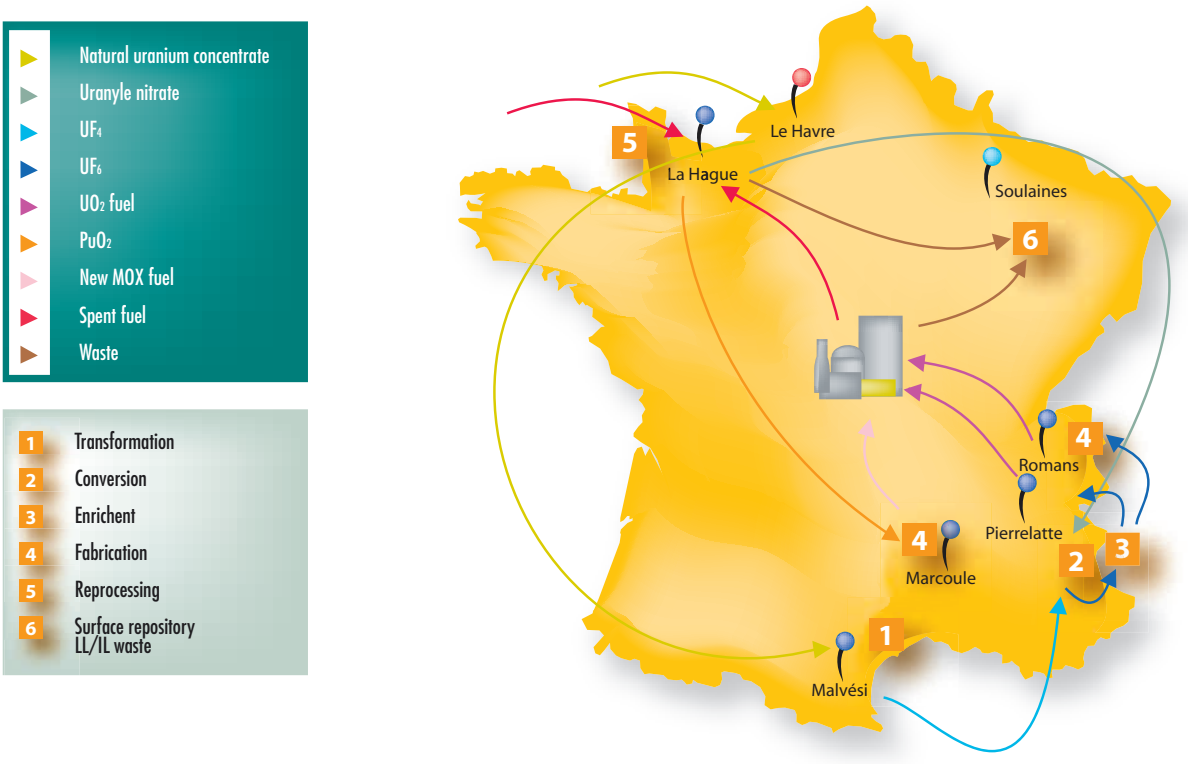
1 | 2 Annual traffic

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. The largest consignments concern about 300 shipments per year for fresh fuel, 250 for spent fuel, about 30 for MOX fuel and about 60 for plutonium oxide powder.

Since transport provisions are international, France is also a transit country for some of these shipments, for instance for spent fuel packages from Switzerland or Germany, bound for Sellafield in Great Britain, which are taken on board ship at Dunkirk.

A large number of international shipments are also due to the presence in the country of plants enriching uranium, fabricating or reprocessing nuclear fuels, along with manufacturers of radioisotopes for medical purposes, all of whom have commercial links with foreign organisations.



Transports associated with the fuel cycle in France

1 | 3 The various industrial players

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 in good safety conditions, a stringent chain of responsibility has to be set up. So, for major transport operations:

– the consignor must be fully aware of the characteristics of the material to be transported, so that he can select the type of container to be used and specify transport conditions accordingly;
– the corresponding container 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 documents are prepared 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 documents and the authorisation certificate;
– the container is sent to the consignor's site, where it will be loaded with the material for transport. 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 transport 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 Regulation of the safe transport of radioactive materials

In the context of regulation of the safe transport of radioactive and fissile materials, the Nuclear Safety Authority (ASN) is responsible for:

– defining technical regulations and monitoring their implementation;
– accomplishing authorisation procedures (approval of packages and organisations);
– organising and implementing inspection procedures;
– proposing and organising public information.

In addition, ASN acts within the context of emergency plans defined by the authorities to deal with an accident.

A decision of 1 December 1998 set up an Advisory Committee of experts (GPE) for radioactive material transport, similar to the other GPEs already in existence for other sectors. Depending on the importance of the issue, expert assessment by the Institute for Radiation Protection and Nuclear Safety (IRSN), at ASN's request, could be supplemented by an Advisory Committee review.

2 PACKAGE MODEL APPROVAL

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).

After technical review of the documents by IRSN, 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 approvals 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 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).

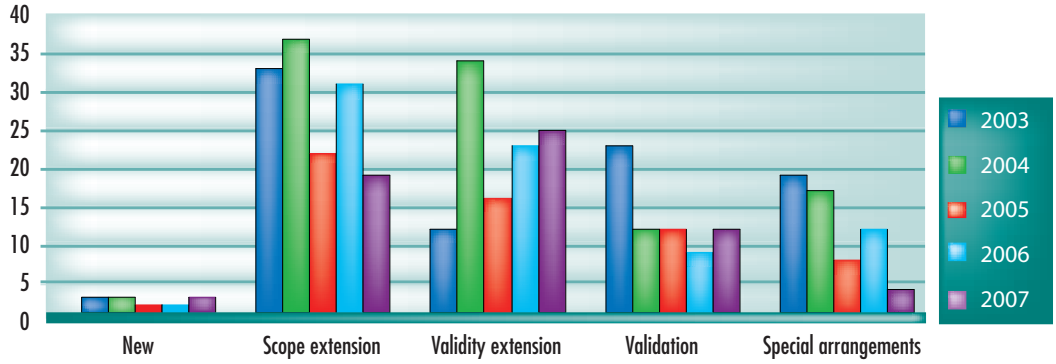
Generally speaking, certificates are issued for package designs and not package by package. However, manufacturing, operating and maintenance conditions are consistently specified.

These certificates are often issued outside the context of specific transport operations, for which no prior notification of 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).

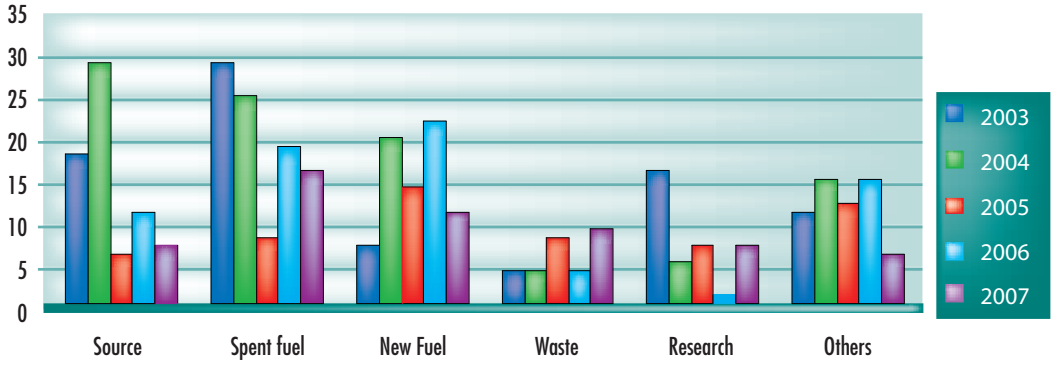
2|1 Issue of package design approval certificates

In 2007, ASN issued 58 certificates, broken down as follows according to type (graphs 1 and 2).

Graph 1: breakdown of approvals according to type



Graph 2: breakdown of approvals according to content



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.

As a result of its 2007 examinations, ASN issued approval certificate F/398/B(U)-96 (Aa) for the new CEGEBOX package model. This new package model was developed by CEGELEC for transport of gamma radiography appliances which fail to meet the quality assurance requirements specified in the regulations.

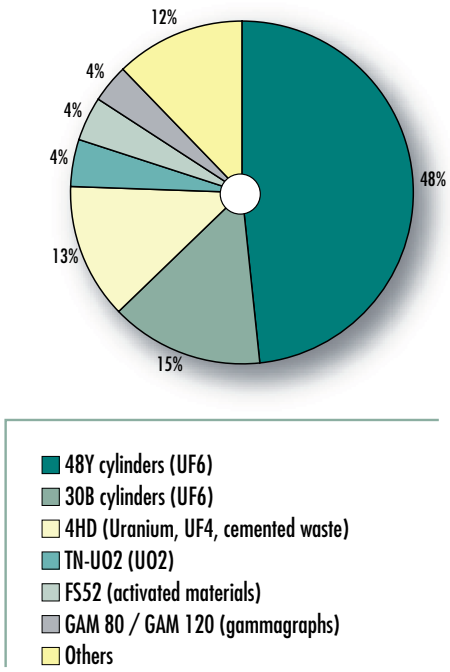
New CEGEBOX packaging

2 | 2 Inventory of approved containers

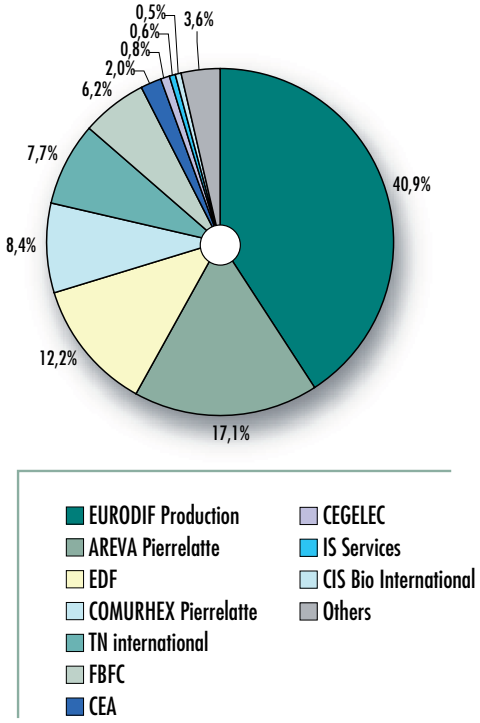
Since 1999, every French owner of type B or fissile packages or packages transported by special arrangement has had to update a record sheet for each package concerned, indicating the date of entry into service, modifications undergone, date of last maintenance operation, use to which it has been put, etc.

The collected package record sheets have provided ASN with a clearer picture of the overall French package situation. The 2007 survey shows that 16,222 containers were declared, 11,551 of which were used for transport, as opposed to 8,122 in the previous susrvey. The containers are divided into 88 package models, instead of the previous 85. The most common containers are the 48Y cylinders used to transport natural uranium hexafluoride, which account for almost 50% of all French containers (7,838 containers, 5,741 of which are the property of a single owner, Eurodif Production). In addition, more than 85% of all type B container owners, representing about 4% of all French containers, possess a gammagraph (GAM 80, GAM 120, GAM 400, GMA 2500 and GR 30-50). These appliances are intended for the transport of special form sources for non-destructive gammagraph testing and are regularly the subject of priority inspections (2001, 2005, 2006) in order to assess how this sector is progressing.

Breakdown according to package model



Number of containers per owner



3 INSPECTION AND FIELD CHECKS

ASN has implemented inspection provisions involving its local Divisions, in similar fashion to the procedures already adopted for basic nuclear installations.

From both the regulatory and practical standpoints, it is important to ensure good cohesion with other regulatory bodies responsible, notably, for the inspection of transport vehicles, for conventional safety inspection in the transport sector or for the protection of nuclear materials. This is why ASN has either already signed or will shortly be signing protocols with the Directorate General for the Sea and for Transports (DGMT) and the Directorate General for Civil Aviation (DGAC). The TSN Act also reinforced the powers of ASN inspectors, in particular with regard to ascertaining violations and imposing penalties.

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 75 inspections were carried out in 2007 in the field of radioactive material transport.

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 cases or, more generally, regulatory texts.

As regards quality assurance, the observations most frequently encountered concern the following:
– organisation;
– quality plan, procedures, established practice;
– traceability of checking operations;
– handling of deviations;
– supplier audits.

With regard to the other fields, the observations mainly concern:
– the training programme for all those involved in transport operations;
– the work of the safety adviser, in particular the annual report;
– procedures for declaring events and incidents.

ASN inspection at the port of Dunkerque

ASN also conducts inspections during package model drop tests. This was done three times in 2007 during the drop tests on containers TN 112 and R72 and during manufacturing acceptance testing of the IR 100 container. ASN aims to intensify package manufacturing inspections.

In 2007, the ASN inspectors' radioactive material transport inspection role focused on three priority topics carried over from 2006:
– gamma radiography devices;
– gammadensimeters;
– packages not approved by an Authority.

Transport of gamma radiography devices

In the gamma radiography sector, small companies do not generally employ a safety adviser. Even though the doses received during transport remain very low, radiological protection programmes could often be improved, although in many cases such a programme does not even exist. A reminder of the regulations applicable to the transport of gamma radiography devices was sent out by ASN to the professionals in this sector. A letter was also sent to the main companies which use gamma radiography contractors, reminding them to ensure that their contractors comply with the regulations.

Transport of gammadensimeters

The companies inspected are generally small structures comprising a maximum of about ten people. There is usually no quality assurance programme, nor any radiological protection programme. In only about one third of cases was the conformity of the type A packages demonstrated. Nonetheless, the companies generally have currently valid special source approval certificates. A few companies have no safety adviser. Finally, the marking of certain devices is incomplete. A letter recalling the regulatory requirements will shortly be sent out to all the companies identified as being in possession of or using gammadensimeters.

Non-approved packages

A third inspection campaign on non-approved packages was run in 2007. This primarily concerns the IP-2 and type A packages. These inspections confirmed the lack of stringency in demonstrating the conformity of non-approved packages, a fact that had already been observed in 2005 and 2006. The inspectors in particular identified the following deviations:
– regulation references are often incomplete or obsolete;
– the allowable contents of the containers are generally not specified;
– the definition of the containers (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.

In order to boost the effectiveness of its actions in this field, ASN sent the licensees a non-approved package conformity guide. This guide is available on the ASN website (professional area).

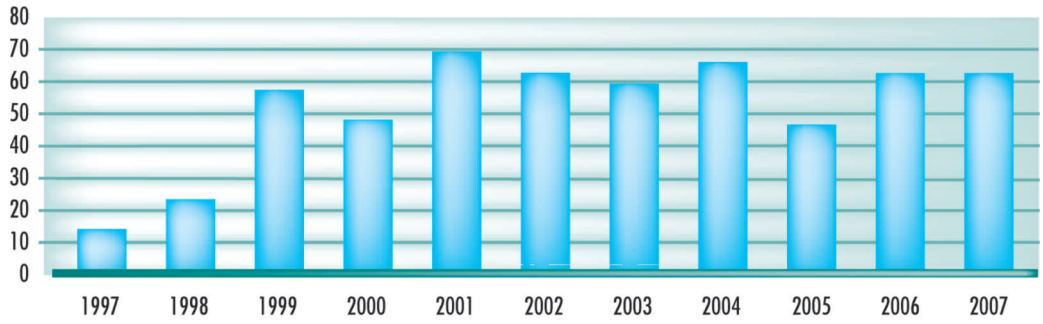
4 INCIDENTS AND ACCIDENTS

The guide associated with the letter of 24 October 2005, sent out by 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 template proposed in the ADR and RID orders.

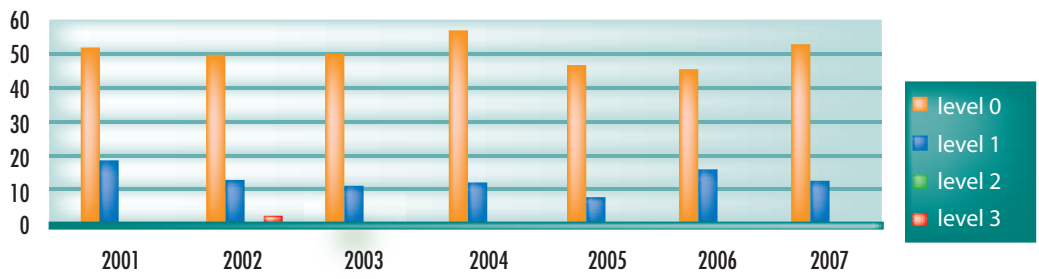
All transport deviations are thus to be declared to ASN. Apart from this declaration, a detailed incident report must be sent to ASN within two months. Events concerning regulatory nonconformities but which do not impair the safety function are not concerned by this report. In the case of contamination, an analysis report is to be sent to ASN within two months.

The main events that occurred in 2006 are detailed below according to category. These events may be of several types:
– nonconformity with the regulations laid down in the orders concerning each mode and in the package model approval certificates, in particular the checks required prior to departure (deviations concerning

Graph 1: evolution of the number of incidents or accidents notified from 1997 to 2007



Graph 2: evolution of INES rated events since 2001



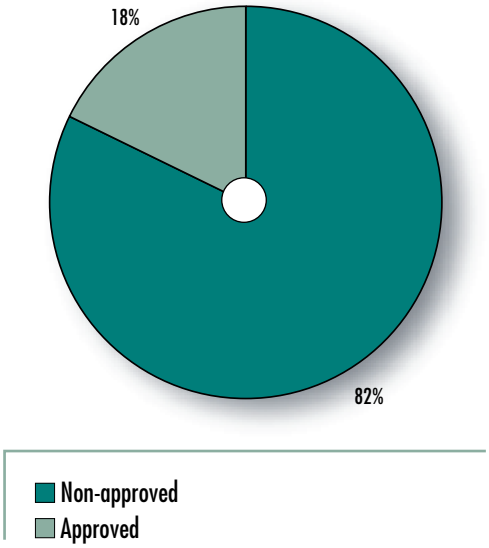
labelling, signalling, signage, transport documents and contamination exceeding the authorised limits);
– package handling event.

The trend in the number of incidents/accidents reported during the last ten years is illustrated in graph 1:

This graph shows a rise in the number of incidents notified, reflecting the creation of the notification system, followed by a phase of relative stability. The events notified since 1 October 1999 were rated on the INES scale, which ASN has decided to apply to transport operations.

In 2007, 51 incidents were rated at level 0, and 11 at level 1. Graph 2 shows the trends since 2001. The significant percentage of the events involving a package not requiring ASN approval is also worth noting. This is naturally due to the large numbers of these packages, but also to the less strict compliance with the regulations in those sectors for which the radioactive risk is not the main hazard.

Breakdown of events per type of package



4|1 Package handling events

Events during package handling are considered to be transport-related incidents. In the eyes of the regulations, handling is part of transport because transport encompasses all operations and conditions associated with the movement of radioactive materials, such as container design, manufacture, maintenance and repair, preparation, dispatch, loading, routing (including interim storage in transit), unloading and reception at the final destination of the shipments of radioactive materials.

Photo of a damaged package at an airport

These events are among those that ASN follows most closely, because their potential impact on workers, whether or not radiological, justifies extreme vigilance. The events that are of the greatest concern to ASN include those occurring in airports.

Incidents in airports

The incidents that occur in airports are generally radioactive material package handling incidents.

In 2007, 12 incidents of this type were recorded in Roissy-Charles-de-Gaulle and Orly airports. These incidents concerned type A packages or excepted type packages, which were damaged to varying extents, although with no breach of the containment.

One type A package loss was also notified in 2007. This was a package that was incorrectly dispatched on arrival at the airport. This incident was rated at level 1 on the INES scale.

Finally, a reactive inspection was ordered following an alert triggered at loading of an aircraft bound for Oran in Algeria. A handling operator detected heat being given off by a package containing a cobalt 60 source intended for medical uses. A precautionary security cordon was set up by the air transport police and the airport fire service.

The measurements taken by the response teams showed that the package was giving off no radiation or contamination higher than the regulation limits. The radiological checks on the personnel concerned revealed no contamination. Monitoring of the surface temperature of the package indicated a return to ambient temperature after two hours. However, at the request of the aircraft's captain, the package was returned to the cargo zone.

The inspectors brought to light a failure to comply with the particular instructions issued by the package consignor. These instructions, which are attached to the packages and stipulated in the transport documents, recommend that air be allowed to circulate freely around the package. The instructions were ignored by the company in charge of package preparation at transfer to Orly airport, and the package had been placed under a tarpaulin.

The event had no safety consequences, as the temperatures recorded on the package surface were unable to damage either the package or its content. ASN rated this event level 0 on the INES scale.

Jointly with the DGAC (civil aviation authority) and the air transport police, 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 hazards of ionising radiation.

4 | 2 Incidents and accidents during actual transport

Transport-related events are generally caused by ordinary road accidents. For this type of event, ASN particularly closely examines not only the consequences for workers, but also for the public and the environment. The following incidents are mentioned as examples:

Fère Champenoise incident

On 5 April 2007, a traffic accident involving a vehicle carrying a radioactive package took place on the RN4 main road between Paris and Nancy close to Fère-Champenoise (51).

A van belonging to a German cosmetics company, which was carrying the radioactive package, collided with a heavy goods vehicle. The van burned completely and both drivers were killed.

At the request of the Marne *préfecture*, the firemen from the Mobile Radiological Intervention Unit (CMIR) at Châlons-en-Champagne went to the site of the accident to carry out initial radiological measurements.

No trace of human contamination was detected. The measurements taken on the site also revealed an absence of contamination.

Additional investigations carried out by ASN revealed that the package contained a high level (81.4 TBq) sealed source, which was to be used in an irradiator at the Henri Becquerel national laboratory operated by CEA.

ASN asked its technical support organisation, IRSN, to transport the package to the CEA site at Saclay. It also asked it to carry out checks on the package and the radioactive source in order to rule on whether it could be reused or needed to be disposed of as radioactive waste.

This incident was rated at level 1 on the INES scale.

Tie-down incident

On Monday 16 April 2007, on the RN 79 main road near Digoin (Saône et Loire *département*), a package fell from a lorry which had come from the Dampierre-en-Burly (Loiret *département*) nuclear power plant, heading for the EDF BCOT site in Bollène (Vaucluse *département*). Two of the four straps which secured it to the trailer gave way for reasons as yet unknown. The package weighed 2 tons and contained handling equipment used in a nuclear zone.

The damaged container was placed in a sealed over-container and transported to its destination during the night.

The container seals were found to be intact, but there was an opening of about 5 cm at the top of one of the doors. The checks carried out by the fire service CMIR and by EDF confirmed that there was no radioactivity on the roadway or in the environment.

Given the degradation of the container's safe containment function, this significant transport event was rated level 1 on the INES scale.

Road accident at Lapalud

On 19 September 2007 at about 3 h 30, a van carrying 72 packages of radioactive products and 2 infectious material packages collided with another vehicle on minor road D63 near Lapalud, in the Vaucluse *département**. These products were intended for medical and research purposes. The fire service CMIR rapidly established a security perimeter. IRSN, ASN's technical support organisation, sent a team to the site to carry out measurements and checks as of late morning. These checks concluded that the integrity of all the packages was guaranteed and that there were no traces of contamination.

Two packages were intended for urgent medical treatments. After checking them, ASN authorised their immediate transport to the health care establishments concerned.

After a detailed inspection of the radioactive package transport documents, ASN authorised them to be

*Administrative region headed by a Prefect.

returned to the carrier's transit centre in Lyon, which will be keeping ASN informed of the steps it takes to re-route these packages to their consignors or to a duly authorised disposal route.

ASN rated this event level 0 on the INES scale.

4|3 Nonconformity of container or content

These events are often rooted in non-compliance with the package approval certificate or the package user's guide. These events include the contamination of spent fuel packages. There are usually no consequences for the workers, public or the environment, however ASN examines these events meticulously given the media and public attention they attract.

Contamination of spent fuel shipments

Spent fuel shipments from EDF sites to COGEMA La Hague continued in 2007.

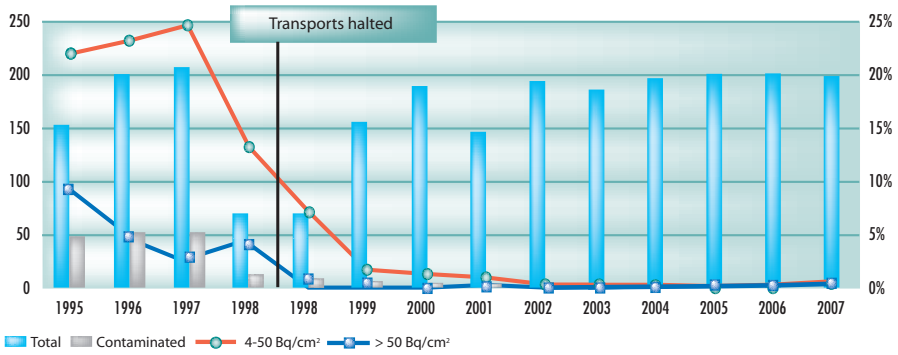
In 2005, the contamination thresholds were found to have been exceeded on several occasions at the Valognes rail terminal or in the EDF plants. In the light of this increase, ASN sent out a letter to EDF management on 25 October 2005, recalling the regulation contamination requirements and asking that corrective measures be taken to prevent such deviations happening again. Immediate corrective measures were thus taken by EDF. Then, in a letter of 3 March 2006, the licensee forwarded the results of its deviations analysis and the additional measures implemented on all the sites.

The proposed corrective action would seem to be effective, given that no contamination incidents were reported in either 2006 or 2007.

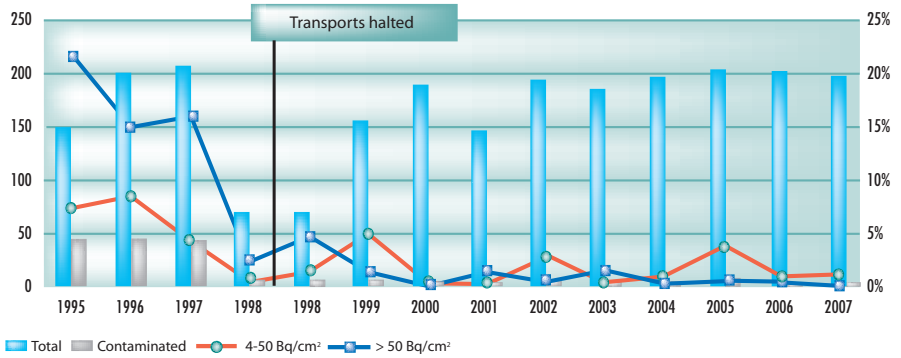
Spent fuel is continuing to be transported normally from foreign countries to La Hague and to Sellafield (Great Britain).

Graphs 3 and 4 show the trend since 1995 in the contamination levels on packages and the means of transport used to carry spent fuel from the EDF plants to the La Hague reprocessing plant.

Graph 3: contamination of packagings – results on 31 December 2007



Graph 4: contamination of convoys and trailers – results on 31 December 2007



5 INTERNATIONAL ACTIVITY

The international nature of radioactive material transport gave rise to regulations, drafted under the supervision of IAEA, ensuring that a very high level of safety is guaranteed. The drafting and implementation of these regulations entails fruitful exchanges between countries. ASN considers these exchanges to be a contributing factor in the constant improvement in the safety of radioactive material transport.

Regulations

ASN is a member of the Transport Safety Standards Committee (TRANSSC) which, under the watchful eye of IAEA, brings together experts from all countries in the field of radioactive material transport. It took part in the corresponding meetings from 12 to 15 March and from 1 to 5 October 2007 in Vienna. At these last meetings, the expert committee confirmed the current radiological cleanness limits for radioactive material transport. Many countries had proposed that the radioactive material transport regulations raise the radiological cleanness limits as they felt that the thresholds were too low and made no distinction between the various radionuclides, even though their toxicity varies considerably. The opposition to this proposal of certain countries, including France, led the expert committee to maintain the existing limits.

ASN considers that the current radiological cleanness limits can be met by industry, as shown by French experience. There is consequently no justification for raising them. Furthermore, ASN is firmly attached to maintaining a demanding level of cleanness for radioactive material transport, to ensure the protection of the population and the environment. ASN is therefore satisfied with this decision by the IAEA expert committee.

At this last meeting of TRANSSC, ASN also pointed out its concerns with regard to the situation of packages requiring no approval by the competent Authority. Even if in this field ASN's proposed regulatory changes were not adopted, some foreign competent authorities did recognise that the situation could certainly be improved. ASN will continue with its international efforts to ensure that the safety of these packages is not overlooked.

European guide to package model safety cases

ASN is participating actively in a European working group tasked, on behalf of the European authorities with competence for radioactive material transport, with drafting a guide for the production of safety cases for package models intended for the transport of radioactive materials. The aim is to harmonise international practices by proposing a common safety case structure. This is also an opportunity to share feedback concerning the points raised during the reviews.

Bilateral relations

ASN devotes considerable effort to maintaining close ties with the competent authorities of the countries concerned by the numerous shipments to and from France. These in particular include Belgium and the United Kingdom. Relations with the competent authorities in these two countries are both frequent and fruitful.

Belgium

For its production of electricity from nuclear power, Belgium uses French designed containers for fuel cycle shipment. In order to harmonise practices and achieve progress in the safety of these shipments, ASN and the competent Belgium authority (Belgian Federal Nuclear Regulating Agency - AFCN) regularly exchange know-how and experiences.

Since 2005, an annual exchange meeting is held by ASN and AFCN, in order to take a closer look at the safety cases for the French package models validated in Belgium. The meeting of 23 May 2007 reviewed package models TN24 and TNUO2 for which an approval extension application has been submitted.

Finally, two joint inspections were carried out in May 2007. These inspections carried out in Belgium concerned transport of FCC4 and UX30 packages, loaded with new fuel assemblies and uranium hexafluoride respectively. These inspections found nothing significant.

United Kingdom

France and the United Kingdom use radioactive materials for similar civil applications such as the production of nuclear generated electricity, reprocessing and use of radioactive materials for medical purposes, and both authorities therefore have a similar level of expertise. Both France and the United Kingdom also apply the same regulations covering radioactive material transport. Both countries also underwent a review coordinated by the International Atomic Energy Agency, demonstrating the high level of competence of the two authorities with regard to radioactive material transport, thus enhancing their mutual trust and confidence.

Against this backdrop, ASN signed a memorandum of understanding on 24 February 2006, for the mutual recognition of the approval certificates confirming the safety of radioactive material transport. As they meet the applicable rules, the approval certificates issued by the

United Kingdom's competent authority (DfT, Department for Transport) are recognised by ASN, and vice-versa. This MoU eases the procedural burden between the two countries and enables the two Authorities to devote more time to important issues. This arrangement also increases the level of competence through sharing of know-how and experience.

Having cooperated successfully on the MoU concluded in February 2006, ASN and the DfT decided to extend their cooperation in the near future to a range of specific topics:
– licensing procedures;
– inspections;
– emergency procedures;
– guides for domestic and international transport of radioactive materials;
– radioactive material transport standards;
– quality assurance systems.

6 OUTLOOK

Every year in France, large numbers of radioactive material consignments take place. Not only their number, but also the considerable radioactivity involved in some of them, require scrupulous enforcement of the regulations.

In 2007, ASN continued with its programme of inspections at the designers, manufacturers, users, carriers and consignors of radioactive material containers.

The inspections carried out in 2007 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 room for improvement. In particular for packages that do not require approval by the competent authority, ASN considers the situation to be unsatisfactory. Whether through regulations conformity demonstrations or checks prior to shipment, the inspections brought a large number of shortcomings to light. This situation is all the more worrying as these packages are the source of a large percentage of the incidents that occurred in 2007.

2007 was also an opportunity for ASN to toughen its supervision of drop tests, design, manufacture and maintenance. These are key steps in package safety. In 2008, ASN will continue to enhance its activities in these areas.

It also once again tested its response to an accident involving a radioactive material transport. ASN considers that transport emergency exercises are of particular importance, especially as an accident can happen anywhere, even in *départements* which contain no basic nuclear installations, so the local stakeholders are liable to be inadequately prepared to deal with such an event. These national exercises, in association with local exercises, make a contribution to training and educating the protagonists.

Finally, ASN continued the technical background work prior to issue of approval certificates: periodic safety reviews of existing package models and the approval of new models incorporating innovative design features contribute to the overall upgrading of transport safety.

These actions as a whole have led to an improvement in transport safety. ASN also believes that the framework for its actions in this field is an international one. ASN intends to intervene as far upstream as possible in the drafting of IAEA's recommendations. As, by their very nature, the regulations concerning the transport of radioactive materials are the subject of international exchanges, harmonised interpretation must be a major objective for ASN. This was the background to the MoU for mutual recognition of the certificates issued by each of the authorities, signed with the British authority in February 2006, which will be extended in 2008.

CHAPTER 12

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6 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 of this report produce the fuel intended for these plants or reprocess it, store the waste produced by them or are used to study 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 on each particular site can be obtained from the ASN regional divisions.

1 GENERAL INFORMATION ABOUT EDF'S NUCLEAR POWER PLANTS

The nineteen French nuclear power plants currently in operation are appreciably the same. They each comprise from two to six PWRs, which in total amounts 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 series, consisting of the four reactors at Bugey (reactors 2 to 5) and two reactors at Fessenheim;

– the CPY series, consisting of another twenty-eight 900 MWe reactors, that can also be subdivided into CP1 (eighteen reactors at Blayais, Dampierre, Gravelines and Tricastin) and CP2 (ten reactors at Chinon, Cruas and Saint-Laurent-des-Eaux).

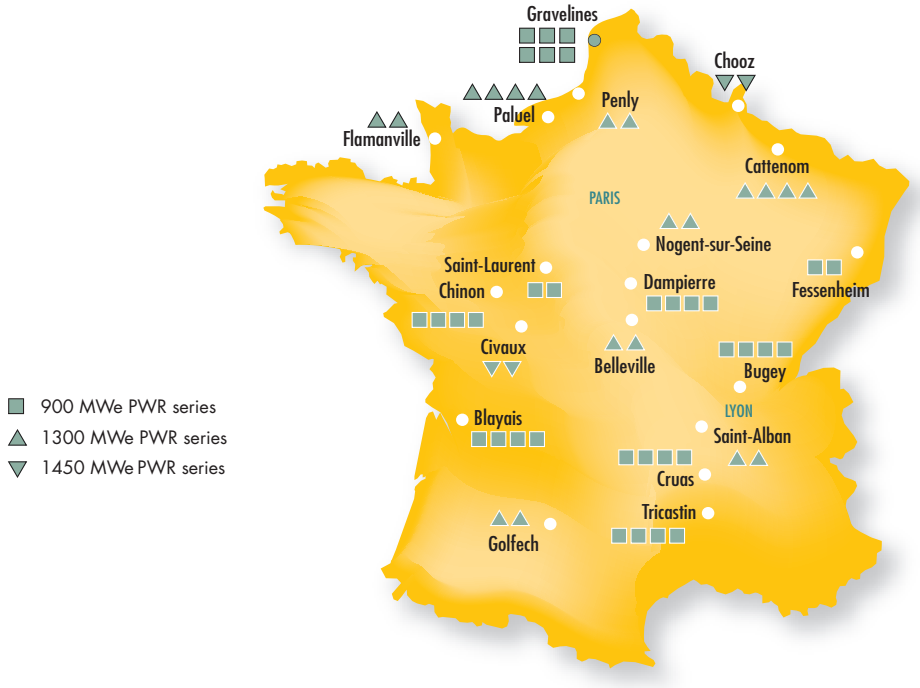
The twenty 1300 MWe reactors comprise:

– the P4 series, consisting of the eight reactors at Flamanville, Paluel and Saint-Alban,

– the P'4 series, consisting of the twelve 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.



Location of nuclear power plants in service

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. The power increase means a primary system with four steam generators, 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 as with 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 systems.

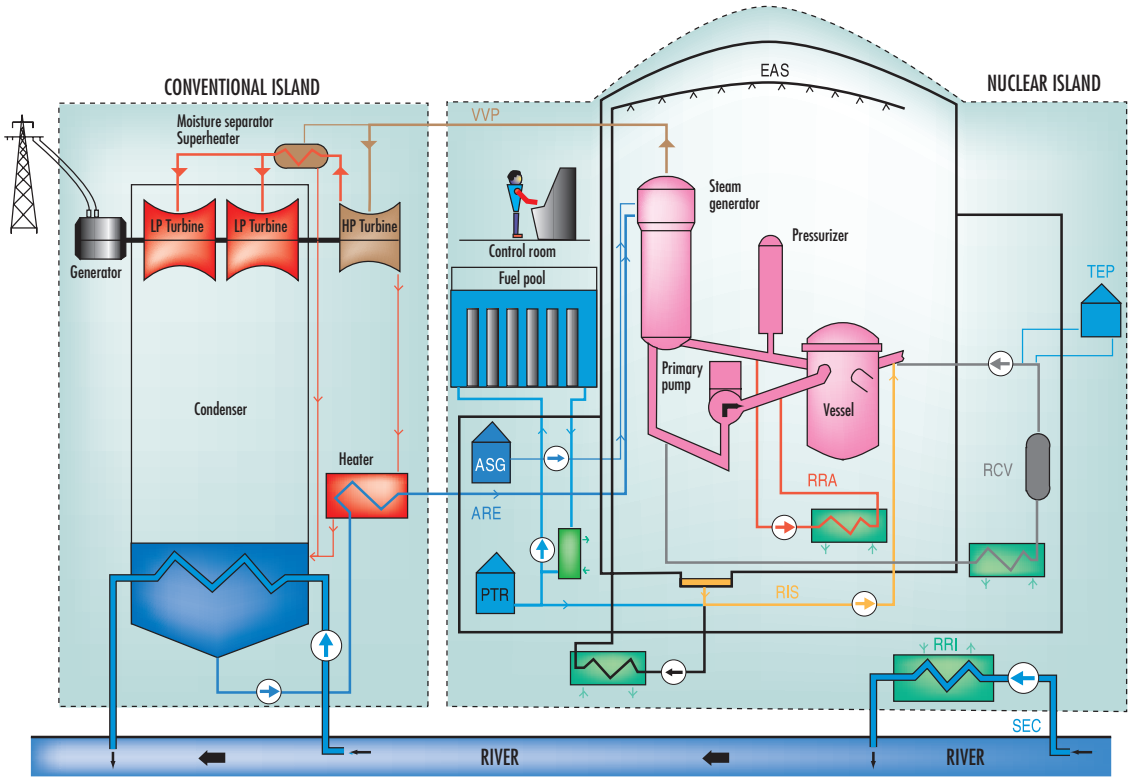
Finally, the N4 series differs from the previous reactor series in the design of the more compact steam generators and of the primary pumps and in the computerised instrumentation and control system.

1|1 Description of a nuclear power plant

1|1|1 General description 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, which 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.



Block diagram of a pressurised water reactor

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 spraying, steam generators feedwater, electrical, C&I 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 fuel storage pit.

The conventional island equipment includes 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.

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. As a result of fission, the uranium or plutonium nuclei emit neutrons which, in turn, produce further fissions: this is known as the chain reaction. These nuclear fissions release a large amount of energy in the form of heat. The primary system 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:

– inserting control rod assembly clusters, containing elements that absorb neutrons, to varying depths in the core. 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 content of the primary system water. The chain reaction is moderated by the boron - in the form of boric acid dissolved in the primary system water – owing to boron's ability to absorb neutrons. 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 reaches 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:

– uranium oxide (UO_2) fuel enriched with U-235. Most of this fuel is manufactured by FBFC, a subsidiary of the AREVA group. However, with a view to diversifying its supplies EDF has, since 1980, been obtaining fuel from several foreign fuel manufacturers. The uranium 235 enrichment of the UO_2 fuel loaded into the reactor is limited to 4.2 % (maximum enrichment authorised for the CP0 series fuel);
– fuels consisting of a mixture of depleted uranium oxides and plutonium (MOX). MOX fuel is produced by the MELOX plant that belongs to the Areva group and is located at Marcoule. The initial plutonium content is limited by the regulations to an average of 8.65 % per fuel assembly and provides an energy equivalence with UO_2 fuel initially enriched to 3.7 % U 235. This fuel can be used in the CP1 and CP2 series reactors for which the creation licence (DAC) makes provision for MOX fuelling. Twenty-two of the twenty-eight reactors 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 an operating cycle (generally expressed in months);
– the number of new fuel assemblies loaded at each reactor refuelling outage (generally 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 system and the secondary systems are used to transport the energy given off by the core in the form of heat to the turbine generator set which produces electricity, without the water in contact with the core ever 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 (three loops for a 900 MWe reactor, four loops for a 1,300 MWe, 1,450 MWe, or EPR reactor). Each loop, connected to the reactor vessel containing the core, comprises a circulating, or primary pump, and a steam generator. The primary water, heated to more than 300 °C, is kept at a pressure of 155 bar by the pressuriser, to prevent it boiling. The entire primary system is located inside the containment.

The primary system waster transfers the heat to the water in the secondary systems, via the steam generators.

The steam generators contain thousands of tubes through which the primary water circulates. These tubes are immersed in the water of the secondary system and boil it, without ever coming into contact with 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.

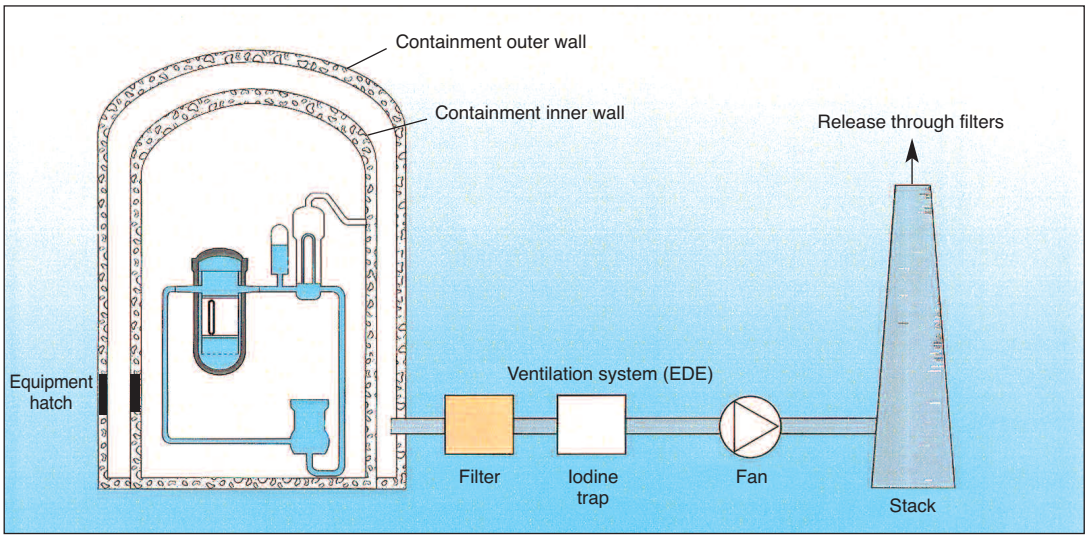
1 | 1 | 4 Reactor containment building

The PWR containment building has two functions:
– protection of the reactor against external hazards;
– containment, thereby protecting the public and the environment against radioactive products likely to be dispersed outside the primary system in the event of an accident. The containments are therefore designed to withstand the pressures and temperatures that could be reached in an accident situation, and offer sufficient leaktightness in such conditions.

The containments are of two types:
– 900 MWe reactor type containments, which consist of a single pre-stressed concrete wall. (concrete containing tensioned steel cables designed to compress the structure). This wall provides mechanical resistance to the pressure that would result from the most severe design-basis accident and ensures structural integrity in the event of an external hazard. Leaktightness is assured by a thin metal liner on the inside of the concrete wall;
– the 1,300 MWe and 1,450 MWe reactor 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, channels any radioactive fluids and fission products that could come from inside the containment as a result of an accident. Resistance to external hazards 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 residual heat from the fuel and then to keep the primary system water at a low temperature as long as there is fuel in the core. After the chain reaction stops, the reactor core continues to pro-



Containment of a 1300 MWe reactor

duce heat, which must be removed to avoid damaging the fuel. The RRA system is also used to transfer reactor pool water after fuel reloading.

During operation of the nuclear steam supply system, the chemical and volume control system (RCV) is used to control neutron reactivity by adjusting the boron concentration of the primary water. It is also used to adjust the mass of water in the primary system according to temperature variations. The RCV also enables the quality of the primary system water to be maintained, reducing the amount of corrosion and fission products it contains by injecting chemicals (corrosion inhibitors for instance). Finally, this system permanently injects water into the primary pump seals to guarantee their tightness.

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 moderate the nuclear reaction and remove the residual heat. It comprises passive pressurised accumulators and various pumps with appropriate flow rates and release pressures for different types of accident situations. In the event of a loss of coolant or steam line rupture accident, these pumps initially draw from the reactor cavity and spent fuel pit cooling and treatment system tank (PTR). When the tank is empty, they are then 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 rise in the pressure and temperature in the reactor building, the EAS system sprays water containing soda. This helps restore acceptable ambient conditions, protect the integrity of the containment and damp down any radioactive aerosols dispersed.

The ASG system is used to maintain the water level in the secondary part of the steam generators and thereby cool the primary system water if the normal feedwater flow control system (ARE) becomes unavailable. 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 component cooling system (RRI), which cools a number of nuclear equipment items and operates in a closed loop between the auxiliary and safeguard systems on the one hand, and the systems carrying water pumped from the river or the sea (heat sink) on the other;
– the essential service water system (SEC), which uses the heat sink to cool the RRI system;
– the reactor cavity and spent fuel pit cooling and treatment system (PTR), used notably to remove residual heat from irradiated fuel elements stored in the spent fuel pit;
– the ventilation systems, which play a vital role in containing radioactive materials by depressurising the premises and filtering all discharges;
– the fire-fighting water systems.

1 | 2 Operation of a nuclear power plant

1 | 2 | 1 EDF's organisational structures

Within the EDF Engineering and Production Branch (DPI), created in 2004, a difference is made between the function of operator and that of an 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 a daily basis.

The DPN

The responsibility of operator is assumed by the Nuclear Generating Division (DPN). Day-to-day operation of the nuclear power plants, including safety, worker 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 operations.

In 2006, EDF decided to modify the organisation of engineering for the nuclear power plants in operation. The changes being looked at concern both the process concerning documentation and that concerning modifications to operating documentation. These changes are made in an attempt to simplify processes and to ensure greater accountability from the various entities: the sites for the changes that concern them, the designer for the project management aspects delegated to it and for incorporating the operational impacts of hardware and documentary modifications and operational engineering for its site support and policy drafting role. These changes were implemented in 2007.

In ASN's opinion, the principle underpinning this reorganisation, which is to have the designer and the licensee work together more closely when defining modifications and drafting the documentation, helps improve the quality of these operations.

For the purposes of implementing these changes, the operational engineering unit (UNIE) was created within the DPN. Its two-fold role is to support the sites in order to help them attain their safety and performance objectives, and help the DPN management with its project management function and with enforcement of national level decisions concerning all the nuclear power plants. The UNIE also helps support the DPN management and the nuclear power plants in implementing changes and integrating technical aspects and human, social, organisational and economic factors.

For all power plants, the operational technical unit (UTO) is responsible for integration of operations (modifications and maintenance). It is in charge of generic maintenance, subcontracting policy, oversight of reactor outages and purchasing 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 Director's responsibilities are those of the nuclear licensee of the installations. The departments are organised according to discipline, comprising safety, radiation protection, production and maintenance. Cross-functional project teams are set up for specific activities such as unit outages. The production and maintenance activities can also call on an engineering department.

The DIN

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 concerning future issues, in other words, studies, draft projects and long-term upgrade projects for the facilities which go beyond the natural scope of the licensee's work. Finally it has oversight for projects designed to maintain the assets, primarily concerning design aspects, in particular the periodic safety reviews. It is responsible for new nuclear power plant projects in France (EPR Flamanville 3) and those taking place abroad in which EDF is involved. It is responsible for dismantling work.

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 in charge of equipment design and modification on the nuclear island of the N4 series reactors and the new nuclear power plant projects in France (EPR Flamanville 3) and for export.

The Engineering Centre for Operating Plants (CIPN) is in charge of the nuclear islands for the 900 MWe and 1300 MWe reactors.

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.

ASN contacts

For the purposes of its national regulatory activity, ASN is primarily in contact with the DPN. ASN's contacts are the head office departments with regard to generic matters, in other words those that concern some or all of the plant reactors; ASN deals directly with the management of each plant for questions specifically concerning the safety of reactors in it. 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 (DCN).

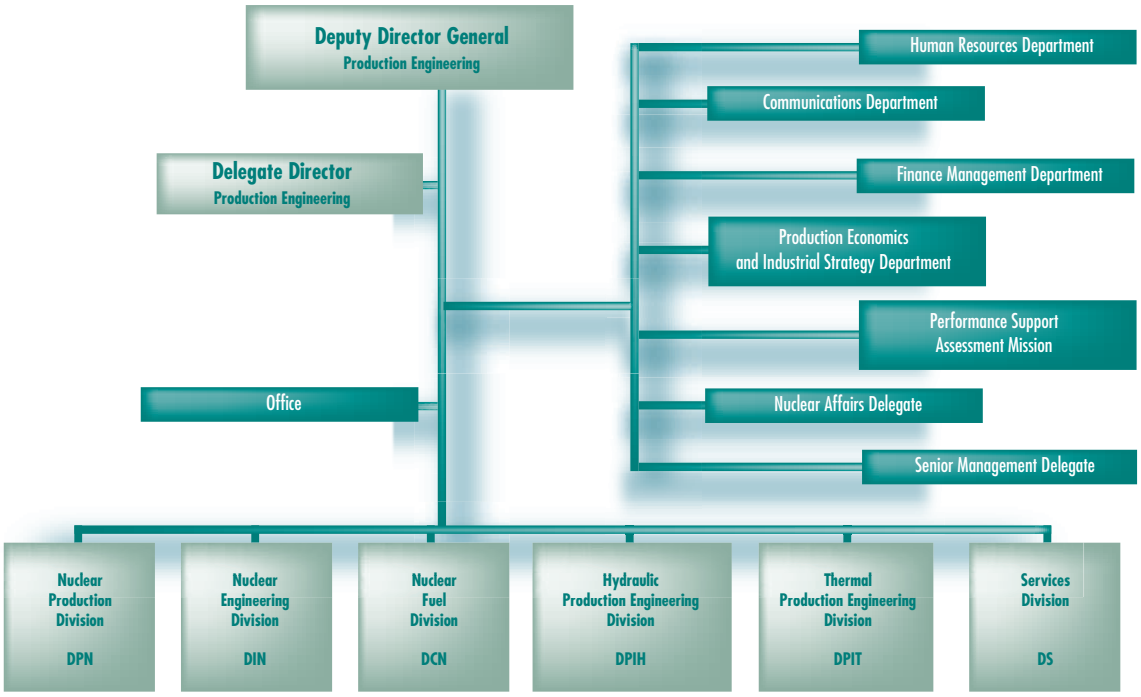
1 | 2 | 2 Operating documents

Nuclear power plants are operated on a day-to-day basis in accordance with a set of documents. All those concerning safety are given particularly close attention by ASN.

These first of all comprise the general operating rules (RGEs) applicable to reactors in service. They supplement the safety case, which mainly deals with the measures taken at the design phase of the reactor, and translate the findings of the various studies into operating rules.

The RGEs comprise several chapters, among which those having particular safety implications are carefully reviewed by ASN.

– Chapter III describes the "Technical Operating Specifications" (STEs), which specify the reactor's nor-



Organisation of the EDF DPI

mal operating range and in particular the allowable range for the operating parameters (pressure, temperature, neutron flux, chemical and radiochemical parameters, etc.). The STEs also specify the required reaction if these limits are exceeded. In addition, the STEs define the equipment needed according to the condition of the reactor and state what action is to be taken in the event of malfunctioning or unavailability of this equipment.

– Chapter VI comprises operating procedures applicable in an incident or accident situation. It stipulates the reactor operations required in these situations in order to maintain or restore the basic safety functions (reactivity control, core cooling, containment of radioactive products) and return the reactor to a safe condition.

– Chapter IX defines the programmes of checks and periodic tests run on the equipment and systems that are important for safety, in order to ensure their availability. If the results are unsatisfactory, then the required response is specified in the STEs. This type of situation may sometimes require the licensee to shut down the reactor in order to repair the faulty equipment.

– Chapter X finally defines the physical test programme for reactor core loads. It contains the rules defining the core verification programmes during reactor restart and for in-service core monitoring.

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

Reactors need to be shut down periodically in order to renew the fuel, which becomes gradually depleted during the operating cycle. At each outage, one third or one quarter of the fuel assemblies is replaced. The length of the operating cycles depends on the fuel management adopted.

These outages mean that it is possible to access parts of the installation which would not normally be accessible during operation. The outages are therefore an opportunity to check the condition of the installation by running checks and performing maintenance work, as well as to implement the modifications scheduled for the installation.

There are two types of outage:
– simple refuelling outage and partial inspection (VP) outage: these outages last a few weeks and are devoted to renewing part of the fuel and conducting a programme of verification and maintenance;
– ten-yearly outage (VD): 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|4).

These outages are scheduled and prepared for by the licensee several months in advance. ASN checks the steps taken to guarantee on the one hand safety and radiation protection during the outage, and on the other the safety of operation during the coming cycle(s).

The checks carried out by ASN mainly concern the following aspects:
– during the outage preparation phase, the conformity of the reactor outage programme with the applicable reference system. ASN will give its opinion on this programme;
– at the regular information meetings and inspections during the outage, how the various problems encountered are dealt with;
– 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, ASN authorises reactor restart;
– after criticality, the results of all tests carried out during the outage and after restart.

2 THE MAIN NUCLEAR SAFETY AND RADIATION PROTECTION ISSUES

2|1 Organisations, safety, competitiveness

2|1|1 Regulation of organisational and human factors

Safety issues

The regulation of human and organisational factors (HOF) in such a high-risk system as a nuclear power plant, must address the effectiveness and safety aspects of human intervention. Human intervention, both individual and collective, must be taken into account at the various levels of the organisation.

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.

Many factors determine human performance and thus the ability of the staff to perform their functions efficiently and safely: human capabilities and limits, skills, working of groups and organisations, operating procedures and instructions, quality of the man-machine interface on the working tools, constraints inherent in the working environment. Organisation is therefore crucial in setting up and maintaining the conditions conducive to the improvement of human performance.

Incorporating the HOF aspect into safety therefore requires coherent action on a number of levers, such as training and the skills of the staff working on the sites, the ergonomics of the installations and the operating documents, individual and collective working methods, organisation and management.

ASN's action principles

With regard to HOF, ASN relies on the following general principles:
– the responsibility of the licensee: with respect to the general safety objectives, it is up to the licensee to define its organisation and adapt it as and when necessary, to take the steps necessary to incorporate human factors into the design and operation of the installations and to ensure that its staff are correctly trained. ASN analyses and adopts a stance with regard to certain provisions, but does not specify any standard organisation. Similarly, it is up to the licensee to define and implement the training curriculum for its staff and assess their ability to carry out their duties;
– defence in depth: to enable man to play his safety role, technical but also human and organisational lines of defence must be set up. These mainly involve defining systematic technical checks on sensitive operations, providing support for the various stakeholders, detecting and dealing with nonconformities, taking steps and deploying resources to enable those in the field to intervene in the safest possible conditions, and ensuring that those in charge at the various levels of the

organisation are familiar with the constraints encountered in the field so that appropriate decisions can be taken;
– operating experience feedback: operating experience feedback loops should enable the licensee to carry out a more in-depth assessment of the lines of defence, particularly human and organisational, and take appropriate measures to improve them. A first loop is based on analysing significant events and looking for their underlying root causes. Other loops are designed to ensure structured and systematic feedback concerning human activities, for example in the form of the debriefings held following certain activities, the observations made by the managers in the field and the early warning signs collected during the course of day-to-day operations.

ASN regulation of HOF is based in particular on the inspections performed in the nuclear power plants. They are an opportunity to look closely at how the organisations are working, with assessment of the extent to which human and organisational issues are considered. ASN also relies on the evaluations carried out by IRSN at its request.

Incorporating HOF into engineering activities

Generally speaking, organisational and human factors must be systematically engineered into the design of a new installation or into a modification of an existing one. The aim of such an approach is to ensure that all aspects of the working situation which, for the individuals and teams involved, contribute to controlling the installation and ensuring work in the best possible conditions of safety, have been taken into account. These aspects can concern the various determining factors in the work done, that is the technical arrangements, documents, buildings and premises, but also how work is organised and training.

When a new installation is designed, the organisational and human aspects must be taken into account as extensively and as early as possible. In 2007, with the support of IRSN, ASN continued with its review of EDF's implementation of this approach in the design of the EPR reactor at Flamanville.

The changes made during the course of operation of the installations often have control or maintenance repercussions. It is therefore important to identify them early enough and involve the future users in the various stages of the design of a system, so that the system finally obtained is adequate and appropriate and safety is improved.

EDF presented ASN with its strategy for taking account of HOF in technical and documentary modifications with an impact on control or maintenance activities. EDF also presented the steps taken to ensure that this approach was implemented into the modification projects, in terms of both organisation and skills, particularly to develop HOF skills within the DPI's engineering units.

ASN duly noted the considerable efforts made in this field and asked EDF to provide it with further information so that it could review this approach in 2008.

During an inspection at the CIDEN, ASN also noted that this approach constituted the basis for the approach adopted to take account of HOF in dismantling operations and in the creation of the installations necessary for decommissioning.

The contribution of human performance to safety in power plants in service

In 2006, EDF presented ASN with its project for placing human performance at the heart of safety management, based on the reliability of human intervention and an increased management presence in the field. The corresponding measures are currently being deployed on all sites. This approach and the corresponding tools are in particular implemented during sensitive activities identified by EDF.

In 2007, EDF decided to extend the scope of application of the intervention reliability practices to families of activities deemed to be "high risk".

ASN considers that the work done on this project represents a significant safety improvement for the nuclear power plants in service. When analysing significant events, the sites often identify corrective action based on the implementation of intervention reliability practices (pre-job briefing, secure communications, cross-checks, etc.). During the inspections carried out in the nuclear power plants, ASN was able to observe the actual implementation of some of these practices. However, ASN is closely monitoring the extent to which the staff are able to use human performance tools when under deadline pressure or in adverse intervention conditions.

ASN also noted that the sites have devoted efforts to increasing the presence of managers in the field. ASN will remain attentive to the organisational arrangements made on the sites to guarantee that the managers are able to meet their field presence objectives.

Finally, EDF presented ASN with the measures it intends taking to involve contractors and their subcontractors in the human performance practices process, in order to achieve uniform implementation of these practices between the contractors and the EDF personnel.

Safety management and operational stringency

During its inspections in the nuclear power plants, ASN saw examples of information feedback from field operations as a result of observations made by the managers during their field visits, and as part of the "early warning signs" approach. Generally speaking, ASN takes a positive view of EDF's clear desire to be more attentive to feedback from the operational staff and management during the course of their day-to-day activities. This approach contributes to the process of continuous learning and improvement which should be the foundation of safety management. ASN will be closely monitoring the lessons learned by the licensee in terms of operating experience feedback of use in improving safety and radiation protection.

To improve safety management, EDF also has at its disposal a tool for analysing how safety is considered in the decision-making process, when faced with other constraints such as installation availability, radiation protection, or the environment. During its regulatory activities, ASN noted that this tool is used to varying extents and that implementing it still entails problems in certain nuclear power plants.

2|1|2 Management of skills and qualifications within EDF

With regard to personnel training and qualification, EDF's management policy is based on a local system of skills development deployed on each site, comprising members of the various departments, representatives of the human resources departments and training specialists. This policy should lead to the local senior management becoming more closely involved in skills management, in particular through their assessment and identification of requirements.

In 2007, EDF presented ASN with its national project entitled "Skills adaptation and renewal" (ARC). This project aims to reinforce the role of management in skills management, to encourage internal mobility, to enable the staff to become involved in the field during their training and to include the contractors in this skills management improvement process. The transfer of skills and know-how focuses primarily on new staff, but also on transfers between senior professionals as well as the specific case of skills identified as rare.

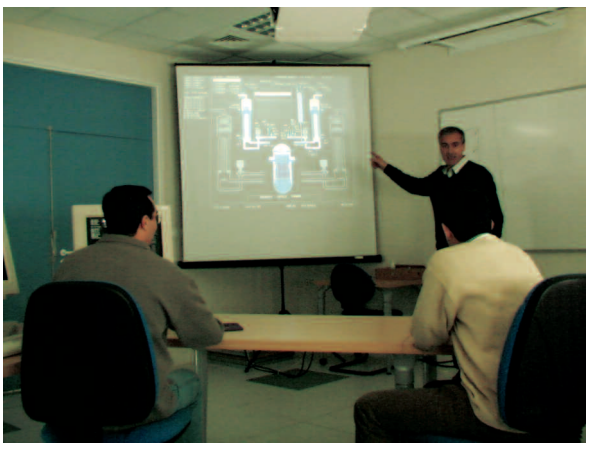
Academies are created, not only for regional pooling of new employee initial training among several power plants, but also to ensure that this training process more accurately reflects life in the field. A process of gradual qualification aims to make the new employee increasingly accountable for his or her actions as training progresses.

Following a 2006 review by the Advisory Committee for nuclear reactors (GPR) of EDF's skills management and staff qualification approach, ASN regards the skills management and qualification of the staff operating nuclear power plants as satisfactory. On this occasion, ASN recalled the particular importance it attaches to having EDF continue and step up the actions already in progress, in order to ensure that the skills vital to safety continue to be present when the large-scale wave of retirements starts in 2008.

Generally speaking, the inspections carried out by ASN are a means of assessing the considerable efforts made by the nuclear power plants with regard to skills management and the role played nationally by the DPN in coordinating and promoting the action taken by the sites. They reveal a situation that is on the whole satisfactory. However, during its inspections, ASN sometimes observed problems with bringing organisations and reference systems into line with changes at a national level. The progress achieved in the skills management process often varies from one discipline to another.

In this process, skills assessment is an important factor, both in determining the skills required in each department and ensuring that these skills are maintained. ASN notes that even if managerial presence in the field is improving, it is hard to implement a system within the departments for observation of the skills actually employed in a working situation, particularly when assessing skills in the disciplines assigned to reactor outage activities, as well as for contractor surveillance activities.

ASN noted that when training was postponed or cancelled, the reason was usually a lack of availability. The lack of staff availability can also pose problems when attempting to bring together a full team for training and can compromise the collective skills improvement objectives.



A training session in an EDF nuclear power plant

Since 2004, EDF has had a full-scope simulator on each site for training the control teams. ASN notes with satisfaction that the presence of the simulator on the site means that other forms of training can be gradually implemented within the control department (professional training by mentoring on the simulator for example) and that other disciplines, even up to site management, can be involved in control activities. Specific sessions are held to improve coordination between control and the other disciplines (tests, automation). Ideally, simulator availability should be sufficient to enable the teams to play out scenarios on it, whenever they wish to.

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 involves about 20,000 contractors and subcontractors.

Implementing an industrial policy such as this is left to the initiative of the licensee. Pursuant to the order of 10 August 1984, mentioned in section 2|2|1 of chapter 3, ASN's role is to ensure that EDF assumes its responsibility for the safety of its installations, by implementing a quality approach, and in particular by monitoring the conditions in which this subcontracting takes place. This approach is officially laid out in the "Progress and sustainable development charter" signed by EDF and its main subcontractors.

Selection and supervision of the activities performed by the contractors

EDF has set up a contractor qualification system based on an assessment of their technical know-how and their organisation. In addition, EDF is required to monitor its contractors' activities, or have them monitored, and use operating experience feedback for a continuous assessment of their qualification.

In 2007, ASN conducted inspections on the "general site assistance services" (PGAC) and on integrated maintenance services. These structures are designed to improve the control and coordination of the activities subcontracted in the nuclear power plants. After noting the problems encountered in 2006 with implementing the PGAC, ASN considers that the sites inspected conducted adequate oversight of these activities. It nonetheless feels that EDF must improve the definition and traceability of the surveillance carried out in the field, and the processing of nonconformities identified during the course of this surveillance. Furthermore, ASN considers that EDF must check that the resources allocated to surveillance are commensurate with the number of contractor interventions to be monitored, in particular for reactor outages which are covered by large-scale verification and maintenance programmes.

Intervention conditions

With regard to the intervention conditions, ASN feels that on the basis of the inspections performed in 2007, EDF needs to improve the quality of the surveillance programmes, in order to check effective implementation on the worksites of the compensatory measures identified in the risk assessments.

Radiation protection and conventional safety

In terms of radiation protection for workers, ASN focused its attentions on enforcing the Labour Code through inspections conducted during the reactor outages. ASN in particular ensured that exposure to ionising radiation was checked with the same level of quality, regardless of whether the work was done by contractors or by EDF employees. It also ensures compliance with the rules concerning work in a contaminated environment and the radiological cleanness levels of the premises.

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.

Even if EDF has set up an organisation for surveillance of its subcontractor market and oversight of the available resources, ASN maintains a close watch on the subject through its inspections on the sites and in head offices, through analysis of the EDF diagnosis and through external audits.

In 2007, ASN therefore commissioned an expert assessment of nuclear contractors from an independent firm. It will analyse the conclusions of this assessment to help guide its regulation of EDF starting in 2008.

2|1|4 Safety and competitiveness

Act 2000-108 of 10 February 2000, concerning the modernisation and development of the public electricity service, significantly changed the electricity market in France. While specifying EDF's public service duties, the particularity of this Act – which transposes a European directive on the internal market in electricity – placed EDF in competition for the generation and supply of electricity to corporate and private 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.

Cost control concerns are now more clearly apparent in the licensee's dialogue with 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 changes and the new practices implemented or foreseen by the licensee.

ASN regulation

To adapt its regulatory work to this new context, ASN is developing tools to ensure early identification of any drift: economic situation, expenditure trends, workforce management, changes in safety and radiation protection indicators and licensee organisational changes are the subject of closer attention. As in previous years, ASN reviewed the summary forwarded by EDF on these points. The expenditure trends show that EDF is continuing to invest in maintaining the assets and that the R&D effort remains satisfactory. Overall, the review conducted by ASN showed no worrying drift. However in the future, ASN will be keeping a close watch on the consequences of any reorganisation by EDF designed to attain its economic performance targets.

ASN also asked its technical support organisation, the Institute for Radiation Protection and Nuclear Safety (IRSN), to review the EDF safety management system "in a competitive context". This review, including consultation of the GPR in April 2008, will aim to clarify the following:
– the emphasis actually placed on safety;
– the operational nature of safety;
– the possibility of continuing to improve safety.

Finally, ASN is developing exchanges with its foreign counterparts, with a view to achieving harmonisation of requirements, at a time of licensee internationalisation and the advent of a competitive electricity market. The work done within the WENRA association, in which ASN plays an active role, contributes to this harmonisation.

2|1|5 Operations subject to enhanced supervision by the licensee

ASN requested that EDF apply a system of enhanced internal supervision to certain operations it felt to be particularly sensitive in nuclear safety and radiation protection terms. "Internal authorisation" arrangements (see chapter 4, point 2|1|1) were thus approved by ASN for the following operations:
– 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, authorisations in these two areas have been issued by EDF management or the management of the site concerned, following a review by an independent internal commission comprising the safety and quality managers. EDF also checks the working of these processes and reports on them to ASN.

In 2006, ASN conducted a review in each plant on the subject of internal authorisations. These reviews were an opportunity to check compliance with the new requirements.

The "internal authorisations" system is now covered by Article 27 of decree 2007-1557 of 2 November 2007. The scope of these internal authorisations could eventually be extended, at the licensee's request, to other types of reactor outages or to certain documentary modifications.

2|2 Continuous safety improvements

2|2|1 Correction of anomalies

Anomalies are detected in nuclear power plants through the systematic checks required by ASN and proactive measures taken by the licensee. EDF is cultivating a questioning attitude whereby it takes the initiative to look for anomalies.

ASN requires that anomalies with an impact on safety be corrected within a time-frame commensurate with their severity.

It considers that periodic reviews and a continuous search for anomalies by the licensee help guarantee an acceptable level of safety.

Systematic checks: conformity reviews

EDF performs periodic safety reviews of its nuclear reactors every ten years (see point 2.2.4). These reviews are stipulated in Article 29 of the 13 June 2006 Act on Transparency and Security in the Nuclear Field (TSN Act). EDF thus compares the actual condition of the installations with their safety requirements and identifies any anomalies. These anomalies can have a variety of origins: design problems, construction defects, nonconformities introduced during preventive or corrective maintenance operations, deterioration caused by ageing, and so on.

A review of the reference design studies is therefore an opportunity to detect and deal with any anomalies. This

review is carried out by the EDF engineering centres, draws on the latest updated knowledge and takes advantage of the latest design methods used in the field of reactor operations. This review includes a check on the conformity of the measures taken for protection against external hazards, such as extreme meteorological conditions (particularly heat waves) and earthquakes. The conformity of protection against internal hazards, such as high-energy line breaks, is also examined. In addition, the licensee ensures that the equipment is still able to function in the degraded ambient conditions liable to occur in the event of an accident (referred to as "accident conditions qualification"). These checks are supplemented by a programme of additional appraisals. The aim is to check those parts of the installation which are not covered by a preventive maintenance programme owing to the difficulty involved in accessing them.

One particular aim of the conformity reviews on the various EDF reactors is to track down any generic anomalies that could simultaneously affect reactors of similar design.

"Real time" checks

ASN considers that the questioning and analytical attitude adopted by EDF needs to be maintained and indeed strengthened. This approach effectively completes the systematic anomaly tracking process. For example, routine field visits are an effective means of discovering faults. The performance of periodic test and preventive maintenance programmes on the equipment and systems also helps identify these anomalies.

Informing ASN and the public

The public is informed of the most significant conformity anomalies (INES scale level 1 and higher) by means of ASN's website.

An upstream system was created to ensure that ASN is specifically informed of any conformity anomalies discovered by EDF. When there is any doubt concerning the conformity of an equipment item, EDF notifies ASN accordingly. At the same time, the licensee attempts to characterise the problem encountered. The purpose of this characterisation is to determine whether there is really any nonconformity with regard to the safety requirements defined during the design process. If so, EDF specifies which equipment is affected and evaluates the safety consequences of the nonconformity. ASN is notified of the results of this characterisation. As applicable, EDF sends it notification of a significant safety event.

This procedure guarantees transparency with regard to both ASN and the public.

ASN's remediation requirements

Any conformity anomaly which significantly impairs safety must be corrected rapidly, even if the remedial measures entail a large volume of work. This is why ASN examines the remediation methods and time-frame proposed by EDF. To do this, ASN takes into consideration the actual and potential safety consequences of the anomaly. ASN may require that the installation be shut down or be kept shutdown, until such time as the repair is completed. This is the case if the risk involved in operation while the anomaly is present is considered to be unacceptable and if there is no appropriate remedial measure. Conversely, correction of a less serious anomaly may be spread over a longer period of time if particular constraints so warrant. These constraints may be linked to operational safety. They may also arise from national and European electricity grid security objectives.

For example, 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 an equipment item which can already withstand a large-scale earthquake, longer repair lead-times may be granted.

2 | 2 | 2 The main anomalies currently being dealt with

Anomaly affecting the recirculating sump filters

Summary of the anomaly affecting the recirculation function

This generic anomaly concerns the possible clogging of the sump filters involved in the recirculation function. In certain accident situations, recirculation is used to cool the reactor core and reduce the pressure and temperature inside the containment.

This anomaly was rated level 2 on the INES scale by ASN. It was notified by EDF at the end of 2003 and ASN made it known to the public in a press release early in 2004.

The recirculation function

The RIS and EAS systems are automatically triggered in the event of a major leak (or break) on the primary system of a pressurised water nuclear reactor (accident known as a LOCA – loss of coolant accident). Water injection into the primary system by the RIS system helps cool the reactor core (nuclear fuel). Spraying by the EAS system is designed to reduce the pressure and temperature inside the containment.

The water injected by the RIS and EAS systems is first of all pumped from a tank. When the tank is empty, the

water from the leak and the water sprayed into the containment is collected in the sumps located at the bottom of the reactor building. It is then reused by the RIS and EAS systems: hence the term "recirculation" function. Correct operation of the recirculation function is a basic "line of defence" in preventing a serious core meltdown accident in pressurised water reactors.

The debris generated by the break (particles of heat insulation, concrete, paint or dust) can be entrained by the water flows in the reactor building and can therefore reach the sump filtration system. This creates a risk of filter clogging that could eventually lead to malfunctioning of the recirculation function. This phenomenon was taken into account when designing the reactors and various systems were in principle designed accordingly.

In the light of international operating feedback, ASN in 2003 asked EDF to re-examine the sump filter clogging phenomenon in accident situations for all its PWR reactor models. ASN in particular asked EDF to clearly state its position regarding the loss of the recirculation function as a result of this phenomenon.

EDF's position

In the reply it submitted at the end of 2003, EDF stated that in certain highly unlikely accident situations involving a major break in the primary system (break larger than 4 inches), sump filter clogging could not be ruled out. It can however be ruled out for less significant breaks. All French nuclear reactors are concerned to varying degrees, but the older reactors would however seem to be the most susceptible as they have a smaller filtration surface area.

Characterisation of the anomaly by EDF

In order to characterise the anomaly and produce a robust solution, EDF defined a "study reference framework" in 2004. This reference framework defines the scenarios to be used in analysing the sump filter clogging phenomena and in designing new filters. The parameters that can influence filter clogging are many and varied. Furthermore, the physical processes involved are complex and hard to model.

In 2005, after obtaining the opinion of the GPR, ASN asked the licensee to conduct additional studies to underpin certain scenarios, although it considered that this requirement in no way constituted an obstacle to rapid commencement of anomaly correction work.

The additional studies requested in particular concern the impact of the physical and chemical effects liable to occur over the long term in the reactor building in accident conditions. These phenomena could lead to the creation of chemical compounds in the form of precipitates, thereby amplifying sump filter clogging. It is necessary to check that these physical and chemical effects do not compromise the solution chosen to correct the anomaly.

Anomaly correction solutions

As of 2004, EDF began to look at solutions likely to correct this anomaly. The modifications decided on by EDF consist in replacing all the filters fitted to the sumps in order to achieve a significant increase in the filtration surface area.

In 2005, EDF replaced the sump filters on three 900 MWe reactors. The three filter suppliers chosen by EDF are AREVA NP, COMEX/MITSUBISHI and WESTINGHOUSE.

Design anomaly in the COMEX/MITSUBISHI filters

On 14 February 2007, EDF informed ASN that in the event of a medium-sized break on the primary system, certain recently installed filters would be unable to guarantee a sufficient recirculation flow rate (and would not therefore satisfactorily correct the initial anomaly). In certain operating conditions, the new COMEX/MITSUBISHI filters would not be able to guarantee the nominal recirculation flow rate for the 900 MWe reactors.

This second anomaly was rated level 1 on the INES scale. It concerns seven 900 MWe reactors already equipped with COMEX/MITSUBISHI filters: Tricastin 2, 3 and 4, Gravelines 2 and 4 and Fessenheim 1 and 2.

Processing of the second anomaly by EDF

EDF now uses a new COMEX/MITSUBISHI filter design which corrects the second anomaly and guarantees that the filters will function correctly, except for the two Fessenheim reactors, which employ a particular configuration. The new design for their filters is still being defined.

EDF therefore has to revise its anomaly correction programme for those reactors which are to be equipped with the filters designed by COMEX/MITSUBISHI:

– by postponing until 2009 the installation of new filters on Gravelines 3, initially scheduled for the beginning of 2007 (time-scale incompatible with the supply of the new design);
– by intervening as planned in 2007 on Tricastin 1 and Gravelines 1, directly fitting the new design of filters;
– by scheduling the upgrading of the seven reactors already modified as of September 2007 and until 2009.

Pending this upgrade, EDF took specific control measures designed to partly mitigate this anomaly during the current transitional period. As a result of these measures, the first generation of COMEX/MITSUBISHI fil-

The anomaly initial correction programme

As requested by ASN at the end of 2005, EDF submitted a new programme for industrial deployment of modifications reducing the initially proposed anomaly correction times. This programme – accepted by ASN in 2006 – provides for correction of the anomaly before the end of 2007 for those reactors most susceptible to the clogging phenomenon, and before the end of 2009 for all reactors.

The issue of sump clogging affects all of the world's pressurised water reactors. France is playing a driving role in dealing with the recirculation sump filters clogging risk. The results of the experimental research programme conducted by IRSN into the clogging phenomena and the stances adopted by ASN have placed this issue at the forefront of the international stage. With a view to facilitating information sharing with its foreign counterparts, ASN and the OECD's Nuclear Energy Agency are organising a seminar devoted to this risk. This seminar will take place in Paris, on 4 and 5 December 2008.

ters do constitute an appreciable safety improvement as they significantly reduce the probability of sump filter clogging.

Finally, this change to the initial anomaly correction programme does not in any way compromise EDF's commitment to correction of the reactors most susceptible to the clogging phenomenon by 2007, and the other reactors concerned by 2009.

Steam generator clogging

The steam generators in certain 900 MWe and 1300 MWe reactors are experiencing high levels of clogging. This anomaly was rated 1 on the INES scale.

2 | 2 | 3 Review of events and feedback from reactor operations

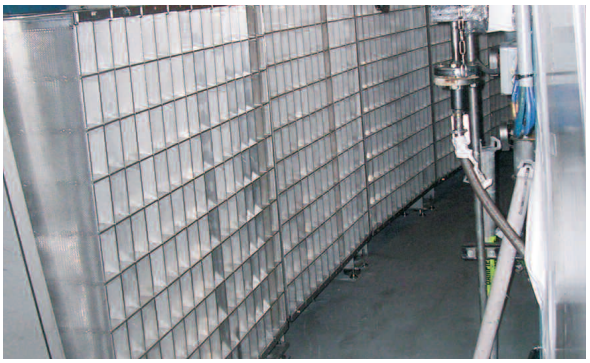
The general process for incorporating operating experience feedback

Operating experience feedback is a major source of improvement in terms of safety, radiation protection and the environment. This is why ASN requires that EDF notify it of significant events occurring in the nuclear power plants in service. Criteria for notification of the authorities were defined for this purpose in a document entitled "guide to notification procedures and the codification of criteria concerning significant events in terms of safety, radiation protection or the environment, applicable to basic nuclear installations and radioactive material transport". Each significant event is rated by ASN on the International Nuclear Events Scale (INES), which comprises eight levels from 0 to 7.

Both locally and nationally, ASN reviews all notified events. For certain significant events felt to be most important, because of their significance or their recurring nature, ASN carries out a more in-depth analysis.

ASN oversees how EDF utilises operating experience feedback from significant events and uses it to improve safety, radiation protection and environmental protection. During inspections in the nuclear power plants, ASN also reviews the organisation of the sites and the steps they take to deal with significant events and take account of operating experience feedback.

Recirculation sump filter



Close-up of recirculation sump filters

ASN also ensures that EDF learns the lessons from significant events that have occurred abroad and which can be transposed to the French nuclear reactors.

Finally, at the request of ASN, the GPR periodically reviews operating experience feedback from the operation of pressurised water reactors. The GPR met on 20 December 2007 to review the significant events during the period 2003-2005.

Significant events in 2007

In accordance with the rules for notification of significant events in terms of safety, radiation protection and the environment, EDF notified 764 significant events in 2007, rated on the INES scale, including 647 relating to safety and 117 relating to radiation protection.

The significant events declared with respect to environmental protection and which concern neither nuclear safety nor radiation protection, are not rated on the INES scale. Forty-eight significant events were notified in this respect in 2007.

Graph 1 shows the trends in the number of significant events notified by EDF and rated on the INES scale since 2003.

The total number of significant events rated rose slightly in relation to 2006 but has been essentially stable since 2005.

Graph 2 shows the trends since 2003 in the number of significant events per area concerned by the notification: significant safety events (ESS), significant radiation protection events (ESR), significant environmental events (ESE).

The graph shows a slight rise in the number of significant safety events, while the number of significant radiation protection events is stable in relation to 2006. The number of significant environmental events rose slightly to reach the level of 2003-2004. The proportion of the number of events in each area as compared with the total number of events notified has changed little.

The proportion of the number of significant events rated level 1 on the INES scale as compared with the total number of events rated in the year is about 7 %, down on 2006, with 54 safety events rated and 2 radiation protection events rated. The total number of events rated level 1 is down in relation to 2006.

The average number of events rated levels 1 and 0 per year and per type of reactor, varies according to the plant series, as shown in graph 4.

Significant safety event that occurred on 9 April 2007 on reactor 3 in the Dampierre nuclear power plant

Chronology of the event

On 9 April 2007, a significant safety event occurred on reactor 3 of EDF's Dampierre-en-Burly nuclear power plant.

Failure of an electrical protection relay led to loss of the electrical switchboard supplying the electrical equipment on reactor protection system train A.

Given that the trains A and B electrical equipment is redundant, train B remained available for the entire duration of the event.

In accordance with the operating rules specified for this type of situation, EDF reduced reactor power before uncoupling the unit from the off-site electricity grid.

However, a second failure then occurred on the uncoupling system, leading to total loss of the reactor equipment power supply from the off-site electricity grid, followed by automatic reactor trip.

Until the defective equipment was replaced and the train A switchboard power restored, reactor protection was provided by the train B backed-up electrical systems supplied by the corresponding electricity generating set. A gas turbine was also ready to take over if this generating set were to fail.

The event caused no radioactive release into the environment and ASN rated the incident level 1 on the INES scale.

ASN carried out a reactive inspection on the site on 13 April 2007. The inspectors looked at the causes of the event and the control procedures followed by EDF. The inspection revealed no anomaly in how the incident was handled.

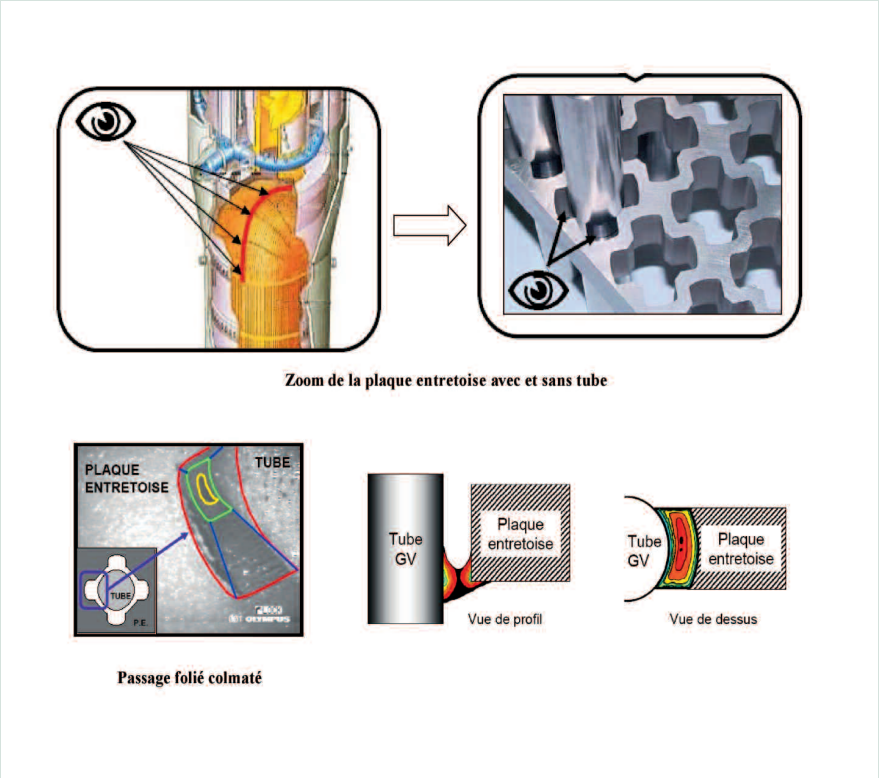
ASN decision concerning the steps to be taken by EDF following this event

Given the similarity between this significant safety event and the events involving the same protection relays that occurred in 2000 in the Tricastin and Dampierre-en-Burly power plants, and the programme of checks then defined by EDF for the CPY reactor series, ASN sent a number of demands to EDF in its decision 2007-DC-0051 dated 26 June 2007.

This decision in particular required that EDF undertake a programme of analysis and implementation of correc-

Steam generator clogging

The clogging phenomenon concerns the steam generator tube support plates in certain EDF reactors. It involves gradual blockage by oxide deposits of the passages between the tubes and the support plates, designed to allow circulation of the water (see diagram).



Steam generator clogging

This situation was brought to light by the investigation conducted following an event that occurred in February 2006 on the Cruas 4 reactor: a crack appeared on a steam generator tube and grew in a few months until a leak occurred between the primary and secondary systems. EDF is of the opinion that one of the key factors behind this crack is clogging of the upper tube support plates in the steam generator concerned.

At the request of ASN, the checks carried out by EDF were extended to cover the steam generators in the other 900 MWe reactors, on the occasion of their respective outages. High clogging levels were observed on a number of reactors, a fact that had not been anticipated by EDF. On the upper tube support plates of some of them, up to 80 % of the surface area of the water circulation passages is affected. EDF also estimates that clogging is progressing at a rate of about 5 % per year.

Of the 900 MWe nuclear power plants, EDF has identified those at Cruas and Chinon as those which at present have the highest clogging levels.

EDF will also be checking the hypothesis whereby certain reactors could be more susceptible to this phenomenon owing to a particular design or operating conditions. The chemical conditioning of the secondary system and the geometry of the tube support plates would indeed seem to be determining factors.

Steam generator clogging has a number of safety consequences:

– *it is probably the determining factor in the appearance of excessive tube vibration in certain steam generator zones, which can lead to rapid development of cracks, as happened in Cruas 4. EDF thus preventively blocked off a zone of fifty-eight tubes in the steam generators potentially concerned by the phenomenon;*

– it can induce considerable mechanical stresses on the steam generator internal structures, particularly in certain incident situations;

– it reduces the water circulation in the steam generators and therefore, for the same measured water level, leads to a reduction in the quantity of water available inside the steam generator. Water level oscillations can also occur in the steam generators in certain operating situations if the clogging levels are high.

ASN considers that EDF needs to continue work to refine its evaluation of the clogging levels and more precisely identify the consequences of this phenomenon for the reactors. ASN sent EDF a number of requests to that effect in 2007.

As the phenomenon is liable to affect certain 1300 MWe reactors, ASN asked EDF to carry out the appropriate checks. EDF initially estimated the clogging rate based on the evolution of certain operating parameters. ASN asked that these assumptions be validated by TV inspections, which required the development of specific tools. These inspections were carried out for the first time on the steam generators in the Saint-Alban 1 reactor.

For those reactors with the highest clogging levels, ASN asked EDF to propose a solution to reduce them. EDF opted for a steam generator chemical washing process. This consists in injecting a high-temperature chemical solution into the secondary part of the steam generators during an outage, thus dissolving the oxide deposits.

Owing to its environmental effects (ammonia releases in particular) and its potential impact on the equipment (corrosion of certain parts of the steam generator), this intervention must be examined beforehand by ASN whenever it is to be used. ASN in particular asked EDF to improve the procedure in order to minimise the associated releases.

Chemical washing was carried out in 2007 on the Cruas 4, Cruas 1, Chinon B4 and Saint Alban 1 reactors. It proved to be effective and significantly brought down clogging levels.

ASN also asked EDF to propose solutions to limit the appearance and development of oxide deposits. EDF envisages modifying the operating conditions of its reactors in order to minimise the clogging phenomenon.

In response to ASN's requests, EDF is completing and refining its analysis of the impact of clogging on the safety of the 900 MWe and 1300 MWe reactors. Pending completion of this analysis, ASN asked EDF to propose operating provisions appropriate to the clogging level of the steam generators.

tive action to limit the probability of this type of event happening again.

This programme in particular comprises in-depth analysis of the causes of the equipment failures behind the 9 April 2007 event (electrical switchboards protection relay), appraisals of the equipment involved, and a surveillance plan for this type of equipment on all the reactors in service. All these actions should enable EDF by June 2009 to define any changes to the equipment, maintenance or surveillance practices and, as necessary, optimise the stock of spares available in each nuclear power plant.

2 | 2 | 4 Periodic safety reviews

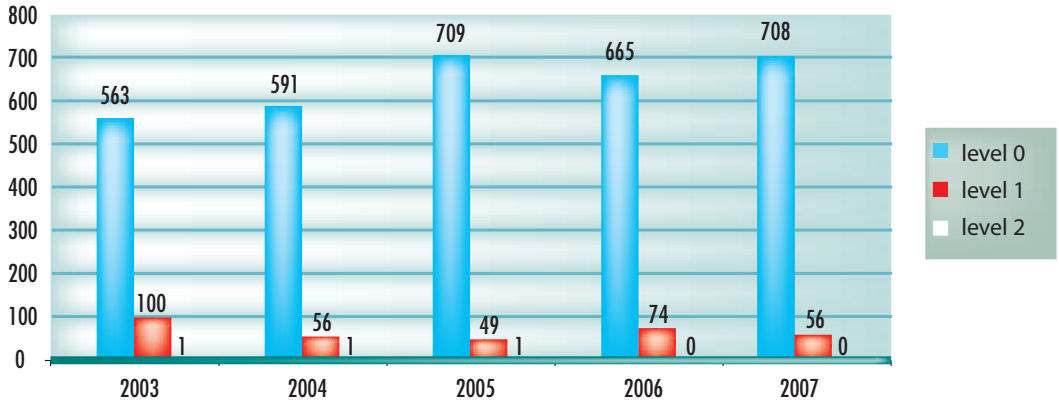
In France, the licensee is required to conduct a safety review on each nuclear power plant every ten years (III of Article 29 of the TSN Act). This review is an opportunity for in-depth inspection of the installations to check that they comply with all the safety standards. It is also an opportunity to compare the safety level of the installations with the more recent installations and to make the modifications considered to be necessary with a view to improving safety.

In this respect, the safety reviews are one of the cornerstones of ASN policy, which is to ensure that not only does the licensee maintain the level of safety of its installations, but also improves it.

The safety reviews therefore have two primary objectives:

– to compare the level of safety of the facilities with their initial "safety reference system" in order to identify any deterioration over time, as well as the faults and weaknesses of the safety analysis. This is the conformity review;

– to compare the safety of the facilities with the most recent safety standards, in order to improve the level of



Graph 1 : evolution of the number of significant rated events in EDF nuclear power plants from 2003 to 2007

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 system". Reactor ten-yearly outages (see section 1|2|3) are the opportunity for these modifications to be made.

For a given reactor series, 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 involves a proposal by the licensee, consultation of the GPR and adoption of a stance by ASN. Before the ten-yearly outage inspection associated with the reactor series safety review, ASN issues an opinion on the results of the approach, the acceptability of the new safety reference system and the continued operation of the reactors following the ten-yearly outage.

The twenty-year safety review for the 900 MWe reactors

Implementation of the modifications resulting from the safety review, which will be ongoing until 2010, continued in 2007 on the occasion of the second ten-yearly outages of the Gravelines 6 and Cruas 2 reactors.

The modifications made by EDF include 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 orientations of this safety review in 2003, ASN consulted the GPR at the end of 2004 and in the first half of 2005 with regard to the various study topics selected, including serious accidents, containment, fire, risks of explosion and the use of probabilistic safety studies. Subsequent to these consultations, ASN requested modifications and additional studies for possible design or operations changes. Implementation of the modifications arising from this safety review is scheduled for the third ten-yearly outages on the 900 MWe reactors, from 2009 to 2020.

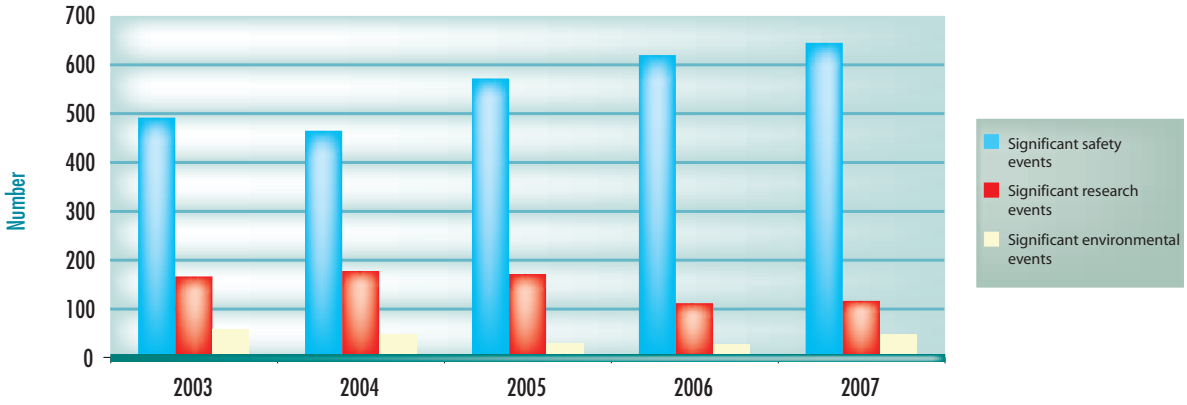
The twenty-year safety review for the 1300 MWe reactors

In 2006, subsequent to the safety review, ASN declared itself to be in favour of continued operation of the 1300 MWe reactors up to their third ten-yearly outage.

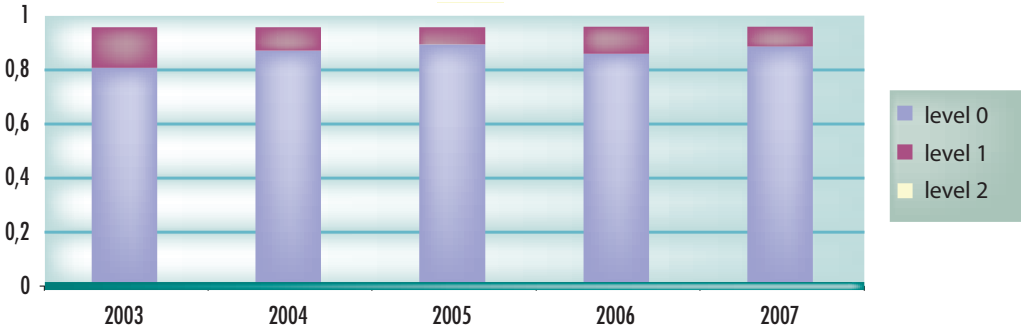
Implementation of the modifications arising from this safety review continued in 2007 on the occasion of the second ten-yearly outage of the Paluel 3 and Saint-Alban 1 reactors. It will continue on the other reactors until 2014. Of the modifications implemented by EDF, particularly noteworthy are those designed to improve the fuel handling operations during refuelling outages, or activation of the backup pumps from the control room if the reactor's off-site electricity supply is lost.

The ten-year safety review for the 1450 MWe reactors

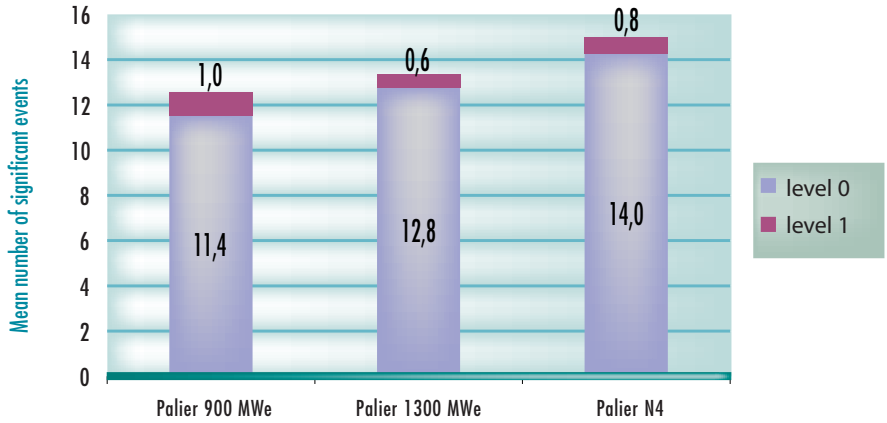
EDF has begun a safety review of the N4 series reactors and will present the conclusions in 2008. Implementation



Graph 2: evolution of the number of significant events per domain since 2003



Graph 3: evolution of percentage of significant events rated per level since 2003



Graph 4: mean number of significant events per year and per EDF reactor for the year 2007

of the modifications arising from this review is planned for the first ten-yearly outages of the N4 reactor series, which will start in 2009 and run until 2012.

2|2|5 Modifications to equipment and to operating rules

As part of the process of continuous improvement of reactor safety, but also to improve the industrial performance of its production tool, EDF periodically makes series of changes or specifically programmed modifications to equipment important for safety and to general operating rules. These changes can be the result of correction of nonconformities, periodic safety reviews, or to take account of national and international operating experience feedback.

Modifications to the equipment
In 2002, ASN set up a process to examine and approve these modifications, compatible with the reactor safety issues.

The first part of this process aims to adapt the level of examination of the hardware modifications to their importance for safety. Equipment changes are divided into three examination groups and only groups 1 and 2, which have the highest safety impact, are subject to prior ASN approval. With the publication of decree 2007-1557 of 2 November 2007, this practice will doubtless change.

The second part of this process specifies the nature of the information the ASN expects from the licensee by stipulating the content and transmission frequency of certain information documents associated with the modification file concerned.

In 2007, ASN approvals mainly concerned equipment changes made during the second ten-yearly outages of the 1300 MWe reactors and the first ten-yearly outages of the N4 series reactors.

Modifications made to the general operating rules (RGEs)
Documentary modifications, whether temporary (referred to as concessions) or permanent (referred to as amendments) and whether they concern a single reactor (local modification) or more than one (generic modification), are subject to review by ASN when they affect chapters III, VI, VII, IX or X of the RGEs, presented in section 1|2|2.

Before carrying out any such modifications, the licensee must send ASN a memorandum presenting the safety issues concerned.

Documentary modifications dealt with in 2007 are presented in points 3|1|1, 3|1|2, and 3|2|4.

2|3 Nuclear power plant ageing

Nuclear power plants, like all industrial installations, are subject to ageing. ASN's role in this area is to ensure that, in line with its general operating and maintenance strategy, EDF takes account of ageing-related phenomena in order to maintain a satisfactory level of safety throughout the life of the installations.

2|3|1 A relatively young population of nuclear power plants

Apart from the Chinese nuclear power plants, the French NPP population is the youngest in all the leading nuclear countries.

The nuclear power plants currently in operation in France were built in a relatively short space of time: 45 reactors, representing 50,000 MWe, or three quarters of the nuclear power plants, were commissioned between 1979 and 1990, and thirteen reactors, representing an additional 10,000 MWe, were commissioned between 1990 and 2000.

In December 2007, the average age of the reactors, calculated from the date of initial reactor criticality, is as follows:
– 26 years for the thirty-four 900 MWe reactors;
– 20 years for the twenty 1300 MWe reactors;
– 10 years for the four 1450 MWe reactors.

2|3|2 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
The design of a number of reactor components was based on a predetermined operating period. These components require close surveillance ensuring that their ageing rate is indeed as expected. This is particular the case with the reactor vessel, designed to withstand embrittlement of the core zone steel as a result of neutron irradiation for a period of 40 years (equivalent to 32 years of continuous operation at full power). The reactor vessel is checked by monitoring "control samples" of metal and appraising them at regular intervals (see point 3|4|3).

Deterioration of replaceable items
Equipment ageing is the result of phenomena such as wearing of mechanical parts, hardening and cracking of polymers, corrosion of metals, and so on. 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
Equipment that is important for safety is "qualified" for installation in nuclear power plants. The availability of spares for this equipment is heavily dependent on industrial production by the suppliers. Should the manufacturer cease to make certain components, or simply go out of business, this could create original part procurement problems for certain systems.

The safety level of any new spares must then be demonstrated prior to installation. This is to ensure that the equipment remains "qualified" with the new spare part. 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 acceptability of risk in our societies, 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 - closure at some time in the relatively near future.

2|3|3 How EDF manages 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. The periodic surveillance and preventive maintenance programmes, the conformity reviews (see point 2|2|1) and the review of operating experience feedback (see point 2|2|3) are designed to detect 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's 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, current practice – as confirmed by the TSN Act - is to require that the licensee conduct a safety review of its installation every ten years. The primary aim of this review is to ensure that the installation's safety level is continuously improved, but it is also an opportunity to conduct an extensive examination of the effects of ageing (see point 2|2|4).

In preparation for the 900 MWe reactors third ten-yearly outages, 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 response to this request, EDF drew up a programme of work concerning management of the ageing of its 900 MWe reactors. After consulting the GPR on two occasions, ASN asked EDF to make a number of additions to one programme, in particular with regard to the large-scale R&D resources available.

The 900 MWe nuclear reactors are the oldest French reactors still in service. Their third periodic safety review is now under way. The third ten-yearly outages corresponding to about thirty years of operation will be starting in 2009. During the course of these outages, which last several months, the reactor will be shut down and in-depth, extensive checks will be carried out. Based on the results of these checks, ASN will adopt a stance, reactor by reactor, with regard to their ability to continue operating beyond the third ten-yearly outage and for a period of thirty to forty years. As necessary, it could request intermediate checks before the forty year deadline.

More generally and in the European energy context, France ideally needs sufficient electricity supply capacity to enable the Government, should the situation so demand, to make a calm and pressure-free decision to shut down reactors for which the safety level is no

longer considered to be acceptable by ASN. A decision such as this could for example be made during the safety review mentioned above. It is therefore important that adequate preparation be made for renewal of the means of electricity generation, whatever the method of generation adopted, so that a situation never arises in which nuclear safety requirements conflict with the pressures of energy supply.

2|4 The EPR reactor

2|4|1 EPR safety options

ASN deems the safety of the reactors in operation in France to be satisfactory. However, it considers that the new generation of PWR reactors must be even safer.

Therefore, in 1993, the French and German nuclear regulatory bodies together set stricter safety objectives for the EPR (European Pressurized water Reactor) project, as part of an "evolutionary" design process taking advantage of the experience gained from the reactors in operation:

– the number of incidents must be brought down, in particular by improving systems reliability and taking greater account of human factors;
– the risk of core meltdown must be reduced even further;
– the potential radioactive releases from all conceivable accidents must be minimised.

Finally, owing to the operational experience acquired with the reactors in service, ASN also asked that the operational constraints and human factors aspects be taken into account as of the design stage, in particular with a view to improving worker radiation protection, limiting operational radioactive releases and minimising the quantity and activity of the waste produced.

The safety objectives set led the reactor designers to propose a number of improvements to the safety options, including, for example:

– concerning the reduced risk of accident, greater diversification and redundancy of equipment performing safety functions or a significant reinforcement in civil engineering of the nuclear island to offer greater protection against external hazards, including earthquakes, industrial explosions and aircraft crashes;
– concerning designed-in management of serious accidents, the positioning under the reactor vessel of a device specially designed to recover, contain and cool a molten core.

The review of the EPR project safety options came to an end in October 2000, with the GPR and corresponding German experts adopting a document entitled "Technical guidelines for the design and construction of the next generation of Nuclear Power Plants with Pressurized Water Reactors". These technical guidelines give a structured and ordered presentation of all the technical recommendations drafted by the French and German experts and ratified by ASN, throughout the safety options review process. They thus constituted the backbone of the technical reference system for the EPR project's authorisation licence review by ASN and IRSN.

These technical guidelines were officially finalised and made public in 2004 in a letter sent to the EDF Chairman, in which the public authorities stated that the safety options reviewed were felt to be satisfactory in the light of the stated goal of achieving an overall improvement in safety in relation to the nuclear reactors currently in service.

2|4|2 The Flamanville 3 reactor authorisation licence

On 9 May 2006, EDF sent the Ministers in charge of nuclear safety an authorisation licence application for an EPR type reactor on the Flamanville site, which is already home to two reactors.

Review of the authorisation licence application

The review was carried out in accordance with the provisions of the Environment Code and decree 63-1228 of 11 December 1963 concerning nuclear installations.

As required by the Environment Code, the *préfet*[1] of the Manche *département*[2] organised a local public inquiry from 15 June to 31 July 2006. On 12 October 2006, the *préfet* of the Manche *département* approved the project, based on the conclusions of the report from the commission of inquiry and the opinions expressed during the consultation of the administrative services of the Manche *département* and the municipal councils of the communes[3] located within a 10 km radius around the Flamanville nuclear site.

1. In a *département*, representative of the State appointed by the President.
2. Administrative region headed by a *Préfet*.
3. Smallest administrative subdivision administered by a mayor and a municipal council.

The national public debate ahead of the authorisation application

On 4 November 2004, EDF made preliminary contact with the National Public Debates Commission (CNDP) concerning the construction project, in accordance with the Environment Code. The Commission decided to hold a public debate, with a special committee given responsibility for organising it.

Nineteen public meetings, at which ASN was a participant, took place between 19 October 2005 and 18 February 2006 both in the area chosen for the site of the project and nationwide.

At the same time, two working groups were set up by the special committee: a first group looked at anticipated electricity requirements while a second group looked at defence confidentiality and access to information. ASN took part in the second group. The debate made it easier for the public to obtain information about the issues and objectives of the project. In its conclusions, the special committee considered that new methods of promoting the expression of expertise from a variety of backgrounds were required in order to develop the public civil nuclear debate.

Following the debate, on 14 September 2006, EDF released a public version of the project's preliminary safety case and placed it on its website. EDF also made a commitment to ASN to promote public information and the expression of opinions by experts with recognised competence on the Flamanville 3 reactor project, to analyse the observations designed to improve its operation, its safety and its impacts, and to take account of them insofar as is possible.

It was at the conclusion of the public debate that EDF submitted the application for the authorisation licence.

With the help of its technical support organisations (IRSN and GPR), ASN in September 2006 completed the safety review of the reactor project concerned by the application. ASN thus ensured that the data presented to support the application in the reactor preliminary safety case were in conformity with the regulations, the objectives and the technical safety guidelines defined in 2004 for the EPR reactor.

On 8 December 2006, the Interministerial Commission for Basic Nuclear Installations (CIINB) was consulted, in accordance with IV of Article 3 of decree 63-1228 of 11 December 1963, concerning the draft authorisation licence (DAC) prepared by ASN. Its opinion was favourable.

In accordance with Article 29 of the TSN Act, the ASN Commission reviewed the draft DAC for the "Flamanville 3" EPR reactor and approved it on 16 February 2007 (opinion 2007-AV-0016), on the basis of the fact that ASN:

– could identify no point compromising compliance with the general safety objectives;
– considers that the experience acquired on the reactors in service since approval of the EPR safety options has been satisfactorily taken into account;
– considers that the changes made in relation to the design of the reactors already in operation and intended to address industrial concerns, are acceptable in terms of safety;
– does not at this stage of the project call into question any of the main design choices for the large components of the main primary and secondary systems;
– identifies no significant non-radiological industrial risk for either the population or the environment.

This opinion of the Commission was based on a summary report from the ASN staff which was published in report ASN/DCN 0080-2007.

The authorisation licence (DAC) and the project's forthcoming regulation milestones

Following approval by the Minister for Health on 20 March 2007, DAC 2007-534 was signed on 10 April 2007.

The DAC specifies that reactor commissioning, corresponding to initial loading with nuclear fuel, must take place within ten years and that both this step and the introduction of nuclear fuel inside the installation, require authorisation from ASN.

Without waiting for transmission of the complete commissioning application file, expected for the end of 2010, ASN and IRSN have already begun an advance review of certain topics that will be lengthy and time-consuming, such as the accident study methods used in the safety case or the reactor control principles to be adopted in the RGEs.

While conducting this advance technical review in preparation for the commissioning application, ASN is also overseeing construction of the installation and manufacture of the nuclear pressure vessels.

2|4|3 Construction oversight

ASN carries out its nuclear safety and radiation protection regulation and inspection duties at all stages in the life of a BNI, including during construction.

The checks carried out in 2007

In July 2006, EDF began preparatory work for the construction of the Flamanville 3 EPR reactor. This work mainly consisted of earthworks, mining and laying of infill and blinding concrete.

Once the DAC was granted in April 2007, EDF began building, with the main work being construction of the reactor building inner containment pre-stressing gallery and pouring of concrete for the nuclear island raft.

Site management to ensure the safety of the neighbouring reactors in service

Ahead of each work phase on the site, ASN and its technical support organisation IRSN conducted an analysis of the safety risks involved for the two reactors in service in the Flamanville nuclear power plant.

All the analyses submitted so far by EDF have been judged to be satisfactory on the whole, apart from the risk of falling of the very high cranes. On this point, ASN asked EDF to reconsider certain scenarios in its analysis and to delay the planned erection of certain cranes. Following a review of the new risk analysis forwarded by EDF, ASN was able to authorise this erection to proceed.

Flamanville 3 construction site

In addition to this documentary review, ASN also carried out inspections to check correct implementation of the remedial measures defined in the risk analyses or required by ASN and IRSN further to their review.

ASN considers that implementation of the remedial measures and management of the interfaces between the Flamanville 3 reactor site and the nuclear reactors in service do not meet some of the requirements stipulated. Anomalies were identified with regard to incorporation of operating experience feedback from the first phase of work as well as in the organisation between the site and the nuclear reactors in service. Even if most remedial measures were indeed implemented, ASN is of the opinion that EDF needs to further improve some of them and carry out surveillance.

An exercise simulating an accident on a reactor in service in the Flamanville nuclear power plant was held on 27 November 2007. This exercise was an opportunity to test coordination between the worksite teams and those of the Flamanville nuclear power plant, for implementation of the on-site emergency plan. In ASN's opinion, the 800 people present on the site on the day of the exercise were mustered within a reasonable time. Furthermore, the distribution of roles among the various parties was effective. However, areas for improvement were identified as a result of this exercise, such as improving the alert systems on the worksite and increasing the capacity of the muster points on the worksite, given that the size of the workforce is scheduled to increase.

Oversight of construction work

In 2007, in the light of the activities ongoing on the worksite, ASN oversight primarily concerned civil engineering aspects. Nine inspections were performed in 2007:

– seven inspections on the site, including one to check first pouring of the concrete for the nuclear island raft;
– two inspections in the engineering departments in charge of carrying out the detailed design studies.

For ASN, the quality of the preparatory work and initial construction of the Flamanville 3 reactor is on the whole satisfactory. However, as a result of the checks carried out in 2007, ASN believes that EDF must give greater priority to guaranteeing quality rather than meeting the schedule. Moreover, although the technical competence of the workforce is satisfactory, ASN considers that EDF needs to improve its safety culture.

Regulation of nuclear pressure vessel manufacture

In 2007, regulation of the manufacture of nuclear pressure vessels concerned the equipment of the main primary and secondary systems. Ten inspections were carried out by ASN at the manufacturer AREVA-NP and its

An inspection team on the Flamanville 3 construction site

Concreting the nuclear island

subcontractors in France and abroad. A large number of files concerning the supply of forged components (vessel, steam generator and primary piping elements) and castings (primary pump casings) requiring technical qualification were reviewed.

Conventional safety inspection on the Flamanville 3 reactor construction site

Conventional safety inspection on the EPR worksite was carried out during the preparatory work phases, up until signing of the DAC by the departmental directorate for labour, employment and professional training of the Manche *département*. Since 10 April 2007, conventional safety inspection has been the responsibility of ASN's Caen division. The action taken consisted in:

- participation in the meetings of the inter-companies health, safety and working conditions commission;
- performance of safety inspections on the site;
- review of labour accidents on the site, in particular those involving temporary staff.

2|4|4 Cooperation with foreign nuclear regulatory bodies

Rising demand for bilateral cooperation

After China and Canada and 2005, ASN this year had to respond to increasing pressure for it to share its experience of safety requirements for new reactors and

Defining regulatory policy

In November 2007, the Commission – which is responsible for defining ASN regulatory policy – approved the regulatory principles and procedures for construction of the "Flamanville 3" EPR reactor presented by the ASN departments.

Through its regulatory procedures, ASN will ensure that those in charge of construction (the installation licensee and the nuclear pressure vessels manufacturer) fully meet their responsibilities and are in full control of:
- *the conformity of the detailed design studies;*
- *the conformity of the equipment or installation construction activities, in order to assess the quality of the overall building process;*
- *the impact of the work site on the safety of neighbouring BNIs;*
- *conventional safety inspection duties.*

The construction checks implemented by ASN will be proportionate to the safety issues and will involve spot-checks and the technical expertise of IRSN or any other third-party organisations necessary. These checks will involve a documentary review and a programme of inspections covering the activities of the engineering services, the work site and the manufacturers.

A dedicated team of inspectors will support the Caen division, so that the worksite activities can be inspected on average every two weeks.

licensing procedures for new installations. In 2007, ASN and IRSN therefore took part in bilateral meetings with the nuclear regulatory bodies of Bulgaria, India, South Africa and the United Kingdom.

In the case of the United Kingdom, increased bilateral cooperation on new reactors led in 2007 to the secondment of a British inspector to ASN for a period of several years, in order to take part in oversight of the construction and design assessment of the Flamanville 3 EPR project.

Towards multinational cooperation

Owing to the EPR reactor construction projects at Olkiluoto in Finland and Flamanville in France, ASN and IRSN in 2004 set up enhanced cooperation with the Finnish nuclear regulatory body (STUK). On this point, it is worth noting the meeting in 2007 between STUK and the ASN Commissioners, who were able to visit the Olkiluoto worksite on this occasion.

This cooperation between France and Finland on the EPR was broadened in 2006 to include the American Nuclear Regulatory Commission (NRC), which had received a pre-certification application for an EPR type reactor from an industrial group, followed by a final certification application in 2007.

Given the renewed interest in the development of new nuclear power generating reactor construction projects around the world, this tripartite cooperation between regulatory bodies concerning the EPR is now part of a more general multinational cooperation programme for new reactors proposed by the NRC and known as the MDEP (Multinational Design Evaluation Program).

Other nuclear regulatory bodies involved in this project have expressed their desire to take part in the exchange meetings concerning EPR type reactors in 2008.

2|5 Reactors of the future: generation IV

Although one could legitimately expect generation IV reactors to incorporate safety improvements over today's reactors, ASN considers that it would be premature at present to look to define the required safety objectives for these future reactors, which will not enter service for another few decades.

ASN intends in the coming years to monitor the areas of research into the safety of these projects and the reasons for which the designers chose these areas over any others. A system of exchanges between ASN, IRSN and the French stakeholders in the "Generation IV International Forum" (CEA, AREVA and EDF) will therefore soon be organised to deal with the orientations of research into the safety of the new reactor projects.

2|6 Nuclear safety and radiation protection research

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 processes for operation and maintenance; these solutions replace techniques or intervention methods which offer a lesser degree of protection;
– certain research work aims to improve knowledge of the risks, in order to better target protective measures or even spotlight risks that had hitherto been poorly assessed: this is for example the case with experiments concerning the phenomenon of sump clogging, or studies into individual and group behaviour in stressful situations, leading to an improved evaluation of the role of human and organisational factors;
– 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.

Knowledge of the latest research findings and those questions which still remain unanswered enable the regulatory bodies to measure how realistic their demands really are. ASN therefore keeps abreast of ongoing research work to ensure that its demands are pertinent. The ability of the regulatory bodies, or their advisory expert organisations, to control the direction in which research is going, enables them to look again at safety issues that were assumed to be resolved: for example, interpretation of the experiments conducted by IRSN led to a review of the sump clogging risk.

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. ASN therefore asked EDF to send it its annual budgets and workforce numbers allocated to research, with a view to monitoring trends. ASN's findings today show that EDF's budget in this field has remained at a high level, even if there has been a slight downward trend for a few years. It also observes with satisfaction that research in this area is still driven by a number of factors:
– new reactor projects: the research work initiated for the EPR reactor led to the development of new technical solutions, some of which could be implemented on the existing reactors;
– the desire of industry to improve the performance of its tools: for example, EDF's intention to increase

nuclear fuel performance in particular generated work on uranium oxide ceramics, cladding materials and the design codes. This work is also a means of advancing the store of available knowledge and, in certain cases, enhancing safety, for example by improving accident study methods;

– 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 operating experience feedback from incidents; for example the research into the risk of flooding or modelling of oil slick drift.

3 NUCLEAR POWER PLANT SAFETY

3|1 Operation and control

3|1|1 Normal operating conditions

Technical operating specifications (STEs)

The RGEs include reactor technical operating specifications (STEs) (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 condition 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 required to modify the STEs to take account of operating experience feedback, improve safety, improve economic performance or even incorporate equipment modifications.

In 2007, ASN reviewed a number of documents modifying the STEs, which were approved or are the subject of additional justification requests. These include:
– a new version of the STEs for the CPY series, that is *palier technique et documentaire n° 2*;
– an amendment document concerning surveillance of the neutron power azimuth imbalance;
– an amendment document for the N4 series linked to implementation of the new ALCADE fuel management.

ASN also continued with its review of several other files, including one amending the conditions for opening of the equipment access hatch and changes to the calculation of the minimum required exchange capacity of the RRI/SEC exchangers during heat waves.

Temporary STE modifications

When, in exceptional circumstances, EDF has to deviate from the normal operation required by the STEs, during an operating phase or particular intervention, it has to submit a waiver request to ASN, which will then analyse the request and may either accept it or impose additional compensatory measures if it feels that those proposed by the licensee are inadequate.

ASN remains vigilant regarding the number of waivers and carries out a detailed analysis every year, on the basis of data produced by EDF. EDF is therefore required:
– periodically to re-examine the reasons for the waiver requests in order to identify those which would justify permanent modification of the STEs;
– to identify "generic" waivers, in particular those linked to implementation of national modifications and periodic tests.

155 waivers were reviewed in 2007, including 12 that were generic.

Field inspection of normal operation

During nuclear power plant reviews, ASN checks:
– compliance with the STEs and, as necessary, with the remedial measures associated with the waivers;
– the quality of the normal operating documents, such as the operating instructions and alarm sheets, and their consistency with the STEs;
– staff training in reactor operations.

3|1|2 Incident or accident operations

The condition-based approach (APE)

In the event of an incident or accident on the reactor, the personnel have operating documents at their disposal, designed to enable them to return the reactor to and maintain it in a stable condition.

The steps to be taken in the event of an incident or accident use the condition-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.

These operating documents are drafted on the basis of the incident and accident response rules contained in chapter VI of the RGEs and which have to be approved by ASN.

During 2007, the ASN continued to review changes to the operating rules proposed by EDF and in particular approved:
– the amendment file for implementing ALCADE fuel management on the N4 series reactors;
– the amendment file for implementing the future GALICE fuel management on the 1300 MWe reactors;
– documentary amendments to take account of various equipment modifications.

2007 was also marked by a review of the on-site emergency plan (PUI) trigger criteria for radiological safety reasons. This work is designed to guarantee that EDF's national PUI reference system is consistent with the PUI trigger criteria contained in the instructions in chapter VI of the RGEs.

Following on from the "incident or accident response" (CIA) project, ASN this year reviewed the "simplified use of the water level in the reactor vessel" policy. The amendments to the operating rules will be reviewed in 2008 in accordance with this policy. Similarly, the work done during the course of this project to look at the interfaces between APE operations and the national emergency response organisation were formalised in an EDF policy memorandum, approved by ASN.

Finally, ASN and its technical support organisation worked together with EDF on formalising chapter VI of the RGEs. This work led to harmonisation of the various RGE chapters and uniformity between chapter VI of the RGEs in use in the various nuclear power plants.

Regular inspections are organised on the subject of incident and accident operation. These inspections in particular review the management of the chapter VI 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. On the basis of the inspections conducted in 2007, ASN feels that adoption by the sites of the incident or accident operations rules is on the whole satisfactory.

Reactor operation in severe accident situations

If the reactor cannot be brought to a stable condition after an incident or accident and/or the scenario resulting from a series of failures leads to 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). In 2006, EDF completed transcription of the GIAG into operator documents for all plant series. The documents produced are intended for use by the control teams, staff on duty in the nuclear power plant and by the local and national emergency teams.

The GIAG and its upgrades are currently being reviewed by ASN and its technical support organisation.

Since the end of 2006, ASN has also carried out inspections concerning the GIAG in EDF head offices and on the sites.

During the inspection at EDF head offices, ASN appreciated the considerable work done on the subject in just a few years: updating of the study memorandum on all the plant series, transcription into operator documents, implementation of these documents on all the nuclear reactors and with all the local and national emergency teams, training in use of the documents. ASN did however note the need for a more formal document drafting and verification process.

The site inspections showed that the operator documents are correctly incorporated into the local reference systems but that they do not always include the most recent study memoranda.

Finally, ASN asked the GPR in 2008 to review the progress of work devoted to serious accidents. The main subjects to be tackled are the serious accident reference system, the operating options concerning water injection, use of the releases filtration system, the risk of sump clogging and the measures to prevent contamination via the water table.

3 | 2 Maintenance and testing

3 | 2 | 1 Maintenance practices

Since the mid-1990s, EDF has been implementing a policy to reduce the volume of maintenance work (RVM project). Its aim is to boost the competitiveness of its nuclear power plants, while maintaining the same high level of safety. This chiefly involves focusing the maintenance effort on equipment which, if it were to fail, would entail the highest safety, radiation protection or operational risks.

As is already the case in the aeronautical industry and in the military, EDF therefore developed the reliability-centred maintenance optimisation method (OMF) which, based on a functional analysis of a given system, can be used to define the type of maintenance required according to the contribution of its potential failure modes to the safety, radiation protection or operational risks. ASN felt that the principles underlying the OMF approach did not lead to a reduction in safety.

In order to take account of operating experience feedback on the sites, EDF made changes to the OMF method. These changes, for example, now enable redundancy loss and common cause failures to be dealt with, along with failure modes that cannot be detected from the control room.

Following on from the RVM project, and benefiting from the standardisation of its nuclear power generating reactors, EDF is currently deploying the concept of "pilot item" maintenance. This type of maintenance aims to take advantage of the creation of uniform technical families of similar equipment operated in the same way in all the nuclear power plants. EDF considers that 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.

ASN is closely monitoring how EDF takes account of operating 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. In the more general context of ageing power plants, ASN therefore wishes to see a detailed review of EDF maintenance policy and its implementation by the sites. A meeting of the GPR was therefore scheduled for March 2008.

3 | 2 | 2 Qualification of scientific applications

The scientific applications contributing to the safety cases are subject to the requirements of the order of 10 August 1984 mentioned in point 2|2|1 of chapter 3. One of the key requirements is qualification, which consists in ensuring that the application can be used in complete confidence within a specific field.

In 2007, ASN continued its analysis of the scientific applications used by EDF, particularly for assessment of the loadings applied to the fuel assemblies in the reactor core and the accident studies. ASN also initiated a review of the applications which will be used in the EPR reactor studies.

Furthermore, ASN is continuing its work aimed at defining the principles and methods to be used for the qualification review of the computer codes used in the safety case demonstrations.

3 | 2 | 3 Qualification of inspection methods

Article 8 of the order of 10 November 1999 specifies that the non-destructive test processes used for in-service monitoring of nuclear reactor primary and secondary systems must, before they are used, undergo qualification by an entity chosen by the licensee, of proven competence and independence.

Ultrasound inspection of a welded joint

This entity, called the qualification commission, received accreditation by the French accreditation committee (COFRAC) in 2002, followed by renewal in 2006.

It assesses the representativeness both of the mock-ups used for the demonstration and the faults introduced into them. On the basis of the qualification results, it confirms that the performance of the examination method is as expected. A description of the qualification process was also codified in the RSE-M code. As applicable, this entails either demonstrating that the inspection technique used is able to detect a deterioration described in a specification, or explaining 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 granted transitional periods of varying lengths for implementation of their respective programmes.

The French aim was to qualify all the non-destructive testing processes used for the operational inspection programmes. The 144 processes were grouped into 76 qualification dossiers, based on technical similarities. At the end of 2007, all the processes were declared as qualified. At present, new processes are being developed and qualified in order to meet new requirements. The Flamanville 3 EPR project anticipates requests for qualification of 42 applications (12 new applications and 30 existing applications to be adapted) by the time of the pre-service inspection scheduled for the summer of 2010.

3 | 2 | 4 Periodic tests

In order to check the correct operation of equipment important for safety and the availability of the back-up systems that would be called on in the event of an accident, tests are periodically conducted in accordance with the programmes of chapter IX of the RGEs.

In 2007, ASN continued to review the periodic test programmes, which led in particular to approval of the following:
– the periodic test programmes of the "PTD Lot VD2" technical and documentary level for the CP0 series reactors;
– the periodic test programmes of the "PTD EFP" technical and documentary level for the N4 series reactors;
– the test programmes linked to deployment of the ALCADE and MOX-parity fuel management systems.

ASN also initiated review of the design policy for the EPR series periodic tests.

At the same time, ASN is regularly called on to issue rulings on requests for amendments to the periodic test programmes.

3 | 3 Fuel

3 | 3 | 1 Fuel management trends

In order to enhance the availability and performance of reactors in operation, EDF, together with the nuclear fuel industry, 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. As a result of the operating experience feedback from the fuel management review conducted, ASN in 2006 revised the management review procedures, particularly in terms of the technical content of the various phases of this review.

In 2006, EDF applied for authorisation to insert MOX fuel into Gravelines reactors 5 and 6. ASN reviewed the modification to the DAC for these installations which did not originally cover the use of MOX fuel. The DAC for Gravelines reactors 5 and 6 was modified in November 2007.

MOX-parity

MOX-parity management concerns the twenty-two 900 MWe reactors authorised to recycle plutonium. It is characterised by:
– increased burnup fraction of the MOX fuel assemblies as a result of the greater number of irradiation cycles (four cycles in the reactor instead of three);
– changes to the initial plutonium content (average of 8.65 % instead of 7.1 %).

This management is a means of keeping the quantities of plutonium generated by the French nuclear power plants under control.

In 2006, ASN finalised the review of this fuel management and considered that it could be used.

GALICE

As of 2008, EDF envisages replacing the existing GEMMES management, operational on the twenty 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.

In 2007, ASN continued its technical review of this fuel management.

ALCADE

ALCADE management concerns the four reactors of the N4 series. It is characterised by:

– increased length of the operating cycles from 12 to 17 months;
– increased uranium 235 enrichment of the assemblies to 4 %. Maximum fuel burnup nonetheless remains unchanged at 52 GWd/t.

In 2007, ASN finalised the review of this fuel management and considered that it could be used.

3 | 3 | 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 assemblies

Since 2005, ASN has authorised the use of AFA3GlrAA fuel assemblies (M5 alloy cladding and structure) for a period of three operating cycles in three 1300 MWe reactors (Cattenom 3, Golfech 2 and Nogent 2) and for a period of four cycles in the four reactors of the N4 series (Chooz B1, Chooz B2, Civaux 1 and Civaux 2).

Acquisition of operating experience feedback and characterisation of tightness defects that appeared on some of these assemblies, led EDF to take steps to improve the manufacturing process for the rods making up the assemblies used as of 2007, in order to reduce the incidence of cladding tightness defects.

WESTINGHOUSE RFA fuel assemblies

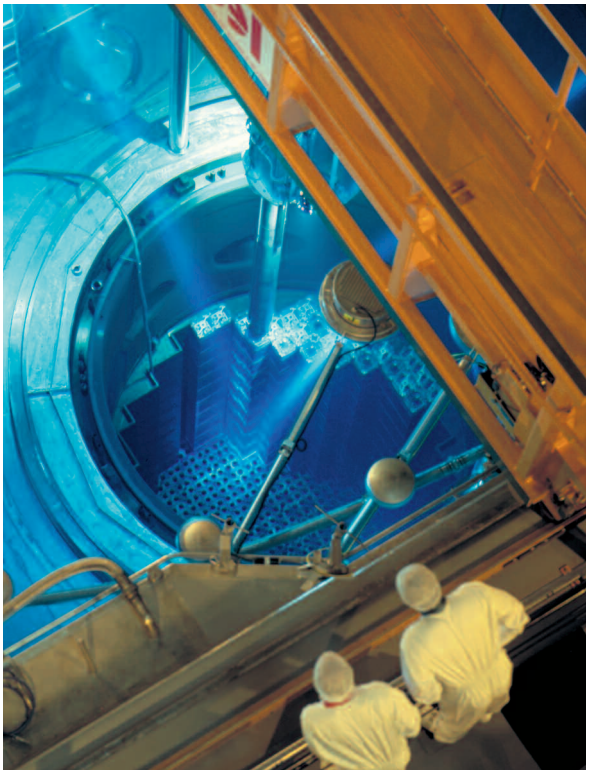
Westinghouse RFA type fuel assemblies are characterised by technologies for holding the rods in their skeleton assembly which are different from those used by AREVA. In 2006, ASN authorised the introduction of RFA type fuel reloads into the 900 MWe reactors.

In addition, based on the data presented by EDF and the satisfactory operating experience feedback, ASN in 2006 authorised general use of the RFA Zirlo assembly on the 1300 MWe reactor series. Similarly, in 2007, ASN authorised general use of the RFA Zirlo assembly on the CPY reactor series. These assemblies are characterised by the use of Zirlo alloy as the fuel rod cladding and assembly structural material.

3 | 3 | 3 Fuel handling operations

Fuel handling 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 pond and that in the reactor building, so that they can be positioned in the reactor vessel in accordance with a predetermined plan and pre-defined reloading sequences.

In 2007, ASN reviewed the steps taken by EDF to limit the risk of a loading error and make fuel assembly handling operations more reliable. ASN noted that the technical and organisational steps taken by the sites vary



Fuel handling in the reactor vessel

widely. It asked EDF to ensure that the steps guaranteeing the best level of safety be implemented on all reactors except when technically impossible.

3|4 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 fundamental safety functions - confinement, cooling, reactivity control - they are the subject of extensive surveillance and maintenance by EDF and in-depth monitoring by 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.

On the whole, the ASN feels that the condition of the CPP and CSP in the French nuclear power reactors give no cause for concern in the short term but that the known ageing and deterioration phenomena need 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|4|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.

Owing to the uniformity of French nuclear reactors, EDF has chosen to arrange these reference files in "series" for all the reactors in each series (CP0, CPY, P4, P'4 et N4) and to break them down into "reactor" files for each individual reactor. Each "reactor" file in particular contains data concerning maintenance, faults and events that have occurred on this reactor.

Transient bookkeeping

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 keep track in its documentary system of those transients actually experienced by the NSSS main systems. The purpose of transient bookkeeping is to ensure that the safety margins are maintained throughout the life of the reactor.

Between 2002 and 2007, ASN carried out a series of inspections in order to obtain an overall picture of how EDF performed this activity. ASN observed an improvement over the period 1995-1997 but considers that continued efforts are needed.

With regard to dealing with the authorised number of transients being exceeded, an update of the reference files is planned before the third ten-yearly outages scheduled as of 2009 for the 900 MWe reactor series. This incorporation of operating experience feedback concerning transient bookkeeping is an important factor to be taken into account when demonstrating the ability of these reactors to continue to function beyond thirty years.

Updating of the reference files is also scheduled before the first ten-yearly outages scheduled as of 2009 for the N4 reactor series.

3|4|2 The use of nickel-based alloys

Several parts of a pressurised water reactor are made from nickel-based alloys: tubes, partition plate, primary side coating of the steam generators tubesheet, vessel closure head adapters, vessel bottom head penetrations, vessel internals lower guide support welds, repaired vessel nozzle areas.

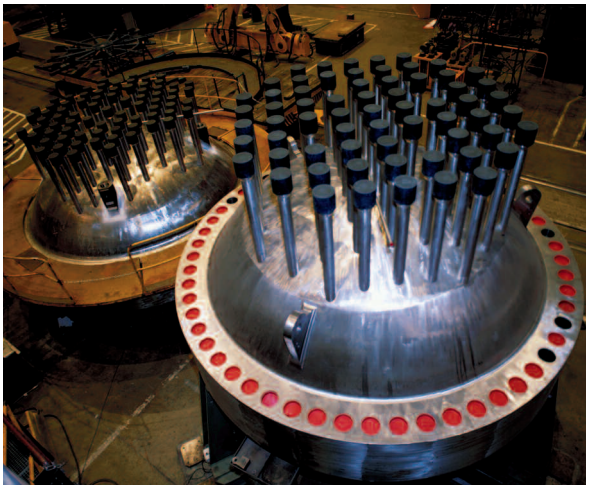
The use of this type of alloy is justified by its resistance to generalised or pitting corrosion. However, in reactor operating conditions, one of the alloys adopted, Inconel 600, proved to be susceptible to stress corrosion. This particular corrosion phenomenon occurs when there are high levels of mechanical stress. It can lead to the appearance of cracking, sometimes rapidly as seen 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.

ASN asked the licensee to adopt an overall surveillance and maintenance approach for the zones concerned. Several main primary system zones made of Inconel 600 alloy are thus subject to special surveillance. 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 point 3|4).

Following the 2004 discovery of cracks attributed to stress corrosion on the partition plate of a steam generator (plate separating the hot leg from the cold leg in the primary part of a steam generator) not initially considered by EDF to be susceptible to this type of damage and following international operating experience feedback, ASN asked EDF to adapt its overall maintenance strategy of Inconel 600 zones to take account of this damage. All the 900 MWe reactor steam generators equipped with an Inconel 600 partition plate will therefore be inspected before their third ten-yearly outage. EDF qualified an automatic tool for inspecting the weld on the partition plate stub (part located between the partition plate and the tube sheet of a steam generator) and is currently developing repair tools. Checks carried out in 2007 on the partition plates again revealed indications of stress corrosion cracking with a cumulative length of 2 m and depths of several millimetres.

3|4|3 Reactor vessels

The vessel is one of the essential components of a PWR. This component, 14 m high and 4 m in diameter, with a thickness of 20 cm, contains the reactor core and its instrumentation. The 300 t vessel is entirely filled with water in normal operation and can withstand a pressure of 155 bar at a temperature of 300 °C.



Vessel and vessel head during manufacture

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.

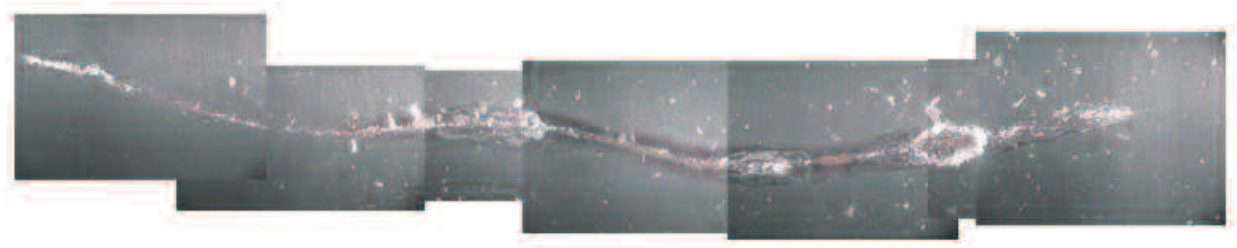
In normal operation, the vessel deteriorates slowly, under the effect of the neutrons resulting from the core fission reaction, which embrittles the metal. This embrittlement makes the vessel particularly sensitive to pressurised thermal shocks or to sudden pressure surges when cold. This susceptibility is also aggravated when defects are present, which is the case of some of the 900 MWe reactor vessels, which comprise manufacturing defects under their stainless steel liner.

To protect against all risk of rupture, 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 removed for mechanical testing. The results give a good picture of the ageing of the vessel metal and can even be used to anticipate it, inasmuch as the capsules located near the core receive more neutrons than the metal of the reactor vessel;
– periodic checks, in particular ultrasonic checks to verify that there are no defects or, in the case of vessels containing manufacturing defects, to check that they are not getting worse.

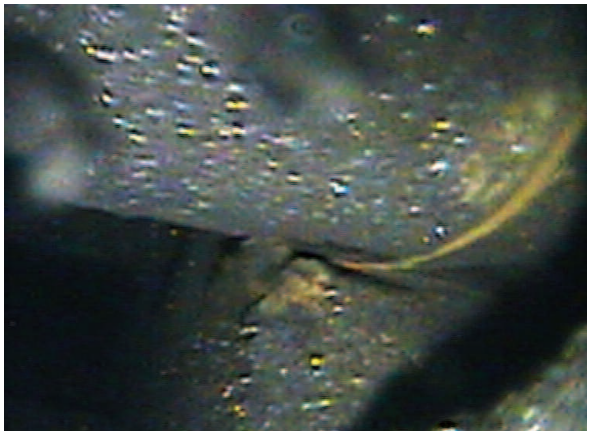
ASN reviewed the files concerning the in-service strength of the reactor vessels forwarded by EDF in preparation for the third ten-yearly outages of the 900 MWe reactors. These files were presented to the experts of the nuclear standing section (SPN) of the Central Committee for Pressure Vessels in 1999 and then in 2005. ASN is today reviewing the answers provided by EDF to the questions raised at this later session. Subsequent to this review and in the light of the results of the inspections made during the third ten-yearly outages on the reactors, ASN will adopt a stance on the conditions for vessel operation beyond thirty years.

3|4|4 Steam generators

LThe 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 bund-



Cracked tube internal view



Cracked tube external view

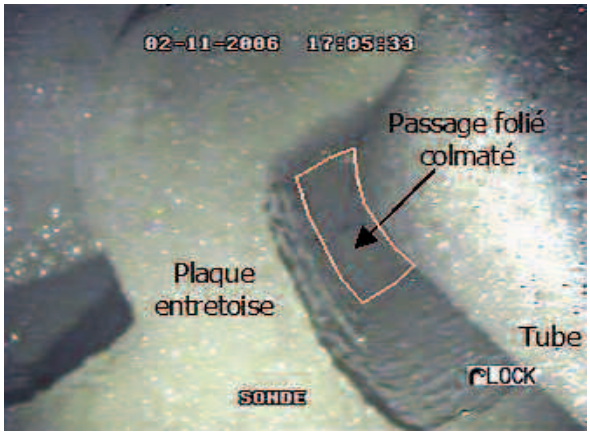


Illustration of clogging

le 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: corrosion, wear, 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 reviewed by ASN in 2003 and accepted by decision n° 030472 on 1 December 2003. 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. At the end of 2007, ten of the thirty-four 900 MWe reactors will still be equipped with steam generators containing Inconel 600 alloy based tube bundles which have not undergone heat treatment (600 MA), these being the main ones affected by stress corrosion cracking (see point 3|4|2).

In addition to in-service surveillance, the steam generators undergo hydrostatic testing every ten years, as part of the reactor ten-yearly outage inspection programme (see point 1|2|3): the primary system undergoes an overall strength test at a pressure in excess of 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, 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 ten 900 MWe reactors still equipped with Inconel 600 MA tube bundles no later than the third ten-yearly outage. At the same time, EDF defined preventive tube plugging programmes and is continuing with study and assessment of the 900 MWe and 1300 MWe reactors equipped with steam generators containing heat treated Inconel 600 alloy (600 TT) tube bundles. This has been under way since 2005 in order to gain a clearer understanding of their behaviour during hydrotesting and determine means of preventing leaks during the tests.

During the night of 11 February 2006, a major leak between the primary and secondary systems reached a flow rate of 500 litres per hour and led to the shutdown of the Cruas 4 reactor. This incident was rated 1 on the INES scale.

The investigations carried out by EDF determined that the leak came from a fault in the upper tube support plate on steam generator 2. Two similar events, but which led to far smaller leaks, had already taken place at Cruas.

The extremely rapid dynamic of this defect, which appeared and grew in less than three months after more than twenty years of operation, indicates a new deterioration phenomenon based on vibration fatigue, probably linked to the design of the steam generator and a high level of upper tube support plate clogging. Eleven other reactors equipped with steam generators of the same design could be likely to experience the same phenomenon.

EDF implemented a programme of preventive maintenance and inspections. At the same time, the licensee is actively seeking to precisely establish the origin of the phenomenon and is drawing up a strategy for preventing it throughout the reactors concerned.

Finally, so that a steam generator tube rupture could be diagnosed as early as possible and until such time as definitive data becomes available, EDF asked that an appropriate instruction be implemented on the eighteen reactors equipped with the more susceptible steam generators, in order to detect a developing primary/secondary leak as early on as possible.

Since August 2004, failures of various origins have led to rapid closure of the main steam isolation valves on the main secondary systems (CSP) on ten occasions. Three of these occurred during the first half of 2007 on the Cattenom 1, Fessenheim 2 and Flamanville 1 reactors. The consequence of these events was to increase the pressure in the secondary systems, which was limited by opening of the system protection relief valves.

Given that the valves were adjusted to a pressure higher than the design pressure of the equipment they protect, this equipment underwent an evaluation of the impact of these loadings on the various CSP equipment zones. Analysis of the causes of these failures led EDF at the end of March 2007 to implement preventive inspection and maintenance measures on all its reactors, with a view to limiting their occurrence. At the same time, EDF is envisaging a design review of this equipment so that it can be made more reliable in the longer term.

3|5 Containment

The containments undergo inspections and tests to check their conformity with the safety requirements. Their mechanical performance in particular must gua-

Flamanville (Manche) nuclear power plant

rantee a good degree of reactor building tightness, in the event of its internal pressure exceeding atmospheric pressure, which can happen in some types of accident. This is why these tests, at the end of construction and then during the ten-yearly outages, include a pressure rise up to the inner containment design pressure.

The results of the ten-yearly outage tests for the 900 MWe reactor containments have so far shown leak rates that comply with the regulations. Their ageing was reviewed in 2005 as part of the 30-year periodic safety review, to assess their 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 results of the ten-yearly outage tests on the 1300 MWe and 1450 MWe reactor containments showed that the leak rate from the inner wall of some of these containments was rising. This was primarily the result of the combined effect of concrete deformation and the loss of pre-stressing of certain cables. Although account was taken of these phenomena at the design stage, they were sometimes underestimated. Consequently, in the event of an accident, certain wall areas would be liable to crack, leading to leaks. To combat 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 from the GPR convened to discuss this subject in early 2002, ASN gave EDF its approval of the strategy. This work is done at each ten-yearly outage. At the end of 2007, the associated work had been completed on thirteen of the twenty-four reactors. All the reactors concerned will have undergone the necessary maintenance work by 2012.

3|6 Pressure vessels

Owing to the energy that they could release in the event of failure, regardless of the possibly hazardous nature of the fluid (liquid, vapour or gas) that would then be released, pressure vessels entail risks that must be kept under control.

This equipment (tanks, exchangers, pipes, etc) is not specific to the nuclear industry and can be found in many sectors such as chemistry, oil processing, paper-making and the 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.

The equipment items in this category liable to emit radioactive releases in the event of a failure are called nuclear pressure vessels and are regulated by the order of 12 December 2005. In addition to the requirements applicable to conventional pressure vessels and the existing texts covering reactor primary and secondary systems, this order imposes additional safety requirements on nuclear pressure vessels. The manufacturers and licensees have five years to implement them. The existing regulatory texts concerning steam and gas pressure vessels remain applicable during this transitional period.

ASN is also contributing to monitoring the enforcement of the regulations concerning the operation of the non-nuclear pressure vessels in nuclear power plants. This in particular entails on-site checks to ensure that the licensee is applying the stipulated requirements. ASN actions in 2007 include reconnaissance audits and review of the site inspection departments. These departments, under the responsibility of the licensees, are responsible for carrying out inspections to ensure the safety of pressure vessels. Creation of these inspection departments continued in 2007 but they are not yet present in all EDF nuclear power plants. These departments are at present only dealing with conventional pressure vessels.

Of the events that occurred in 2007 on pressure vessels (excluding the primary and secondary systems covered in point 3|4), accidental stress loading of the secondary systems requires particular attention. These loadings of thermohydraulic origin, commonly called water hammer, are not included in the design and stress the supports and certain sections of secondary system piping. The Cattenom and Paluel sites were concerned by events such as this. Starting in 2008, ASN will ensure that EDF identifies solutions for minimising the occurrence of these phenomena and implement them.

3|7 Protection against external hazards

3|7|1 Earthquakes

Buildings and equipment of importance for the safety of nuclear power plants are designed to withstand earthquakes of an intensity greater than the strongest earthquakes that have ever occurred in the region of the site. 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.

Although there is no particularly strong seismic risk in France, this topic is the subject of considerable efforts on the part of EDF and sustained attention by ASN.

Incident at the Kashiwazaki-Kariwa nuclear power plant

On 16 July 2007, a large earthquake of magnitude 6.8 on the Richter scale shook the Niigata region in Japan. The epicentre of the earthquake was located about ten kilometres from the Kashiwazaki-Kariwa nuclear power plant operated by the TEPCO company.

By 19 July, 67 anomalies had been identified throughout the site. According to TEPCO, the most significant were the following:
– a fire broke out in an electricity transformer;
– water in a fuel storage pond overflowed;
– several hundred drums were overturned in the solid waste storage building.

The acceleration values recorded by the nuclear power plant's instrumentation were higher than the design basis values.

ASN is in contact with the Japanese regulatory body, NISA, with the French embassy in Tokyo as well as with international organisations, particularly the International Atomic Energy Agency (IAEA), in order to be able to draw the necessary conclusions from this earthquake.

With the agreement of the Japanese Government, an IAEA delegation went to Japan from 6 to 10 August 2007 and inspected the Kashiwazaki nuclear power plant. It submitted a preliminary report on the impact of the earthquake on the plant and the relevant safety conclusions that could be drawn. The delegation considered that the installation behaved in a safe manner during and after the earthquake, even though it significantly exceeded the level used as the basis for the installation's design.

ASN asked EDF to take on board the lessons of this earthquake in Japan with regard to its own installations.

Updating of the design rules

Several years ago, ASN began work on updating the rules dealing with the seismic risks in BNIs.

In 2001, basic safety rule (RFS) 2001-01 dealing with determining the seismic risk for surface BNIs (except for long-term radioactive waste disposal facilities) replaced a rule dating from 1981.

RFS V.2.g concerning seismic calculations of civil engineering works was also revised and published in 2006, in the form of a guide for including the seismic risk in the design of surface BNI civil engineering works. It is the result of several years of work by French experts in the anti-seismic engineering field.

For surface BNIs and based on site data, this text defines the anti-seismic design requirements for civil engineering works and the acceptable methods for:

– determining the seismic response of these works, by considering their interaction with the equipment they contain and assessing the associated loads to be used in the design;
– determining the seismic movements to be considered for the design of the equipment.

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 RFS 2001-01.

For the 30-year periodic safety review on the 900 MWe reactors, ASN asked EDF to review in particular the seismic design of the electrical buildings of the CPY series of reactors. For the reactors of the CP0 series, ASN asked EDF to study the seismic design of the nuclear island buildings and the turbine hall. The studies are in progress to define any equipment or structural modifications needed.

With regard to the twenty-year safety review of the 1300 MWe reactors, EDF studied the earthquake stability of the reactor turbine hall and the strength of the civil engineering works of the electrical building and backup auxiliaries. These studies brought to light the fact that the original design guaranteed the resistance of these reactors to the earthquakes reassessed according to RFS 2001-01, provided that additional justification data was provided concerning protection of the turbine hall from the electrical building civil engineering structures and back-up auxiliaries of the P'4 reactor series.

In preparation for the forthcoming seismic reviews (forty-year review for the 900 MWe reactors and thirty-year review for the 1300 MWe reactors), ASN set up a working group comprising EDF, IRSN and ASN. The aim of this working group is to determine the reference earthquakes to be considered for these forthcoming reviews.

ASN is also a member of a working group comprised of the Directorate for the Prevention of Pollution and Risks (DPPR), IRSN and the geological and mining research bureau. The aim of this working group is to compare the contingencies taken into account and the construction design between installations classified on environmental protection grounds and BNIs.

3|7|2 Flooding

Following the flooding of the Blayais site in December 1999, EDF has begun to reassess the off-site flooding risk and the protection of all of its nuclear power plants against this risk. This reassessment mainly concerns a revision of the maximum design flood level (CMS). The revised CMS takes account of the additional causes of flooding, such as particularly heavy rain, dam failure and rising groundwater. The measures to be taken for the reactors in the event of a rise in the water level was also reassessed. A file was produced for each site and protection improvement works have been defined.

In October 2007, EDF completed the work made necessary by the flood risk reassessment, with regard to the risks of water ingress.

The ASN considers that the progress of studies and work is as expected. However, for the particular case of the Tricastin nuclear power plant, additional studies are still required to deal with the dam failure risk.

In order to finalise the overall approach to the off-site flooding risk for EDF reactors, but also for other nuclear installations, ASN asked the Advisory Committee for nuclear reactors (GPR) and the Advisory Committee for laboratories and plants (GPU) for their opinions. A joint meeting of the two GPs took place on 21 and 22 March 2007.

With regard to EDF reactors, the GPR and the GPU examined the following three topics:
– the progress of the study and working method implemented by EDF following partial flooding of the Blayais nuclear power plant at the end of 1999;
– the results of implementation of this method in various nuclear power plants, in terms of site vulnerability and compensatory protection, material, procedural and organisational measures;
– the vulnerability and protective arrangements for the Tricastin nuclear power plant with regard to Rhone river flooding, breaching of a dyke on the Donzère-Mondragon canal, rainfall that could for example lead to the "La Gaffière" river bursting its banks, and rising groundwater levels.

ASN followed the recommendations of the Advisory Committees and issued six particular demands concerning the risk of breaching of a dam, system or equipment, the flooding risk, protection against rainfall and protection of the Tricastin site.

Another problem was also raised: the safety of certain installations with regard to off-site flooding depends to a large extent on the behaviour of the off-site structures not belonging to EDF, in particular with regard to the Cruas and Tricastin nuclear power plants. Evaluating the robustness and the surveillance and upkeep of these structures entails a decision-making process between the concession-holders, the authorities and EDF that is in principle highly complex. In this context, ASN therefore asked EDF to continue the exchanges initiated between the licensees of these structures and to keep it informed of any difficulties.

At the same time, the working group for revision of RFS I.2.e to deal with the flooding risk, continued its activities in 2007. This group consists of experts from IRSN, licensee representatives and 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 concern all the BNIs.

ASN is also taking part in updating the IAEA guide concerning the off-site flooding risk for nuclear sites. There are a number of objectives:
– to incorporate operating experience feedback;
– to include climate change studies;
– to finally obtain a single guide (replacing the various IAEA guides on the subject);
– to take account of new phenomena;
– to take account of all nuclear installations.

This guide should be published in February 2010.

3|7|3 Heat wave and drought

The exceptional weather conditions observed since the summer of 2003 had resulted in a significant reduction in the flow and a considerable rise in the temperature of the watercourses constituting the heat sink for certain nuclear power plants. They also led to high air temperatures, in turn raising the temperature inside nuclear power plant premises.

During these episodes of heat wave and drought, it became clear that some of the physical limits used in the design of nuclear power plants or stipulated in their RGEs, had been reached.

For the CPY series sites, ASN in 2006 therefore undertook a review of the "heat wave" reference documentation proposed by EDF, in order to reassess the operation of the installations in conditions harsher than those included in the design. ASN adopted a stance on part of this reference documentation in 2007 and will give its decision on the entire documentation in 2008. These reference documentation systems are still being drafted by EDF for the other plant series.

During the first three weeks of July 2006, exceptional weather conditions saw the temperature in certain watercourses exceed their historical maximum values. ASN asked EDF for an analysis of the impact of a theoretical continued rise in the temperature of the Loire river on the safety of the Belleville, Chinon, Dampierre and Saint-Laurent reactors. One of the consequences of these studies led EDF to increase the capacity of certain heat exchangers. This was completed at the end of June 2007.

The summer heat waves of 2003 and 2006 also created problems with reconciling, on the one hand, maintained reactor output to guarantee the nation's electricity supply and the security of the electrical grid and, on the other, compliance with environmental protection and nuclear safety requirements. In order to improve its ability to deal with such problems, ASN organised a number of meetings with EDF and the General Directorate for Energy and Raw Materials at the Ministry for Ecology, Sustainable Development and Spatial Planning (MEDAD), before the summer of 2007. Furthermore, in a memo addressed to the MEDAD, ASN defined its role in the event of a heat wave and also set up a heat wave situation decision-making process. At the same time, RTE and EDF initiated their "electrical vigilance" plan. In order to deal with unforeseen climatic events, this plan organises the interaction between RTE and the producers on the one hand, and communication between the electricity operators and the public authorities on the other.

3|7|4 Fire risk

The fire risk in nuclear power plants is handled using the principle of defence in depth, based on three levels: installation design, prevention and fire-fighting.

The installations design rules should prevent the spread of any fire and limit its consequences. This is primarily built around:

– the principle of dividing the installation into sectors in order to keep the fire within a given perimeter, each sector being bounded by sectoring elements such as doors, fire-walls, fire-dampers, etc.) offering a fire resistance rating specified in the design;
– protection of redundant equipment performing a fundamental safety function.

Prevention primarily consists in:
– ensuring that the nature and quantity of combustible material present in the premises remains compatible with the scenarios used in the design of the sectoring elements;
– identifying and analysing the fire risks. In particular, for all work liable to cause a fire, a fire permit must be issued and protective measures must be taken.

Fire-fighting should enable a fire to be tackled, brought under control and extinguished within a time compatible with the fire resistance rating of the sectoring elements.

Design

With regard to design, EDF is completing deployment of the fire-fighting action plan (PAI), to ensure the conformity of and improve fire protection for the 900 MWe and 1,300 MWe reactors. In 2006, ASN noted that the work to renovate the technical and electrical cable ducting was behind schedule. In 2007, during inspections and six-monthly meetings with EDF, ASN checked the progress of the work and compliance with the associated deadlines. In 2008, ASN will ensure that the work that can only be done during a reactor outage is completed.

During the reviews carried out in 2006, ASN also identified problems with management of loss of sectoring, whether scheduled (for example, when implementing the PAI) or inadvertent. At the request of ASN, EDF proposed a sectoring management reference system which will be implemented experimentally on the sites in 2008. ASN will analyse this management reference system in 2008.

Finally, for the reactors of the CPY series, ASN in 2007 asked EDF to continue with studies into modification of the smoke control system in the electrical buildings. The aim is to restore sectoring of the premises through which the circuits of this system pass and ensure smoke evacuation in the event of a fire, in order to facilitate personnel evacuation and fire-fighting.

Prevention

Preventing fire breaking out and spreading is primarily based on correct management of combustible materials, whether present permanently in the premises, or only temporarily, in particular during reactor outages. In

2007, EDF undertook a revision of its reference system in order to optimise this management. ASN will ensure that it is correctly implemented on the sites.

Preventing fire breaking out and spreading is also based on the quality of the fire permits, in particular the risk assessments and the effective implementation of protective measures in the field.

In the light of the inspections conducted in 2007, ASN considers that EDF needs to improve how the protective measures are implemented as well as the training of those responsible for drafting the fire permits.

Fire-fighting

Since 2006, ASN has observed that the response teams are gradually becoming involved as soon as the alarm is sounded, rather than once the fire has been confirmed. In the light of the inspections conducted in 2007, ASN considers that the fire-fighting response times have improved only slightly. It considers that EDF needs to continue with its efforts in this field, in particular with regard to the actions of the response teams and improving interfacing with the off-site emergency services.

In 2007, a meeting was organised between the heads of the nuclear power plants and of the departmental fire and emergency services (SDIS) and provided an opportunity to look more closely at the areas for improvement identified in 2006. These areas concern the interface between the organisations, assessment of the risks and definition of the response scenarios and means or resources to be deployed in the event of a fire. EDF in particular presented ASN with the figures for the assignment of professional fire-fighters to each nuclear power plant by the SDIS and with the updated partnership agreements between the SDIS and the nuclear power plants.

Finally, in 2007, ASN monitored EDF's review of the operators' fire action sheets. These sheets are designed to bring the reactor to and keep it in a safe condition in the event of a fire. EDF in particular checked the feasibility of the action required locally if a fire breaks out. The answers transmitted by EDF to the ASN requests for improved ergonomics of the sheets and compatibility between the local reaction times and the dynamics of the accidents, will be examined by ASN in 2008.

3|7|5 Explosion risk

In 2005, ASN asked EDF to take greater account of the risk of internal explosion. As part of the thirty-year safety review for the 900 MWe reactors, ASN therefore asked EDF to review the existing means of protection against the effects of an internal explosion. It also asked it to initiate a similar approach for the other plant series.

The reference system for dealing with the risks of internal explosion inside nuclear power plants was transmitted in 2006 by EDF. It is currently being assessed by ASN and its technical support organisation. EDF completed its studies by including gases other than hydrogen and by extending its analyses to buildings other than those housing the reactors.

3|8 Conventional safety inspections

Implementation of these regulations in nuclear power plants is monitored by ASN, pursuant to Article 57 of the TSN Act. ASN's area of competence was thus broadened, with conventional safety inspection duties being entrusted to its officers. The working conditions of the employees of EDF, its contractors and their subcontractors, along with the safety of the installations, are now regulated on a coordinated basis by ASN. This regulation takes place at the various stages in the life of the nuclear power plants: construction, operation and decommissioning.

The main duties of the ASN's officers in charge of conventional safety inspections are:
– to ensure compliance with labour regulations, by checking that they are effectively and correctly implemented, or by assisting the licensee with assimilation and practical implementation of labour regulations;
– to investigate work accidents and ensure that the licensee is taking the necessary steps to guarantee worker safety;
– to identify and as far as possible prevent any labour conflicts.

Risks to the workers

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 for example concern electrical installations, pressurised gas or steam vessels, the chemical products used, the potential explosion risk of hydrogen circuits, the asphyxia risk from nitrogen circuits, work at height, or handling of heavy loads.

These risks must be dealt with in the first place by the employer, 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 preventive 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. Similarly, ASN considers that a climate of social tension is hardly conducive to long-term safety. By regularly participating in the meetings of the health, safety and working conditions committee (CHSCT), ASN's staff familiarise themselves with the social climate, with declared or simmering social conflicts, with labour grievances and, of course, with health and safety issues within the establishment. They are thus frequently called upon to act as mediators between the various personnel and the site management. The alarm signals raised at the CHSCT meetings may identify topics for subsequent inspection.

Conventional safety work in 2007

In 2007, the inspections carried out on the nuclear power plants pursuant to the Labour Code in particular concerned checking the conformity of scaffolding and lifting gear, the presence of the signage prescribed by the regulations in areas involving a risk and the provision and actual use of individual and collective protective equipment. The ASN staff noted problems with compliance with statutory working hours and rest periods on the occasion of checks carried out during reactor outages.

ASN also submitted requests to the licensee's divisions concerned by conventional safety issues, that is the "health and safety division" and the DPN at EDF. The subjects covered in 2007 were:

– revision of the prevention plans (concerning contractors);
– the search for alternatives to certain chemical products entailing a risk for the operators handling them;
– steam generator cleaning work;
– work on the cooling towers;
– adjustment of vessel tie-rods.

If inadequately prepared, these activities can entail significant risks as they are carried out in particular working conditions (illumination, available space, temperature, dosimetry, humidity, chemistry, noise, etc.).

The social climate in the Chinon nuclear power plant

Social dialogue in the Chinon nuclear power plant deteriorated at the beginning of 2007, following the suicide of three EDF staff since the summer of 2006. As a result of these dramatic events, the company's general management delegated two senior managers in March 2007 to the task of "listening, understanding and proposing".

Their report was presented in April 2007 to the Chinon nuclear power plant's personnel representatives. This EDF document gives a diagnosis of the current situation on the Chinon site and makes a series of proposals aimed at taking EDF forward on the question of working conditions, calming conflicts and the grievances expressed, while supporting the organisational changes which were often cited as the problem, in order to facilitate understanding and assimilation by the company's personnel. One of the key proposals announced is the creation of a working conditions observatory for the EDF group, which will concern contractors and subcontractors as well as the company's own staff.

The issue of contractor and subcontractor working conditions, their radiation protection, their training and their integration conditions are all topics which, for a number of years now, have been the subject of sustained dialogue between EDF and ASN. ASN's requirements in this area are becoming stricter and EDF's response to them is progressing satisfactorily.

4 RADIATION PROTECTION AND ENVIRONMENTAL PROTECTION

4|1 Personnel radiation protection

In a nuclear power plant, exposure to ionising radiation can have a number of origins, 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 the doses received are linked to maintenance work carried out during reactor outages.

EDF policy
In 1999, EDF took a number of steps to improve radiation protection and implemented the "Radiological cleanness" plan to establish requirements as stringent as 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).

ASN considers that this process is able to remedy the problems encountered by the nuclear plants. It has led to a significant reduction in worker dosimetry, in particular collective dosimetry, as illustrated by the graphs 5, 6 and 7.

ASN assessment and actions taken
Since 2005, ASN has continued to check that EDF had correctly taken account of the requests made further to the assessments and inspections carried out between 2002 and 2005 on the pressurised water reactors. ASN paid particularly close attention to radiological cleanness, the chemistry of the primary system, gamma radiography and application of the ALARA approach (computer system for dosimetry management, organisational and material resources for dose counting). The result of these actions and the corresponding assessment are presented in point 5|1 of this chapter.

At the same time, ASN continued to check radiation protection requirements implementation. ASN therefore examined how radiation protection was taken into account in preparing for modification of the RCV system letdown lines installed on the CPY reactor series and designed by the EDF engineering centres. ASN considers that EDF has optimised operational dosimetry for this modification. However, ASN did ask EDF to step up the importance accorded to operating experience feedback.

At the end of 2006, EDF for the first time implemented its project for entering certain controlled areas simply wearing overalls. During an inspection, ASN checked this implementation and will remain attentive to the conditions in which this project is deployed, in particular with a view to possible general use throughout all nuclear power plants.

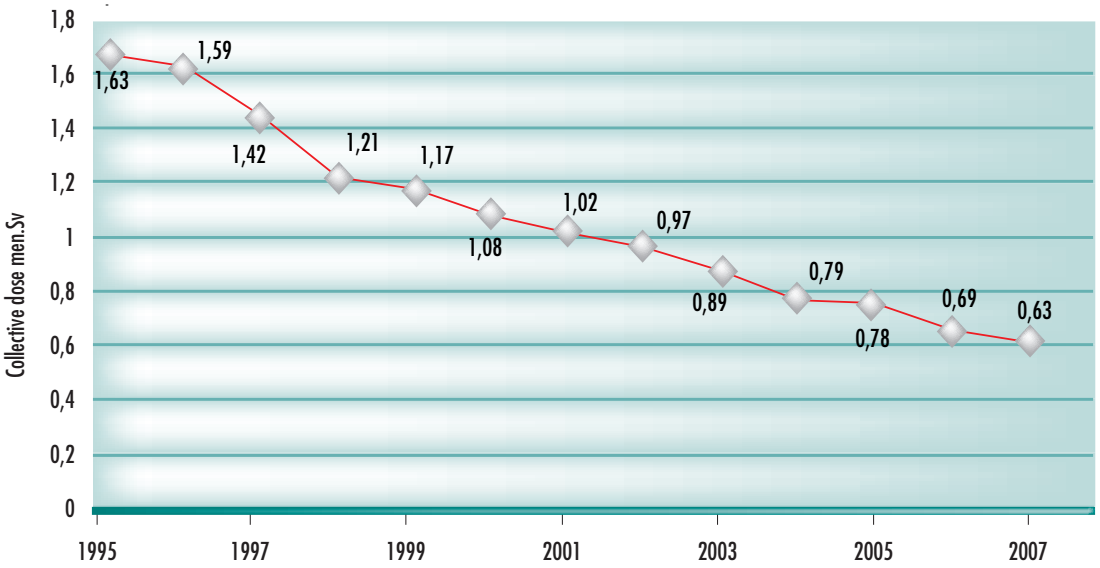
In 2007, ASN informed EDF of its assessment of radiation protection in its installations. This assessment, following on from that of 2004, concludes that EDF is continuing to improve radiation protection in the nuclear power plants. ASN considers that the action plans initiated by EDF are appropriate and duly notes the greater importance attached to organisational and human factors (for example, the performance of studies into the radiation protection duties of the works supervisors, the radiation protection departments and the surveillance officers). However, ASN notes problems in implementation of the radiation protection approach by all the departments on a given site. ASN observes no significant improvement in the behaviour of the participants, in particular because there is still room for improvement in their "radiation protection culture". Finally, progress still needs to be made in the surveillance of implementation of radiation protection rules in the field, particularly during reactor outages.

4|2 Discharges from nuclear power plants

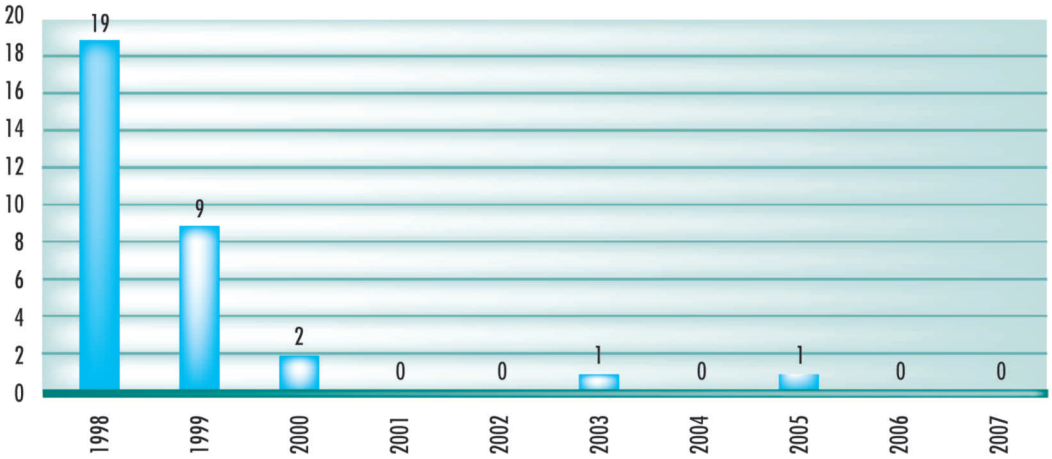
4|2|1 Discharge licence revision

Under application of decree 95-540 of 4 May 1995 concerning discharges of liquid and gaseous effluents and intake of water by BNIs, ASN in 2007 continued to examine applications for renewal of the water intake and non-radioactive liquid effluent discharge licences for nuclear power plants. These licences, issued by the *préfet* under the previous regulations in this respect, comprise a stipulated validity limit. At the request of 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. 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.

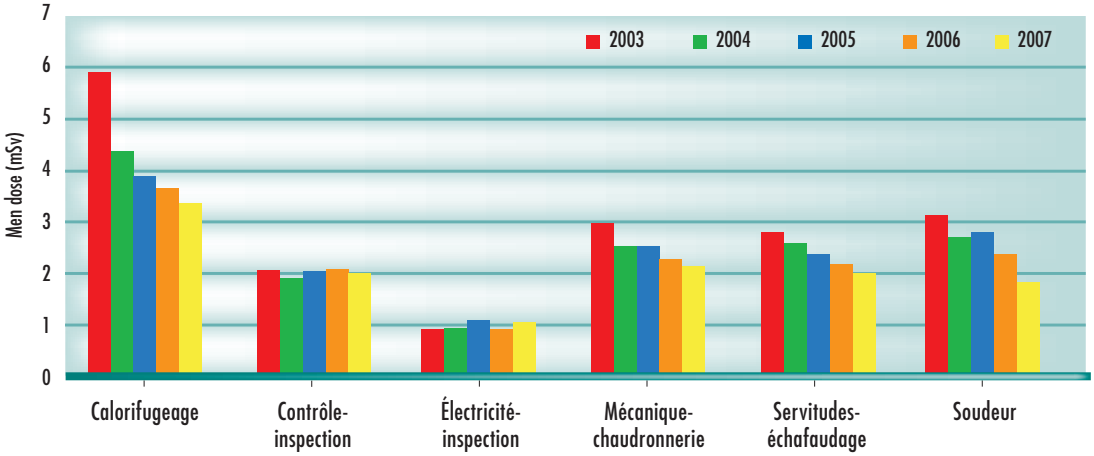
The renewals currently being reviewed were presented by EDF as soon as the previous licences reached their expiration dates. Thus, at the end of 2007, twelve nucle-



Graph 5: mean collective dose per reactor (EDF data)



Graph 6: number of workers (EDF + contractors) who received an annual dose > 20 mSv (EDF data)



Graph 7: evolution of mean individual dose according to categories of workers involved in reactor maintenance (EDF data)

ar power plants were covered by a new effluent discharge and water intake licence. Submissions of applications for the other nuclear plants will be staggered until 2009.

These renewals enable 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, 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 ASN is reducing these limit values. For the 900 MWe and 1,300 MWe reactors, it has set new limit values based on the operating 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 however been raised by a factor of 1.25 for liquid tritium discharges, assuming future high burnup fraction fuel management;
– with regard to non-radioactive materials, ASN decided to regulate discharges more exhaustively than in the previous regulations.

4|2|2 Procedures carried out in 2007

Complete revision of the discharge and water intake licences

Review of the renewal applications for the discharge and water intake licences from the Chooz, Dampierre, Penly and Tricastin nuclear power plants continued in 2007.

With regard to the Flamanville plant, the application submitted in August 2006 concerning the two existing reactors (regulated by the ministerial order of 11 May 2000) and the future EPR reactor, the public inquiry was held from 14 February to 17 March 2007.

A new application was submitted in 2007 for the Civaux nuclear power plant.

Partial revisions

Review of the applications for modification of the water intake and discharge licence orders:

– for the Belleville-sur-Loire and Cruas-Meysse power plants (regulated by the orders of 8 November 2000 and 7 November 2003 respectively) continued in 2007. These applications mainly concern revision of the tritium discharge limit values and certain chemical parameters such as those applicable to metals (copper and zinc), changes to the secondary system conditioning method and the use of biocidal and anti-scaling treatment in the condensers cooling circuits;
– for the Saint-Alban nuclear power plant (regulated by the order of 29 December 2000) submitted by the licensee in 2005 and concerning in particular a revision of the limit values for nitrogenated discharges, suspended solids and pH, also continued in 2007.

In February and April 2007 respectively, EDF also submitted an application for modification of the water intake and discharge licence orders for the Saint-Laurent-des-Eaux and Paluel plants:

– for the Saint-Laurent-des-Eaux nuclear power plant, the application in particular concerns a revision of the tritium discharge limit values and the use of biocidal and anti-scaling treatment in the condensers cooling circuits. This dossier also contains applications concerning discharges linked to the decommissioning of the site's gas cooled reactors;
– for the Paluel nuclear power plant, the modifications in particular concern revision of the tritium discharge limits and changes to the chemical parameters for the secondary systems conditioning method.

Particular operations

Clogging of the steam generator tube support plates was brought to light in a number of French nuclear power generating reactors (see point 3|4|4 of this chapter). To remedy this, EDF decided to carry out chemical washing on the reactors concerned. In 2007, reactors 1 and 4 in the Cruas power plant, reactor 2 at Chinon and reactor 1 at Saint-Alban underwent steam generator chemical washing. These washing operations entail unusual discharges, particularly ammonia.

Pursuant to Article 13 of decree 95-540 of 4 May 1995, EDF submitted information dossiers concerning the liquid and gaseous effluent discharges resulting from the washing operations. Based on the data presented in the EDF dossiers (in particular demonstrating that there are no off-site impacts and presenting the discharge surveillance measures and the steps taken to inform the neighbours) the operations were authorised without modification to the provisions of the licences concerning gaseous discharges from these nuclear power plants.

Examination of management of radioactive and non-radioactive effluents

ASN decided to consult the GPR about the management

of radioactive effluents and certain non-radioactive effluents from the French nuclear power plants in service and the various means of improving it. This review will cover liquid and gaseous radioactive effluents and the associated chemical materials, on the one hand in normal operating situations and on the other in certain external hazard situations.

The technical review conducted by IRSN began in 2006. The belated transmission by EDF of a number of documents required for review of this dossier means that the GPR's recommendation will be delayed beyond 2007.

4 | 2 | 3 Radioactive discharge values

The licensee sends ASN its discharge results every month. These data are regularly cross-checked against reactor operation during the period considered. Anomalies detected give rise to requests for additional information from the licensee.

The 2007 results concerning radioactive effluent discharges are presented in graphs 8 and 9. Graph 9, "liquid radioactive discharges", presents the 2007 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. Graph 8, "gaseous radioactive discharges", presents the 2007 discharges 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.

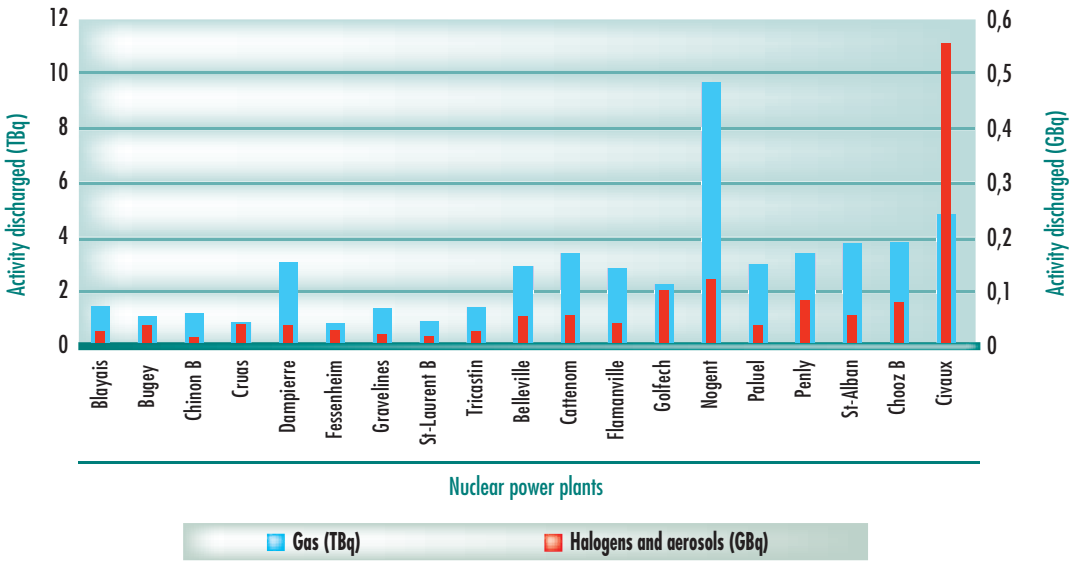
The activity level of the "gas" parameter of the gaseous discharges from the Nogent nuclear power plant is higher than the average for the 1300 MWe reactors. This is explained by higher discharges of rare gases (mainly xenon), linked in particular to tightness defects on the fuel cladding in Nogent reactor 2.

The activity level of the gaseous discharges from the Civaux nuclear power plant is significantly higher than the average for the 1300 MWe reactors and the Chooz plant. This is explained by higher discharges of iodine, primarily linked to tightness defects on the fuel cladding observed in 2007 in the Civaux reactors.

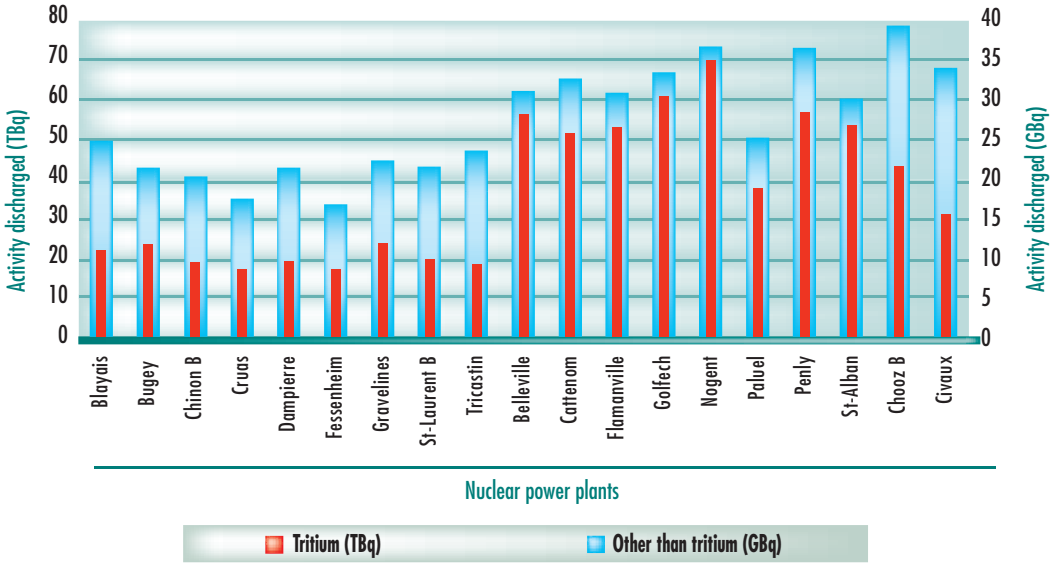
4 | 3 Technological waste management

Most of the operations associated with management of the waste resulting from the operation and maintenance of nuclear reactors take place in nuclear auxiliary buildings (BAN), waste auxiliary buildings (BAC) and liquid waste discharge system buildings (BTE). Investigations have shown that waste management in the BAN, BAC and BTE buildings was unsatisfactory in terms of safety (containment, prevention of the fire risk) and radiation protection. Requests had been sent to EDF in 2002 asking that this situation be corrected.

ASN has begun to review the studies forwarded by EDF for improvements to the design and operation of the waste storage and treatment buildings. EDF also carried out work to improve these buildings in 2004. The safety analyses however revealed inadequacies in risk assess-



Graph 8: gaseous radioactive discharges



Graph 9: liquid radioactive discharges

Radiological impact of discharges

The calculated radiological impact of the maximum discharges given in the EDF licence applications for the most exposed population group, does remain within the dosimetric limit acceptable 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 limit values requested by EDF for renewal of the Nogent-sur-Seine nuclear power plant licence, was evaluated at 2.3 µSv per year. As the actual discharges from the Nogent-sur-Seine nuclear power plant in 2007 were lower than the specified discharge limits, the actual annual effective dose in 2005 is less than this value.

ment, owing to the absence of a precise reference system describing the exact scope of the activities involved in the collection, treatment and storage of waste in these buildings.

The waste management inspections carried out by ASN in 2005 and 2006 showed that the licensee had become aware of the need to improve waste management and closely monitor the installations and the quantities of waste stored in them. 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).

In 2006, ASN asked EDF to define a new operational waste management system for its BAN, BAC and BTE buildings in order to remedy this situation and ensure that packaging equipment is available. ASN asked that this management system be based on an exhaustive risk analysis. EDF took a number of steps, in particular checking the condition of the buildings, comparing current practices and those defined in the design documents, as well as effecting a gradual reduction in the quantities of waste stored in these buildings. ASN monitored the progress of the drafting of the above-mentioned reference system,

which was completed at the end of 2007. ASN will review it in 2008.

4|4 Protection against other risks and problems

4|4|1 The microbiological risk

Amoebae

As stated in point 1|1|1, the condenser is a heat exchanger used to cool the secondary systems. The older exchangers are made of brass while the more recent ones are made of stainless steel or titanium, because they lead to fewer metal releases through wear than brass, which releases copper and zinc.

Amoebae, which are micro-organisms that can be pathogenic, do not develop in circuits fitted with brass condensers, owing to the toxicity of copper for them, but can develop in steel or titanium exchangers.

In order to comply with the limit value set by the health authorities, the nuclear power plants at Bugey, Chooz, Dampierre, Golfech and Nogent-sur-Seine carry out biocidal treatment with monochloramine, leading to releases of chemical substances. The Civaux nuclear power plant uses UV radiation to disinfect the discharged cooling water because the Vienne river into which the discharges flow is more susceptible to chemical treatment discharges.

EDF is also conducting a study programme to look for alternative solutions to chemical treatment.

Legionella

The legionella concentrations in secondary system cooling systems of nuclear power plants with cooling towers are variable and depend on a variety of factors (time of the year, scaling, quality of make-up water, use of anti-amoeba treatment, etc.). They can reach up to several hundred thousand colony forming units per litre (CFU/l – indicating the number of micro-organisms per unit of volume), or even more than a million for those plants not using treatment: Belleville, Cattenom, Cruas, Dampierre (reactors 2 and 4) and Saint-Laurent-des-Eaux. They remain less than one hundred thousand CFU/l at Bugey, Chooz, Civaux, Dampierre (reactors 1 and 3), Golfech, Nogent-sur-Seine and Chinon, the last site equipped with a monochloramine treatment station.

To enhance legionella risk prevention, ASN together with the General Directorate for Health (DGS) in 2005 required that EDF comply with maximum legionella concentration limits in the cooling systems, along with installation surveillance requirements.

At the same time and in conjunction with the DGS and the DPPR, ASN contacted the French Environmental and Labour Health Safety Agency (AFSSET) for its opinion on the assessment of the health and environmental risks linked to the presence of legionella in nuclear power plant cooling systems. This opinion should help ASN more clearly assess the studies performed by EDF and its general risk prevention and surveillance strategy.

On the basis of an initial appraisal submitted by AFSSET in April 2006, ASN asked EDF to take its analysis further on several points:

– demonstration of the specific nature of the large cooling towers in nuclear power plants as compared with conventional towers, with regard to legionella concentrations in the environment as a result of dispersion of the plume;
– reinforcement of the installations surveillance arrangements;
– review of the means for reducing the growth of legionella in the cooling systems as far as possible;
– analysis of the results of epidemiological surveys.

In December 2006, EDF submitted its answers and in February 2007 sent ASN a programme of action designed to reduce the levels of legionella colonisation of the systems.

EDF's intention is to find the best possible balance between preventive and remedial measures involving:

– the generation of little or no chemical discharges (cleanness and maintenance of systems, minimal creation of scaling and biofilm, treatment of make-up water);
– additional means entailing chemical discharges, whether preventive (acid vaccination against scaling) or remedial (biocidal treatments).

EDF also implemented measures and intends to conduct additional studies to guarantee more effective surveillance of its installations, for example by making its sampling points more representative, by monitoring scaling and physical and chemical parameters, by using methods for rapid determination of legionella, or by increasing the frequency of the analyses according to the colonisation of the systems.

At the same time, AFSSET continued its assessment and in particular its review of the health and environmental impact of additional biocidal treatments that could be utilised to further reduce legionella concentrations. ASN also asked AFSSET to adopt a stance on the completeness of EDF's programme of action and the balance between the various working options proposed. In October 2007, AFSSET sent ASN an opinion on the action designed to reduce legionella colonies. It reiterated its

Legionella concentration levels in the large NPP cooling towers

The legionella concentrations not to be exceeded in the secondary system cooling systems are 5.10^6 CFU/l for nuclear power plants with large cooling towers (about 150 m high), and 5.10^5 CFU/l for the Chinon nuclear power plant with its smaller cooling towers (28 m). For systems other than the secondary system cooling system (air-conditioning for example), application of the legal current threshold for ICPEs is required.

Since 2005, the Chinon nuclear power plant has been equipped with a monochloramine legionella treatment unit. This installation, which required updating of the discharge license, enables the licensee to meet the legionella concentration set by ASN.

For the other power plants which do not use specific treatment, the value of 5.10^6 CFU/l is met by means of the preventive measures usually employed by EDF to limit the development of biofilm and the formation of scale in its systems.

"recommendation concerning the urgent need to find biocidal treatment alternatives or additional solutions" in particular by treatment of the make-up water, an option that is currently being examined by EDF. This opinion is at present being analysed by ASN.

AFSSET observes that EDF's 2007 action plan comprises significant improvements over the approaches previously presented but nonetheless considers that additional efforts are required, in particular to continue with the risk analysis, reinforce the surveillance plans, improve inspection and monitoring procedures, and continue with the assessment of additional solutions.

4|4|2 Prevention of accidental water pollution

Pursuant to the order of 31 December 1999 as amended, mentioned in point 2|2|1 of chapter 3, ASN in 2006 required that certain work be done to ensure the conformity of the installations, particularly the effluent tanks.

2007 was marked by the completion of work concerning effluent tank retention barriers.

4|4|3 Noise

With regard to noise pollution, the impact of the installations is regulated by the above-mentioned order of 31 December 1999 as amended. The order limits the noise caused by the installations, referred to as the "sound emergence", in other words the difference between the ambient noise level when the installation is operating and the residual noise level when the installation is stopped. As an example, this difference should not exceed 3 dB (A) at night.

In 2001 and 2002, EDF carried out noise measurements on all its sites. The study showed that ten plants were in conformity while there were nonconformities at the nine other sites of Belleville, Bugey, Chinon, Civaux, Dampierre, Golfech, Nogent-sur-Seine, Penly and Saint-Laurent-des-Eaux. The main noise sources identified were the cooling towers, the turbine halls, the BAN stacks and the transformers.

In response, EDF defined an overall treatment approach based on sound-proofing studies. For each noise source, partial or total sound-proofing techniques were examined. 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 therefore oriented its strategy along three main lines:
– reduction and if possible elimination of the main noise frequencies;
– priority given to industrial noise sources;
– whenever possible, no aggravation of the situation if the installations are modified.

Furthermore, for sites with cooling towers or a river weir, EDF considered that the detrimental effect generated by the noise of falling water in these works is less than noise of an industrial nature.

In 2005, EDF conducted additional measurement campaigns and completed its studies.

In 2006, ASN concluded that EDF's overall approach was acceptable and that the emergence obtained on the sites by including falling water type noises in the residual noise constitutes the performance indicator. ASN at the same time reviewed EDF's justification documents in

order to adopt a stance on each of the sites identified as being non-compliant.

The modifications envisaged are currently being validated by EDF, which is also preparing to start the work. Effective implementation on the sites concerned will begin in 2009 and additional acoustic measurements will be systematically taken to validate the effectiveness of the solutions adopted.

5 ASSESSMENT

5|1 ASN's general assessment of the past year

The following general assessment gives a summary of the various subjects covered by ASN's evaluation of EDF's head offices and the performance of its nuclear power plants in terms of nuclear safety, radiation protection and the environment.

This evaluation is itself based on the results of checks carried out by ASN in 2007, particularly through inspections, oversight of reactor outages and analysis of how EDF handles significant events, as well as on the extent to which the inspectors are familiar with the sites they inspect. In 2007, ASN conducted 374 inspections in the nuclear power plants in service and in EDF head offices.

The general assessment represents the ASN viewpoint for the year 2007 and helps to guide ASN's regulatory actions in 2008.

5|1|1 Safety

Reactor operations

The operating documents, such as the normal operating rules, incident or accident operating rules and reactor maintenance rules, are on the whole clear and of good quality. These documents are generally well implemented on the sites.

ASN noted EDF's commitment to improving operational stringency through national and local action plans. It considers that these actions have not yet borne fruit and that EDF must continue its efforts towards making progress. ASN in 2007 observed nonconformities in the preparation for maintenance work, in monitoring of activities and in implementation of the operating procedures.

ASN considers that the sites are responsive to unforeseen operating events. They correctly implement the national reference documentation for incident or accident operations. ASN noted improvement in how feedback from significant events on other sites was taken into account, in particular through the dissemination of good practices between the sites. ASN considers that EDF needs to make this dissemination of good practices a permanent feature.

In 2007, ASN noted progress in the organisation of fire-fighting and in the adoption and implementation of the reference systems. In ASN's opinion, EDF needs to continue its efforts, particularly in managing sectoring, alarms and compliance with the required response times. On this latter point, ASN considers that the size of the operating teams is insufficient on certain sites, which can lead to problems in managing implementation of operating rules in the event of a serious incident or a fire.

ASN rates the way EDF handles emergency situations as satisfactory overall. The sites implement an adequate staff training and qualification programme and regularly carry out training exercises. ASN however in 2007 noted inadequacies in the organisation of the response teams and inconsistencies in how they react in a radiological emergency and in certain procedures.

Maintenance activities and subcontractors

ASN noted that EDF has undertaken a series of major maintenance projects in order to enhance the competitiveness of the French nuclear power plants, while maintaining the level of safety. EDF is implementing methods designed to focus maintenance operations on the equipment according to the safety, radiation protection or operational issues involved. ASN considers EDF to be strongly committed to this field.

ASN also considers that even if the maintenance reference system is of relatively high quality, it is nonetheless complex. If not accompanied by organisational measures to monitor the adoption and implementation of the new reference systems, this complexity makes it harder for the sites to keep up with the changes made.

In the field, ASN considers that the quality of maintenance preparation could be improved. In particular, EDF needs to improve the quality of the risk assessments and their assimilation by the staff concerned, and to boost

surveillance of the implementation of remedial measures in the field.

Most maintenance activities on the sites are entrusted to contractors selected on the basis of a qualification and evaluation system. ASN considers that this system is implemented satisfactorily.

In ASN's opinion, EDF made progress in contractor surveillance in 2007, even if it did note nonconformities in steam generator replacement or chemical washing operations. ASN nonetheless considers that surveillance in the field of contractor activities should be strengthened.

On certain sites, ASN also noted that material resources are insufficient or inappropriate, which in some cases led to degraded contractor working conditions in terms of safety and radiation protection.

Equipment condition

Equipment maintenance and replacement programmes, the safety review process and correction of conformity anomalies identified contribute to keeping nuclear power plant equipment in a satisfactory condition.

In 2007, ASN nonetheless observed a lack of stringency in the performance of post maintenance equipment requalification, although without any significant consequences. It considers that EDF needs to improve the preparation and oversight of these operations and enhance the competence of the preparation staff in order to minimise the persistent confusion between the objectives set during the periodic tests and those set during the requalification tests.

Pressure vessels

In ASN's opinion, EDF is making progress in management of pressure vessels. ASN nonetheless feels that EDF needs to continue its efforts to ensure that all the inspection departments are recognised in 2008 and adopt inspection plans. ASN noted that cooperation between the recognised inspection departments on the sites and head offices is taking shape, which enables pooling of skills and improved sharing of operating experience feedback.

However, ASN considers that EDF needs to improve its management of pressure vessel documentation and define the perimeter of the equipment subject to the order of 15 March 2000.

The first barrier

For ASN, the condition of the fuel cladding, which constitutes the first protection barrier in the reactors, is satisfactory.

Similarly, implementation of the reference system for fuel assembly handling is satisfactory, although ASN noted a number of handling nonconformities.

ASN considers that EDF showed a high level of responsiveness in dealing with the tightness defects detected in 2006, by stipulating corrective action to be taken in the fuel rod fabrication plants. ASN noted tightness defects on a small number of fuel assemblies in 2007.

The second barrier

ASN considers that the condition of the second barrier, which consists essentially of the primary system and the main secondary systems, could be improved.

Although the steam generator replacement policy is a positive point, ASN nonetheless feels that EDF needs to improve the quality of the documentation for maintenance, spares and disposition of nonconformities and that the sites should be more reactive in detecting and remediating leaks. On this point, ASN will in 2008 be paying particularly close attention to the strict implementation of its 31 January 2006 decision concerning the conditions for the use and maintenance of primary and secondary system spares.

ASN noted discrepancies between steam generator chemical washing and the qualification files. It feels that EDF needs to learn the lessons from operating experience feedback from these operations. ASN also considers that EDF still needs to improve its surveillance of events occurring on the systems and its correction of thickness defects on the main secondary systems.

The third barrier

ASN considers that the condition of the third barrier, consisting of the reactor building containment, is satisfactory. ASN noted that the check on the tightness liners on the inner containments of the 1300 MWe and 1450 MWe reactors revealed no nonconformities in 2007.

In 2007, ASN did however note a lack of stringency in operation of the third barrier, mainly concerning implementation of the containment reference system and personnel awareness with regard to this subject.

5|1|2 Radiation protection

ASN considers that the process of continuous improvement in place for the past ten years to enhance radiation protection in nuclear power plants is bearing fruit. This has led to a continuous drop in collective and individual doses in the plants, even if these doses are at present tending to stabilise.

ASN feels that radiation protection issues are being increasingly taken on board by all departments on the site thanks to the deployment and use of the radiation protection information system and the adoption of radiological working practices informing the participants of the risks of exposure to ionising radiation and the corresponding radiation protection measures to be taken.

It does however consider that EDF needs to continue its efforts to ensure that these issues are shared and taken into account by all.

ASN also noted improvements in radiological cleanness on the sites where the system of entering controlled areas simply wearing overalls was put in place. ASN did however note that the behaviour of those involved and the acquisition of a "radiation protection culture" still have some way to go. It considers that EDF must progress further in implementing radiation protection rules on the worksites, in particular with regard to zoning and checks when exiting a controlled or contaminated area.

5|1|3 The environment

ASN considers that EDF's situation with regard to the environment is on the whole good but that it could still be improved in certain areas.

With regard to equipment and ICPEs, there appears to have been a slackening of the former intensity and EDF head offices are often having difficulty responding on-time to the issues related to waste management in the BAN, BAC and BTE buildings.

With regard to chemical washing of the steam generators, EDF improved the process as requested by ASN, in order to reduce the associated discharges. ASN nonetheless noted that these operations were not entirely free of unforeseen events and that insufficient attention was given by EDF to incorporating operating experience feedback. ASN therefore asked EDF to correct the nonconformities identified in ongoing chemical washing operations, prior to each new steam generator washing operation.

Although the environmental protection organisation on the sites is clearly defined, nonconformities were still observed in 2007 on several sites, particularly with regard to installation conformity, human factors, contractor surveillance and waste management.

5|1|4 Personnel and organisation

ASN considers that the organisation defined by EDF is on the whole suitable for dealing appropriately with safety and radiation protection issues. The nuclear power plants set themselves improvement targets in the various safety, radiation protection, environment and worker safety fields. ASN nonetheless feels that progress is still needed in giving greater importance to non-radioactive discharges in the environmental objectives.

The roles and responsibilities within the departments are defined in organisation memos but organisations are sometimes poorly understood in the field by the personnel. ASN noted that some decisions could benefit from being taken in calmer circumstances.

A lack of communication or coordination between the departments can lead to anomalies.

As in 2006, ASN considers that the skills management and personnel qualification system is implemented correctly, although contractor training could sometimes be better, in particular with regard to radiation protection. Furthermore, in order to deal with the numerous retirements scheduled in the coming years, EDF must continue its efforts to maintain the level of skills required for reactor operation.

Manning levels are generally speaking appropriate. Reactor outages and surveillance of contracted activities are however areas which are sometimes under-manned.

The steps taken as part of the "human performance" project, which aims to improve working reliability, is an essential source of progress if greater stringency is to be achieved in maintenance and operation. ASN considers that these improvement measures will be all the more beneficial once the contractors become fully involved.

The reliability of maintenance work will also be improved by more favourable working conditions. ASN noted that the conditions in which operation and maintenance activities are performed are not always satisfactory: inappropriate working environment (lighting, signage and other problems), insufficient material resources, lack of protective equipment, high workload, increasingly tight deadlines.

A lack of familiarity with safety rules and worksite risks along with tight deadlines sometimes penalise the working conditions. Maintenance activities performed during reactor outages are a good illustration of this point. ASN considers that the risks on the worksites, including for human safety, need to be identified and handled as of the preparation phase and the participants, including contractor staff, must be familiar with these risks and the associated compensatory measures.

5|1|5 Operating experience feedback

Generally speaking, the organisation put into place in the nuclear power plants by the licensee to deal with operating experience feedback, allows satisfactory detection and identification of the events. Analysis of these events by the sites is generally of good quality. However, the analysis reports transmitted to ASN could sometimes be better, in particular with regard to the non-technical aspects of the event. ASN considers that EDF needs to improve its oversight of the corrective action taken following the events.

ASN feels that EDF should make progress in exploiting the information obtained from operating experience feedback. Despite the fact that this operating experience feedback is disseminated to all the nuclear power plants, a lack of awareness of it led to nonconformities in 2007 that could have been avoided.

ASN also considers that the quality of drafting of the event sheets contained in the licensee national application (SAPHIR), available for consultation by all the plants, needs to be improved. Similarly, sharing and dissemination of good practices between the nuclear power plants could be better.

5|2 Individual site assessments

The following assessment of EDF's nuclear power plants summarises ASN's evaluation of the performance of each site with respect to safety, radiation protection and the environment. This evaluation is itself based on the results of controls carried out by ASN in 2007, particularly through inspections, oversight of reactor outages and analysis of how EDF handles significant events, as well as on the extent to which the inspectors are familiar with the sites they inspect.

It takes account of qualitative rather than quantitative data. It represents ASN's view for 2007 and helps to guide ASN's regulatory actions for 2008. However, it must be borne in mind that the level of safety of a site is not set in stone and can change from one year to the next.

The performance of the various power plants in terms of nuclear safety and radiation protection is expressed in relation to ASN's general assessment of EDF.

Belleville-sur-Loire nuclear power plant

ASN considers that the nuclear safety and radiation protection performance of the Belleville site is on the whole in line with the ASN's general assessment of EDF performance.

However, ASN feels that the site must in particular progress in the field of reactor operations. After reminding it on several occasions in 2006 and 2007 of the need to ensure notification at the appropriate level and address nonconformities in relation to the technical operating specifications, ASN considers that the site must make greater efforts in terms of stringency of operation and organisation in order to make up for the shortcomings identified since the in depth inspection carried out at the end of 2006.

Blayais nuclear power plant

ASN considers that the nuclear safety and radiation protection performance of the Blayais site is on the whole in line with the ASN's general assessment of EDF performance.

ASN considers that in 2007 the site made progress in the field of radiation protection. It also noted that the site has a robust organisation for dealing with emergencies, as demonstrated during the national emergency exercise in November 2007.

However, ASN feels that the site needs to make further progress in terms of operating stringency in preparing for maintenance, particularly with regard to the quality and completeness of the risk analyses.

Bugey nuclear power plant

ASN considers that the nuclear safety and radiation protection performance of the Bugey site is on the whole in line with the ASN's general assessment of EDF performance.

ASN feels that the site situation with regard to management of waste and radioactive material transport remains satisfactory.

However, ASN feels that the site needs to make particular progress in operating stringency, as the year was marked by a large number of significant safety events originating in non compliance with technical operating specifications, along with a significant rise in the number of automatic reactor trips. The site also needs to continue its efforts to implement radiation protection rules on the worksites during reactor outages.

Cattenom nuclear power plant

ASN considers that the nuclear safety and radiation protection performance of the Cattenom site is on the whole in line with the ASN's general assessment of EDF performance.

ASN noted that in 2007, the site had initiated a number of approaches for reducing the contamination risk and for improving the radiological cleanness of certain premises.

ASN nonetheless considers that the site needs to progress further in the preparation and performance of periodic tests and maintenance on equipment important for safety, as well as in contractor surveillance. It also considers that the site must continue its fire-fighting training efforts in 2007.

Chinon nuclear power plant

ASN considers that the nuclear safety and radiation protection performance of the four operating nuclear reactors on the Chinon site are on the whole in line with the ASN's general assessment of EDF performance.

ASN noted an improvement in site supervision during maintenance outages, in particular when the reactor 1 steam generators were replaced.

It does however feel that there is room for improvement in the significant events notification process, in particular with regard to the delay involved or when determining the INES scale rating level. The number of events linked to compliance with the technical operating specifications remains high. In addition, several events are linked to insufficient account being taken of the risks involved in the use of chemical products.

Chooz nuclear power plant

ASN considers that the Chooz B site stands out with regard to radiation protection performance and that nuclear safety performance is on the whole in line with ASN's general assessment of EDF performance.

ASN noted that Chooz B has made progress in the field of pressure vessels and in implementation of its fire-fighting response organisation.

However, it feels that the Chooz B site needs to progress in the environmental and maintenance fields as well as in how it incorporates operating experience feedback.

Civaux nuclear power plant

ASN considers that the nuclear safety and radiation protection performance of the Civaux site is on the whole in line with the ASN's general assessment of EDF performance.

Although the site has progressed in terms of operational stringency, ASN feels that continued efforts are needed when considering human factors. ASN also noted, with regard to radiation protection, a lack of vigilance on the part of certain persons during operation and maintenance. It considers that these nonconformities need to be addressed in preparation for the scheduled deployment of the project for access to controlled areas wearing overalls during the future reactor outages.

Cruas-Meysse nuclear power plant

ASN considers that the nuclear safety and radiation protection performance of the Cruas-Meysse site is on the whole in line with the ASN's general assessment of EDF performance.

The Cruas-Meysse site is under-performing in terms of operating stringency and 2007 was marked by a large number of significant safety events originating in non-compliance with the technical operating specifications. ASN also noted an increase in shortcomings in activity oversight.

In 2008, the site will continue to carry out chemical washing on reactors 2 and 3 in order to restore the conformity of its steam generators. The site will need to devote particular attention to the organisation and surveillance of these operations.

Dampierre-en-Burly nuclear power plant

ASN considers that the nuclear safety and radiation protection performance of the Dampierre-en-Burly site is on the whole in line with the ASN's general assessment of EDF performance.

The safety culture is present at all levels, from management down to the field operators. ASN in particular considers that the process to identify and deal with nonconformities is effective.

However, ASN does feel that the site must maintain its vigilance, in particular concerning implementation of the operating and maintenance reference system, post-maintenance requalification of equipment, drafting of and compliance with the risk analyses. Finally, ASN noted that the site's conventional safety results are less than optimal.

Fessenheim nuclear power plant

ASN considers that the Fessenheim site is under-performing in terms of nuclear safety and that performance in the other fields is on the whole in line with ASN's general assessment of EDF performance.

ASN noted that subsequent to implementation of the action plan, progress was achieved in personnel training and in updating of reference documentation.

However, in the field of operating stringency, ASN again in 2007 noted nonconformities in implementation of the reference documents, such as the general operating rules. It feels that the site needs to continue to make progress in maintenance work and in post-maintenance requalification of equipment. In 2008, ASN will devote particular attention to these points.

Flamanville nuclear power plant
ASN considers that the Flamanville site is under-performing in terms of nuclear safety and that performance in the other fields is on the whole in line with ASN's general assessment of EDF performance.

ASN noted that following the difficulties encountered in 2006, an action plan was gradually implemented by the licensee starting in February 2007. The main aspects of this plan accurately reflect the areas for progress identified by ASN, that is operational and management stringency and the quality of the preparation for and performance of maintenance operations. ASN considers that the efforts made by the site will enable it to make progress and that they must be continued.

Golfech nuclear power plant
ASN considers that the Golfech site stands out with regard to operational stringency and radiation protection performance in relation to ASN's general assessment of EDF performance.

The sites operating safety and proactive approach to radiation protection are particularly impressive.

However, problems encountered in these fields in 2007 show that the site needs to maintain its stringency efforts if it is to reach its goals. ASN noted that the site encountered major problems with the contractor in charge of worksite assistance, involving activities such as logistics, scaffolding installation and radiation protection. It will be vigilant in monitoring the expected progress in this field.

Gravelines nuclear power plant
ASN considers that the Gravelines site is under-performing in terms of nuclear safety and that its performance in the field of radiation protection is on the whole in line with ASN's general assessment of EDF performance.

ASN considers that the site's emergency preparedness is particularly good.

However, during the first half of 2007, as in 2006, ASN noted a lack of operational stringency and a need for progress in the management of training, support for recently trained staff, preparation for and performance of maintenance. Based on these findings, the site implemented an action plan during the second half of 2007. Furthermore, given the poor condition of the fire-fighting networks, the site will be undertaking a vast renovation programme in 2008.

ASN will remain vigilant with regard to the results obtained by the site in these areas, following implementation of its action plan.

Nogent-sur-Seine nuclear power plant
ASN considers that the Nogent-sur-Seine site stands out with regard to nuclear safety performance and that its performance in the field of radiation protection is on the whole in line with ASN's general assessment of EDF performance.

In 2006, the site implemented action plans for achieving progress in operational stringency and disposition of nonconformities, which at the time required particularly close attention. ASN reviewed the situation during the December 2007 in-depth inspection.

ASN considers that the site has made clear progress in terms of transparency, management of alignments, management of lock-outs and state changes.

It does however feel that the site needs to continue its efforts in the field of operational stringency, through more robust oversight and improved use of national tools.

Paluel nuclear power plant
ASN considers that the nuclear safety and radiation protection performance of the Paluel site is on the whole in line with the ASN's general assessment of EDF performance.

ASN considers that the Paluel site is efficient in terms of radiation protection, notably during reactor outages.

ASN however considers that the site needs to make progress in terms of operational stringency. This field has been identified as an area of progress for the site for a number of years and a specific action plan was implemented. However, a large number of nonconformities persisted with regard to management of control activities in installation and equipment maintenance.

Penly nuclear power plant
ASN considers that the nuclear safety and radiation protection performance of the Penly site is on the whole in line with ASN's general assessment of EDF performance.

ASN considers that the site stands out with regard to management presence in the field, the management being heavily involved in overseeing human performance. Furthermore, ASN considers that the steps taken in 2007 have corrected certain nonconformities concerning pressure vessels and improved the site's organisation in this field.

ASN nonetheless feels that the site needs to make more progress to ensure that a calmer atmosphere prevails during reactor restarts after maintenance or refuelling outages. Progress is also needed in contractor surveillance,

particularly with regard to implementation of radiation protection rules on the worksites during reactor outages.

Saint-Alban nuclear power plant
ASN considers that the nuclear safety and radiation protection performance of the Saint Alban site is on the whole in line with the ASN's general assessment of EDF performance.

The site once again stands out with regard to the preparation for and surveillance of maintenance operations involving a risk of reactor trip. ASN noted that following the nonconformities that occurred in 2006 during the periodic tests, an action plan was initiated by the site in 2007. ASN considers that implementation of this action plan has borne fruit and that progress has been achieved.

However, it feels that efforts will still be needed in 2008 with regard to stringency in performance of the periodic tests. It also feels that the site needs to ensure compliance with the radioactive material transport regulations.

Saint-Laurent-des-Eaux nuclear power plant
ASN considers that the nuclear safety and radiation protection performance of the Saint-Laurent-des-Eaux site is on the whole in line with the ASN's general assessment of EDF performance.

The improvement which appeared to be taking shape in 2006, in terms of operational stringency and compliance with technical operating specifications, failed to materialise in 2007. ASN thus considers that the site needs to make progress in reactor control operations, particularly during outages. During the 2007 maintenance and refuelling outages, shutdown and restart transients led to the notification of numerous significant safety events. Progress will also be required in coordination of the maintenance and control departments, but also in surveillance of the control room.

Tricastin nuclear power plant
ASN considers that the Tricastin nuclear power plant stands out with regard to nuclear safety and radiation protection and that its environmental protection performance is below ASN's general assessment of EDF performance.

ASN considers that the policy of reducing the number of reactor trips bore fruit in 2007 but that the site must still progress in its performance of physical core tests and compliance with the technical operating specifications. Since 2006, the site has been particularly good in its monitoring of pressure vessels.

However, ASN feels that the site has regressed in its consideration of environmental factors during operation and treatment of effluents.

6 OUTLOOK

For EDF's nuclear power plants, 2007 was marked by important events which will help guide ASN regulatory actions for 2008.

Following a favourable opinion from ASN, the Government signed the authorisation licence decree for the EPR reactor at Flamanville on 10 April 2007. This year, work began on preparation of the site and installation construction began, with oversight by ASN. This oversight of construction, involving spot checks proportionate to the safety issues, will continue until the installation receives commissioning authorisation.

At the same time, ASN will also be continuing with an early review of certain aspects of the commissioning application file, in particular the accident study methods and the installation control principles.

In 2008, ASN will continue to be involved in international, bilateral and multilateral cooperation programmes on new reactors, in order to compare its practices with those of its foreign counterparts and to encourage sharing of experience by the experts.

In particular, and following the success of the initial work launched by WENRA into harmonisation of the safety of reactors in service in Europe, which led in 2007 to the adoption by the seventeen member states of a finalised version of reference levels, ASN will continue to devote efforts to cooperation and to safety harmonisation.

With regard to the reference levels adopted by the European members of WENRA in 2006, ASN intends to make a proposal to the Government by 2010 for transcription into a coherent set of regulatory (ministerial orders, ASN decisions) and other texts (ASN guides).

This effort to develop regulations for nuclear power reactors in the near future also meets ASN's objective of preparing for the possible arrival in France of a new nuclear power plant licensee. It cannot be ruled out that

an operator other than the incumbent EDF will decide to launch a new project in France (for example, the Franco-Belgian SUEZ group, which already operates seven nuclear reactors in Belgium via its subsidiary Electrabel).

With regard to power reactor regulation, given the expansion of ASN's field of competence to include conventional safety inspection, the employees of EDF and its contractors now benefit from coordinated regulation of their working conditions by ASN, in the same way as nuclear safety of the installations and radiation protection. In 2008, ASN will be deploying the strategy defined in 2007 in order to ensure a robust, professional and integrated organisation, maintaining links with the other institutional stakeholders involved in conventional safety inspection and prevention.

ASN considers that the condition of EDF installations is satisfactory and that the operating methods applied – both maintenance programmes and operating rules – are appropriate. In the fields of radiation protection and environmental protection, ASN considers that EDF obtained results in 2007 that were on the whole satisfactory. However, ASN is of the opinion that the efforts made by EDF on the sites in terms of operational stringency need to be continued and that the sharing of operating experience feedback by the sites needs to be consolidated. ASN expects further progress with regard to the preparation for and performance of maintenance activities and surveillance of the work done by the contractors. Finally, ASN considers that conditions on the worksites should also be improved.

Through conformity reviews, a permanent search for anomalies by its engineering departments and the tests and checks carried out during the ten-yearly outages, EDF is attentive to the possibility of generic risks, which are inherent in a standardised population of nuclear power plants. EDF takes advantage of this standardisation in making operating experience feedback between the reactors more efficient and effective. It is also important for EDF to continue to take steps to improve safety still further. To do this, the periodic safety reviews are key opportunities for working with ASN.

In 2007, incorporation of the modifications arising from the second safety reviews on the 900 MWe and 1300 MWe reactors continued, along with the thirty-year safety review on the 900 MWe reactors.

EDF also initiated a safety review of the N4 reactor series and will present its conclusions in 2008. Incorporation of the modifications arising from this review is scheduled for the first ten-yearly outages of the N4 series, which will start in 2009 and continue until 2012.

The third ten-yearly outages of the 900 MWe reactors are scheduled to start in 2009. ASN considers this to be a fundamental step in obtaining a precise picture of the condition of the reactors and in analysing EDF's ability to continue to operate them. On the occasion of the third ten-yearly outages of the 900 MWe reactors, ASN will issue its opinion on the conformity of each installation with the applicable safety requirements and the preconditions for their continued operation.

CHAPTER 13

1 PRINCIPAL AREAS OF INSTALLATION REGULATION

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1 | 2 Checking licensee organisation

1 | 3 Promoting operating experience feedback

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3 INSTALLATIONS IN CLOSURE PHASE

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4 OUTLOOK

Manufacture of the fuel and its subsequent reprocessing after it has passed through the nuclear reactors constitute the fuel cycle. However, by convention, the cycle begins with extraction of the uranium ore and ends with disposal of a range of radioactive wastes arising from the spent fuel.

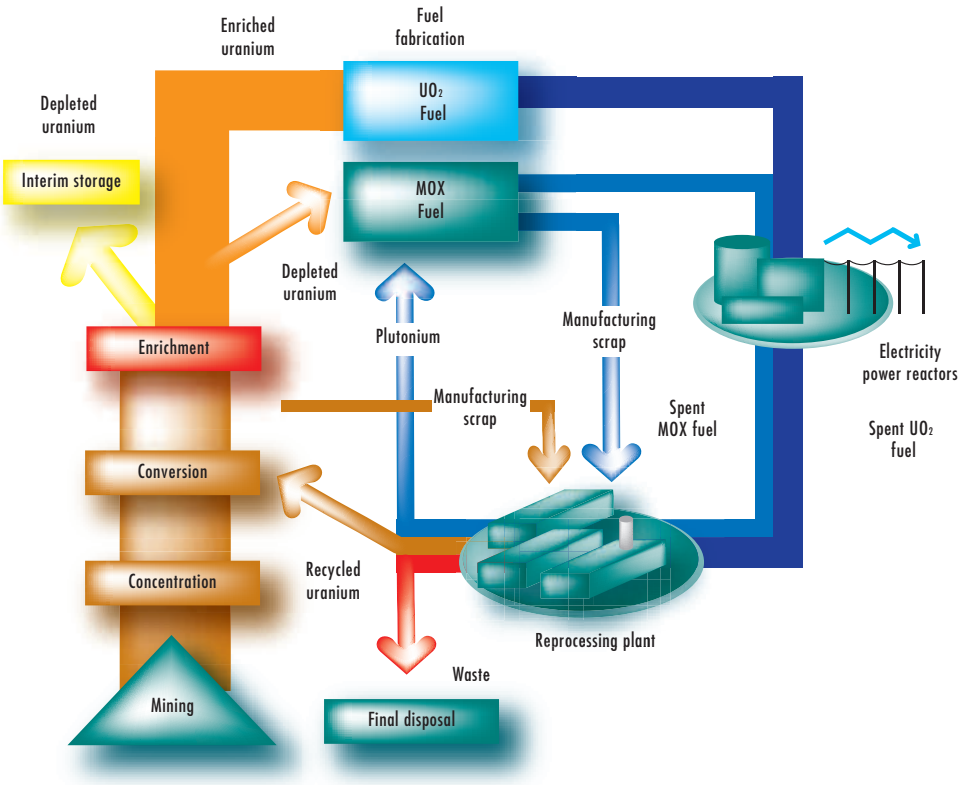
The uranium ore is extracted, then purified and concentrated into "yellow cake" on the mining sites. The solid yellow cake is then converted into uranium hexafluoride gas during the conversion operation. This fabrication of the raw material for enrichment is carried out by COMURHEX in Malvési (Aude *département**) and Pierrelatte (Drôme *département*). The installations involved – which are not regulated as basic nuclear installations (BNIs) – use natural uranium whose uranium 235 content is about 0.7%.

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. Raising the isotopic content of uranium 235 from 0.7% to between 3 and 5% is the role of the EURODIF plant in Tricastin, which separates the uranium hexafluoride by means of a twin-stream gaseous diffusion process, with one stream becoming enriched in uranium 235, while the other becomes depleted during the course of the process.

The process used in the FBFC plant at Romans-sur-Isère transforms the enriched uranium hexafluoride into uranium oxide powder. The fuel pellets manufactured with this oxide are clad to make up the fuel rods, which are then combined to form the fuel assemblies. These assemblies are then placed in the reactor core where they release power by fission of the uranium 235 nuclei.

After about three to five years, the spent fuel is removed from the reactor and cooled in a pond, first of all on the plant site and then in the AREVA NC 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 and then stored for subsequent reuse. The radioactive waste produced by these operations is disposed of in a surface repository if low-level, or in storage pending a final disposal solution.



Fuel cycle

The plutonium resulting from reprocessing can be used to manufacture fuel for fast neutron reactors (as was done in the ATPu in Cadarache). Alternatively, in the Marcoule MÉLOX plant, it can be used to manufacture the MOX fuel (mixture of uranium and plutonium oxides) used in the French 900 MWe PWR reactors.

The main plants involved in the fuel cycle – COMURHEX, AREVA NC Pierrelatte, EURODIF, FBFC, MÉLOX, AREVA NC La Hague – are part of the AREVA group.

Fuel cycle industry movements[1]

Installation	Origins	Material processed	Tonnage	Product obtained	Destination	Tonnage (unless otherwise specified)
COMURHEX Pierrelatte	Marcoule INBS **AREVA NC** Pierrelatte Comurhex Pierrelatte	$UO_2(NO_3)_2$ (derived from reprocessed uranium)	469 4	UF_4 UF_6 U_3O_8	/ / INBS	0 0 537
AREVA NC Pierrelatte TU5 facility	**CEA** Marcoule **AREVA NC** La Hague	$UO_2(NO_3)_2$ (derived from reprocessed uranium)	3,667	U_3O_8	Storage	1,097
AREVA NC Pierrelatte W plant	**URENCO** **EURODIF**	UF_6 (derived from depleted uranium)	8,315	U_3O_8	Storage	6,393
EURODIF Pierrelatte	Converters and **EURODIF** Production Re-enrichment of tails	UF_6 (derived from natural and depleted uranium) UF_6 (derived from enriched uranium)	17,382 1,006	UF_6 (depleted uranium) UF_6 (enriched uranium)	Defluorination and re-enrichment of tails Fuel manufacturers	16,542 2,098
FBFC Romans	**EURODIF** Pierrelatte	UF_6 (derived from enriched natural uranium)	819.026	UO_2 (powder) Fuel elements derived from enriched natural uranium	FBFC, Dessel, NFI, ENUSA EDF KOEBERG	291.887 526.8
MELOX Marcoule	**AREVA NC** Pierrelatte **AREVA NC** La Hague	UO_2 (derived from depleted uranium) PuO_2	124.8 9.8	MOX fuel elements	PNPE EDF FBFC-Dessel	124.3
AREVA NC La Hague	*ND*	Reprocessed spent fuel elements UP3 UP2 800 UP2 400 Spent fuel elements unloaded into pond	 698.13 317.06 0 1 264.69	$UO_2(NO_3)_2$ PuO_2 Vitrified waste packages produced in UP3 Vitrified waste packages produced in UP2 800	*ND*	921.8 11.769 499 containers 485 containers

(1) The table only deals with the movements inside fuel cycle BNIs, including those in the AREVA NC W plant, which is an ICPE (installation classified on environmental protection grounds) located within the boundary of a BNI.

1 PRINCIPAL AREAS OF INSTALLATION REGULATION

1 | 1 Ensuring the consistency of the cycle

ASN ensures the overall safety-related and regulatory consistency of the industrial choices made with regard to fuel management. The question of the long-term management of spent fuel, mining residues and depleted uranium cannot be ignored, and the risks and uncertainties surrounding these industrial choices must be taken into account.

EDF was asked to undertake a forward-looking study in cooperation with the fuel cycle companies, presenting elements concerning compatibility between changes in fuel characteristics or spent fuel management systems and fuel cycle installation developments.

The data submitted by EDF and reviewed to date provide significant clarification of how the fuel cycle operates and the safety issues involved, in particular how changes to fuel management policies may require changes to the technical and regulatory limits, subject to adequate justification.

In order to maintain an overview of the fuel cycle, the data will have to be periodically updated. For any new type of fuel management, EDF will be required to submit a feasibility dossier for this new management process, specifying and justifying any deviations from the "fuel cycle" dossier previously submitted.

An overall revision of this dossier is expected in 2008.

One of ASN's aims is to anticipate and hence avoid saturation of the nuclear power plant storage capacity that has happened in other countries, and to prevent the licensees from using older installations as a remedial interim solution, given that the regulatory and technical requirements to obtain authorisation are less stringent for older facilities.

1 | 2 Checking licensee organisation

Nuclear installation safety is primarily based on the supervision carried out by the licensee itself. In this respect, for each installation, ASN checks that the organisation and resources deployed by the licensee enable it to assume this responsibility.

The restructuring of the AREVA group has led ASN to exercise increased vigilance in this area, in particular with respect to the minor installations. It is important that the fact of centralising resources, particularly financial resources, enables each nuclear licensee declared as such to continue to fully assume its responsibility as licensee.

2007 was an opportunity for ASN to measure initial progress in this respect on the Tricastin site. The work being done to manage the site's flooding risk, the project to create a management centre for non-specific industrial waste common to all group licensees and the implementation of internal general transport rules, all demonstrate the determination of the AREVA group to improve coordination between the various licensees on the Tricastin site.

The deployment of the ORCADE project on the La Hague site dedicated to decommissioning installations no longer in use, is also seen by ASN as a positive step towards improving operational consistency.

Finally, when reviewing new projects, ASN pays particular attention to the financial and technical capacity of the licensees and the organisation put in place to ensure that safety is guaranteed from startup to decommissioning of the installations.

1 | 3 Promoting operating experience feedback

The detection and processing of significant events that have occurred during operation of the installations play a fundamental safety role. The lessons learned from these events lead to new requirements applicable to safety-related items and to new operating rules. Licensees must therefore set up reliable systems for detecting, correcting and learning lessons from all safety-related events.

Graph 1 (following page) presents the trend in the number of significant events reported by fuel cycle installations.

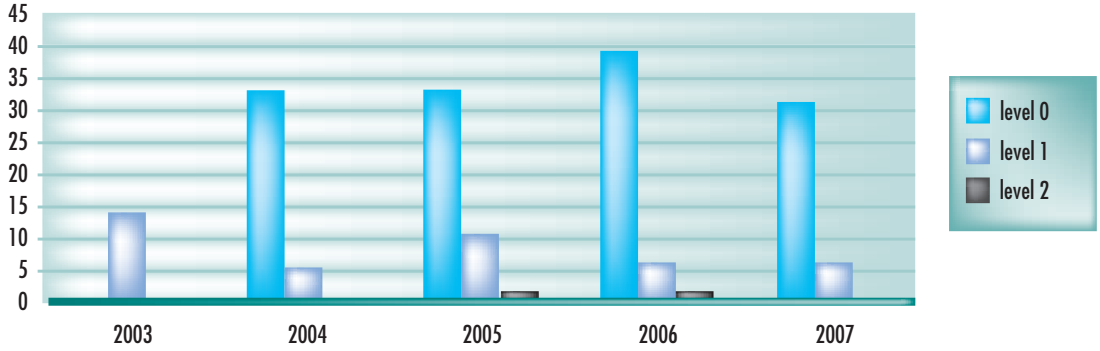
ASN's monitoring of these events and how they are managed by the licensees in particular enables it to identify:

– events recurring on the same installation;

– events requiring operating experience 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.

In terms of operating experience feedback, in a letter dated 17 January 2007, ASN drew the attention of all licensees to two outbreaks of fire caused by a reaction between nitric acid and organic material. ASN asked the various licensees to review the technical and organisational measures implemented to deal with this risk.

Graph 1: evolution of the number of events in fuel cycle installations from 2003 to 2007



2 MAJOR INSTALLATIONS IN OPERATION

2|1 The uranium conversion, processing and enrichment plants in operation at Tricastin

To allow production of fuels usable in the French reactors, uranium ore first has to be converted into UF_6 and then enriched. These operations take place mainly on the Tricastin site, also known as Pierrelatte.

2|1|1 COMURHEX uranium hexafluoride preparation plant

The Comurhex plant in Pierrelatte is designed to manufacture uranium hexafluoride.

This production uses natural uranium in the ICPE part of the plant, or reprocessed uranium in the BNI part of the plant. The latter plant consists of two facilities:

– the 2000 facility, which transforms reprocessed uranyl nitrate ($UO_2(NO_3)_2$) into uranium tetrafluoride (UF_4) or uranium oxide (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.

Facility 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 2004, the licensee also made known its intention to close down the 2000 facility and decommission the entire BNI no later than 31 December 2008.

The site of the present plant should in the next few years be used for the construction of a new installation classified on environmental protection grounds, comprising the fluorine production and fluorination units. If reprocessed uranium were to be used, this would, as in the past, entail classification of part of these installations as a new basic nuclear installation.

2|1|2 AREVA NC TU5 facility and W plant

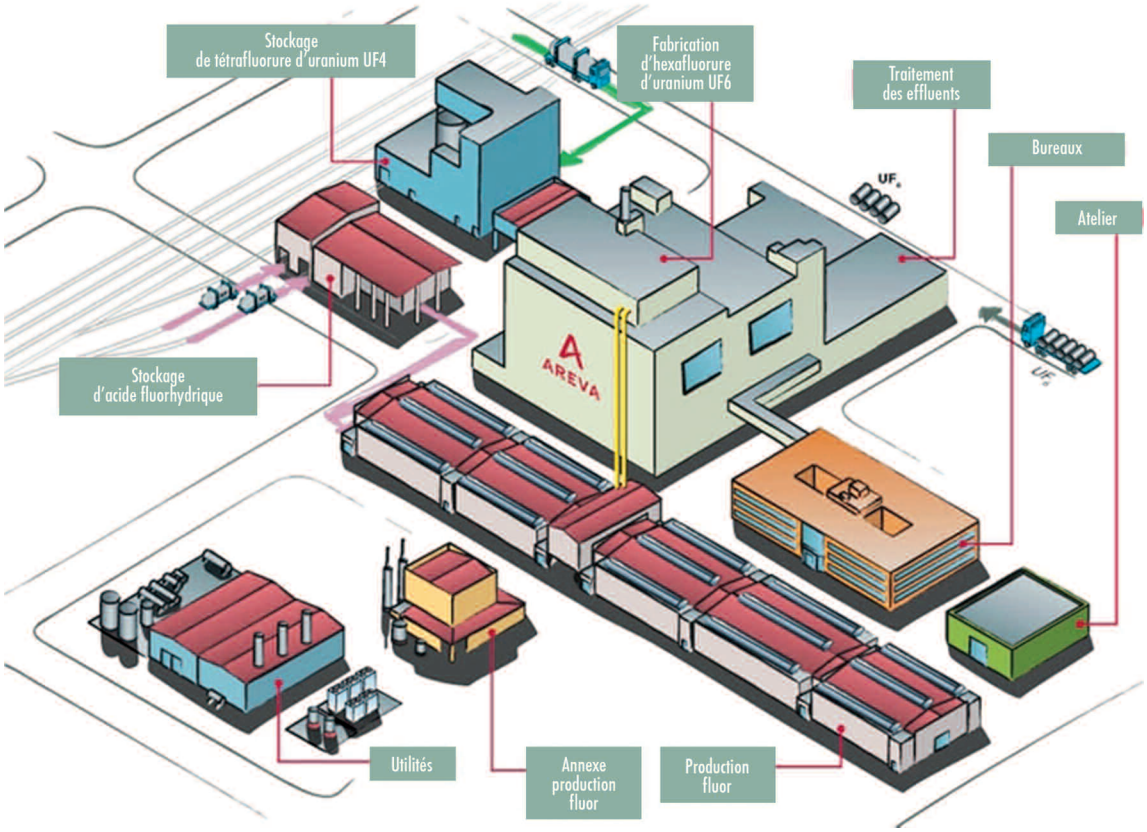
On the Pierrelatte site, AREVA NC operates:

– the TU5 facility (BNI) for conversion of $UO_2(NO_3)_2$, produced by reprocessing spent fuel, into UF_4 or into U_3O_8. However, the current technical configuration of the installation is not compatible with the production of UF_4;
– the W plant (ICPE within the BNI perimeter) for conversion of depleted UF_6 into U_3O_8, a solid compound which offers safer storage conditions and can be used to produce hydrofluoric acid.

The installation can handle up to 2,000 metric tons of uranium per year.

The uranium from reprocessing is partly placed in storage on the AREVA NC Pierrelatte site and partly sent abroad for enrichment.

An incident involving a hydrofluoric acid leak in the chilled water circuit of an exchanger in the W plant was



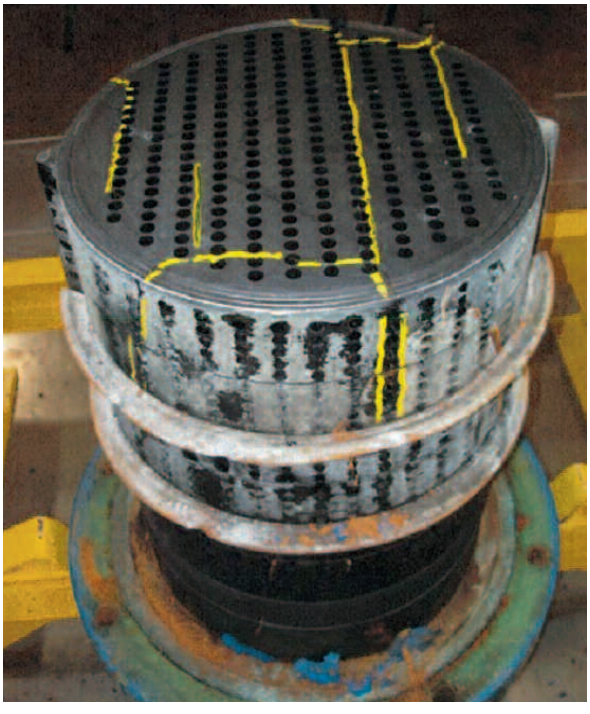
COMURHEX – General view

detected on 13 September 2007. The AREVA NC site installations supplied by the chilled water circuit were damaged by corrosion of the circuits, which were not designed to withstand solutions of hydrofluoric acid. Before the installations, in particular TU5 and W, were restarted, ASN ensured that the licensee had reviewed the risks arising from this incident.

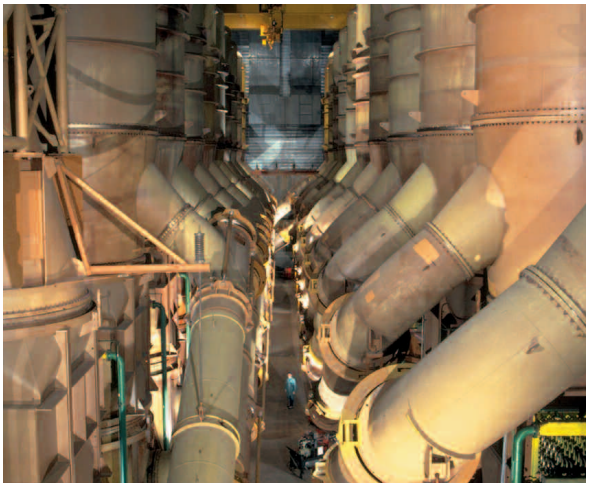
2|1|3 The uranium isotopes gaseous diffusion separation plant (EURODIF)

The isotope separation process used in the EURODIF 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.

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. These barriers give preferential passage to the uranium isotope 235



TU5 – Exchanger cracking



Eurodif – Group of diffusers

contained in the gas, thereby increasing the proportion of this fissile isotope in the UF_6 at each passage.

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.

In the light of the ageing design of this plant, it will be shut down shortly after 2010.

ASN is already monitoring the first studies undertaken by the licensee concerning the shutdown procedures. Given the masses involved – 150,000 tons of steel for the diffusers alone – it is important to anticipate the equipment inventories and characteristics in order to optimise the treatment, disassembly, transport and disposal processes.

Furthermore, to allow the creation of the Georges Besse II plant (see point 2|1|4), the authorisation decree for the EURODIF plant was modified on 27 April. ASN approved the signing of this text in its opinion 2007-AV-0012 of 1 February 2007.

2|1|4 The Georges Besse II ultracentrifugation enrichment plant project

The ultracentrifugation process should eventually replace gaseous diffusion. This process involves rotating a cylindrical bowl containing uranium hexafluoride (UF_6) at very high speed. The centrifugal force concentrates the heavier molecules (containing uranium 238) on the periphery, while the lighter ones (containing uranium 235) are recovered in the centre.

This process has two key advantages over the gaseous diffusion process currently used by EURODIF: on the one hand, it consumes far less energy (75 MW as opposed to 3,000 MW for equivalent production), and on the other, the design is safer (far less nuclear material in the cascades, plus centrifuges below atmospheric pressure).

Creation of the Georges Besse II plant (GBII), which comprises two separate enrichment facilities (South and North) and support facilities, was authorised by a decree on 27 April 2007. After examining the licensee's technical and financial capacity and the safety of the project, ASN approved the signing of this text in its opinion 2007-AV-0010 of 1 February 2007.

The nuclear licensee for this new installation is the Société d'Enrichissement du Tricastin (SET). Building work is continuing and is being monitored by ASN. At the same time, review of the safety cases is ongoing.

As part of its examination of the installation commissioning application, ASN will in particular look at those aspects enabling it to update its assessment of the licensee's technical and financial capacity.

The first cascade should be supplied in early 2009.

The arrangement envisaged by SET when the GBII project was launched, was to rely on a support facility called REC II – an integral part of the GBII BNI – and a TE facility operated by AREVA NC. AREVA decided to merge the TE and REC II functions. The resulting facility, incorporated into the GBII project, could provide services for licensees of other installations on the Pierrelatte site and would have shared resources with the GBII North unit, in particular the storage areas for UF6 containers and the control room.

In autumn 2007, SET therefore submitted an application for a modification to the GBII BNI licensing decree

GBII – Construction site at Tricastin

(168), which will be the subject of a public inquiry. This support installation should enter service by 2011.

2|2 Nuclear fuel manufacturing plants in Romans and Marcoule

After the uranium enrichment stage, the nuclear fuel is manufactured in various installations, depending on the type of reactor for which it is intended. 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.

This fuel, whether intended for PWRs or for fast or experimental reactors, is manufactured at FBFC in Romans-sur-Isère or MÉLOX in Marcoule, the latter installation being designed for the manufacture of fuels containing plutonium.

2|2|1 The FBFC and CERCA uranium-based fuel manufacturing plants

The two basic nuclear installations located on the Romans-sur-Isère site, where they share a number of common facilities, belong to the CERCA and FBFC companies respectively. These two companies are now an integral part of the AREVA group. In the eyes of the regulations, the FBFC company is the sole nuclear licensee for the site.

The CERCA plant comprises a series of facilities for the manufacture of highly enriched uranium based fuel for experimental reactors. FBFC plant production, consisting of uranium oxide powder or fuel assemblies, is intended solely for light water reactors (PWR or BWR).

FBFC fuel elements manufacturing plant

By a decree of 20 March 2006, FBFC was authorised to raise the plant's annual capacity to:

– 1,800 tons for the conversion facility;

– 1,400 tons for the rod, pellet and assembly lines.

At the same time, following the periodic safety review conducted in 2003, the licensee proposed a project to renew and modernise its industrial tool, which was accepted by ASN. This operation is now well under way and the work should continue until 2008.

CERCA plant

The CERCA plant, one of the oldest nuclear sites in France, pre-dates the BNI regulations. The Government was therefore simply notified of this installation in 1967.

FBFC – New autoclaves at Romans-sur-Isère

ASN would like to see the operations of this plant covered by a decree, as is the case with the FBFC fuel manufacturing plant. The procedure could be started on the occasion of an application for modification of the installations and be based on the results of the periodic safety review carried out for this plant.

The conclusions of the periodic safety review on the CERCA facilities were presented to the Advisory Committee for nuclear laboratories and plants in 2006.

Further to this review, ASN identified two areas for progress. The first area is the consideration given to human factors in day-to-day operations and the corresponding need for skills enhancement. The second concerns the storage areas for the waste arising from the site's activities, the organisation and management of which need to be improved.

The licensee must also review the criticality risk in certain facilities, in order to minimise as far as possible the potential consequences of an accident, in particular with regard to off-site exposure to radiation.

CERCA – General view of the facility at Romans-sur-Isère

2 | 2 | 2 The MÉLOX uranium and plutonium-based fuel manufacturing plant

The MÉLOX plant is today the only French nuclear installation producing MOX fuel, consisting of a mixture of uranium and plutonium oxides.

In a decree of 20 March 2007, MÉLOX was authorised to raise the production capacity of its Marcoule plant to 195 tons of heavy metal. After clarifying the relations between the nuclear licensee AREVA NC and the industrial operator, MÉLOX SA, ASN approved the signing of this text in its opinion 2007-AV-0011 of 26 January 2007.

In the context of this capacity increase, ASN is particularly attentive to ensuring that the licensee continues with and steps up actions to optimise radiation protection.

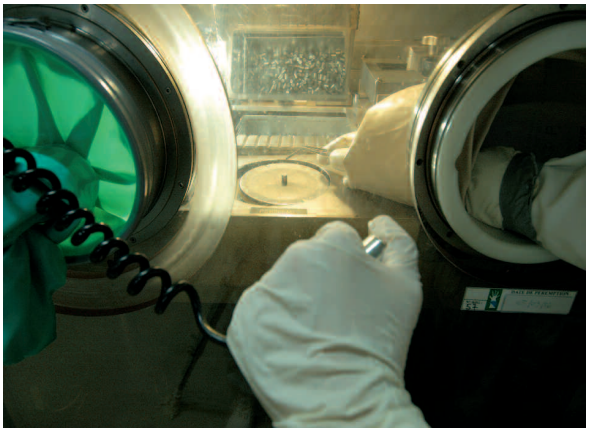
2 | 3 AREVA NC reprocessing plants at La Hague

2 | 3 | 1 Site description

The La Hague plant, designed for reprocessing of fuel irradiated in the power reactors (GCR then PWR) is operated by the Compagnie générale des matières nucléaires (AREVA NC), which replaced CEA as nuclear licensee under the terms of a decree of 9 August 1978.

The various facilities in the UP3, UP2 800 and STE 3 were commissioned from 1986 (reception and storage of spent fuel) to 1994 (vitrification facility), with most of the process facilities becoming active in 1989/1990.

The decrees of 10 January 2003 set the individual capacity of each of the two plants at 1,000 tons per year of metal before passage in the reactor (U or Pu), and limit the total capacity of the two plants to 1,700 tons.



MELOX – Check on pellets in a glove box in Marcoule

The discharge limits and conditions were revised by the order of 8 January 2007.

Spent fuel reprocessing in the UP2-400 plant has now stopped. The production facilities in the UP2 400 plant have been shut down (see point 3).

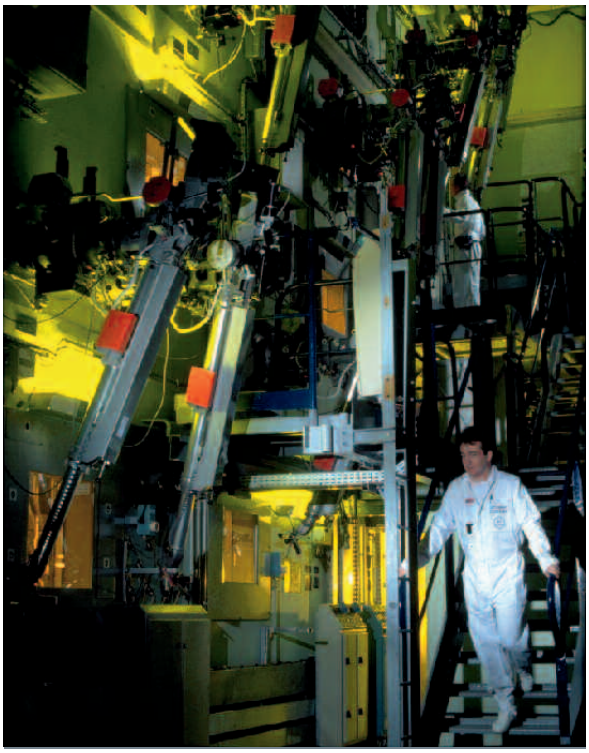
Operations carried out in the plant

The equipment in these facilities comprises the following in succession: reception and storage installations for spent fuel, then facilities for shearing and dissolving it, chemical separation of fission products, final purification of the uranium and plutonium and treatment of effluents.

The first operations to take place in the plant are reception of the transport containers and storage of the spent fuel. Upon arrival at the reprocessing plant, the containers are unloaded, either underwater, in a pond, or dry, in a leak-tight shielded cell. The fuel is then stored in the ponds.

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



AREVA NC La Hague – Remote-manipulator in the T7 vitrification facility

The installations at La Hague

• **INB 33:**	*UP2 400 plant, the first reprocessing facility*
HAO/North:	*facility for underwater unloading and spent fuel storage*
HAO/South:	*facility for shearing and dissolving of spent fuel elements*
HA/DE:	*facility for separation of uranium and plutonium from fission products*
HAPF/SPF (1 to 3):	*facility for fission product concentration and storage*
MAU:	*facility for uranium and plutonium separation, uranium purification and storage in the form of uranyl nitrate*
MAPu:	*facility for purification, conversion to oxide and initial packaging of plutonium oxide*
LCC:	*product central quality control laboratory*
• **BNI 38:**	*STE 2 installation: collection, treatment of effluents and storage of precipitation sludges in AT1 facility, prototype installation currently being decommissioned*
• **BNI 47:**	*Elan II B facility, CEA research installation currently being decommissioned*
• **BNI 116:**	*UP3 plant*
T0:	*facility for dry unloading of spent fuel elements*
D and E ponds:	*ponds for storage of spent fuel elements*
T1:	*facility for shearing of fuel elements, dissolving and clarification of solutions obtained*
T2:	*facility for separation of uranium, plutonium and fission products, and concentration/storage of fission products solutions*
T3/T5:	*facilities for purification and storage of uranyl nitrate*
T4:	*facility for purification, conversion to oxide and packaging of plutonium*
T7:	*facility for vitrification of fission products*
BSI:	*facility for plutonium oxide storage*
BC:	*plant control room, reagent distribution facility and process control laboratories*
ACC:	*hull and end-pieces compacting facilities*
• **BNI 117:**	*UP2 800 plant*
NPH:	*facility for underwater unloading and storage of spent fuel elements in pond*
C pond:	*pond for storage of spent fuel elements*
R1:	*facility for shearing of fuel elements, dissolving and clarification of solutions obtained*
R2:	*facility for separation of uranium, plutonium and fission products and concentration of fission products solutions*
R4:	*facility for purification, conversion to oxide and first packaging of plutonium oxide*
SPF (4, 5, 6):	*facilities for storage of fission products*
BST1:	*facility for secondary packaging and storage of plutonium oxide*
R7:	*facility for fission products vitrification*
• **BNI 118:**	*STE 3 facility: effluent recovery and treatment and storage of bituminised packages*

uranium and plutonium contained in the solutions, and then of the uranium from the plutonium.

After purification, the uranium, in $UO_2(NO_3)_2$ form, is concentrated and stored. It is intended for conversion into a solid compound (U_3O_8) in the Pierrelatte TU5 installation.

After purification and concentration, the plutonium is precipitated by oxalic acid, dried, calcinated into plutonium oxide, packaged in sealed boxes and placed in storage. The plutonium can be used in the manufacturing of MOX fuel. The plutonium from foreign fuel is returned to the licensees in the country of origin.

AREVA NC La Hague – Aerial view

The production operations, from shearing up to the finished products, use chemical processes and generate gaseous and liquid effluents. These operations also generate what is called "structural" waste.

The gaseous effluents are 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.

The spent fuel solid radioactive waste from French reactors is sent to the low and intermediate level, short-lived waste repository at Soulaines (see point 6|1|2 of chapter 16) or stored pending a final disposal solution.

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. In order to guarantee fair distribution of the waste among its various customers, the licensee proposed an accounting system for monitoring items entering and leaving the La Hague plant. This system is currently being examined by ASN, at the request of the General Directorate for Energy and Raw Materials (DGEMP).

2|3|2 Plant changes

The plant authorised operating framework

The revision of the La Hague site nuclear installations licensing decrees, which was completed on 10 January 2003, is a technical decision designed to allow changes to the activities in the installations in satisfactory safety and environmental protection conditions, and in compliance with the regulations.

The reference fuel elements for which reprocessing was envisaged at the time of publication of the old decrees are relatively unrepresentative of the fuel elements currently loaded into the reactors, a difference that will be accentuated in the future. This revision was therefore necessary to allow management of today's fuel movements. The authorised modifications also combine improved nuclear safety with greater environmental protection, through the use of the best available techniques.

AREVA NC La Hague – Interim storage of waste drums in the ADT facility

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 STE 3 facilities for recycling, processing, packaging or storing radioactive substances (effluents, waste, scrap, etc.) and nuclear materials (uranium, plutonium, new fuels) from other facilities, could prove to be of benefit during decommissioning or when retrieving legacy waste.

The decrees published on 11 January 2003 in the Official Gazette therefore 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 decision of ASN.

Adaptation of the industrial tool

Environmental protection concerns and new market trends require the licensee to modify its industrial tool. A number of projects to that end were therefore examined in 2007 and are presented below.

The cold crucible project

Between 1966 and 1985, the reprocessing of Umo (molybdenum alloy) and MoSnAl (molybdenum, tin, aluminium alloy) GCR fuels generated fission product concentrates with a high concentration of molybdenum and phosphorus, which are hard to incorporate into an aluminoborosilicate vitreous matrix. They were stored in tanks in the SPF2 facility, pending possible incorporation into a glass matrix. The solutions stored must now be recovered and packaged. AREVA NC research into a packaging process has led to the development of a vitroceramic type aluminosilicophosphate matrix which would be able to incorporate a large mass of Mo03 while offering good resistance to leaching. This glass will be produced in a cold crucible. The glass poured into this crucible is induction heated, with the metal structure of the crucible being externally cooled, allowing the formation of a protective auto-crucible with high temperatures being obtained at its centre. The work necessary for installation of the cold crucible on line B in the R7 facility was authorised on 18 July 2007.

The cold crucible will also allow incorporation into a vitreous matrix of the sludges created by processing of the effluents from the rinsing involved in the legacy waste recovery operations.

The 3D project

The "3D" project is a range of operations involving removal from storage, cladding removal and dissolving prior to reprocessing of the non-irradiated MOX fuel materials. Implementation of this project required work in the HAO/North and T4 facilities. In 2007, ASN authorised startup of the pellets line and qualification of dissolution in the URP along with reprocessing of "KALKAR" materials packaged in the ESBB 210 container.

Adaptation of the vitrified residues storage removal facility (DRV)

AREVA NC requested authorisation to take delivery of and load TN 85 containers in the DRV so that foreign waste could be returned to Germany. The first TN 85 loads were carried out in the last quarter of 2007. Three high-level vitrified waste (CSD-V) shipments, each consisting of eleven TN 85 or CASTOR HAW 28 M containers, should take place by the end of 2010.

Safety review

Article 29 of Act 2006-686 on Transparency and Security in the Nuclear Field requires that every ten years, the licensee conduct a safety review of its Basic Nuclear Installations (BNIs), taking account of the best international practices. This review should allow an assessment of the compliance of the installation with the rules applicable to it, and an up-to-date evaluation of the risks or drawbacks presented by the installation in terms of security, public health and safety, or protection of nature and the environment, taking particular account of the condition of the installation, experience acquired during the course of operation, new knowledge and the rules applicable to similar installations.

At the request of ASN, AREVA NC in 2007 presented the safety review for BNI 118, which includes the effluent treatment station (STE3), the solvents mineralisation installation (MDS B) and the sea discharge outfall pipe. In 2008, ASN will issue an opinion on the determinations of this review.

3 INSTALLATIONS IN CLOSURE PHASE

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, AREVA NC halted industrial activities in the ATPu in mid-July 2003. The effectiveness of this shutdown was confirmed by ASN inspectors during the course of an unannounced inspection on 1 August 2003.

This shutdown commits the ATPu and its support laboratory, the LPC, to a common final shutdown and decommissioning process to be authorised by decree. Against this backdrop, the licensee submitted in 2006 a common dossier for each of the two installations, pursuant to Article 6 *ter* of the decree of 11 December 1963, along with the impact assessment required by the Environment Code (see chapter 15, point 2|2|3).

3|2 Former AREVA NC La Hague installations

3|2|1 Retrieval of legacy waste

This point is also covered in chapter 16.

Unlike the new UP2 800 and UP3 plants, most of the waste produced during operation of the first plant, UP2 400, was placed in storage without packaging for disposal. The operations involved in recovering this waste are technically difficult and require the use of considerable resources. The issues linked to the age of the waste, in particular its characterisation prior to any recovery and reprocessing, confirm 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.

Subsequent to the November 2005 review of the waste management policy in use at the La Hague establishment by the Advisory Committees for laboratories and plants and for waste, ASN confirmed the need for recovery as early as possible of the sludges stored in the STE 2 silos, the waste in the HAO silo and the waste in the building 130 silo, along with the primarily alpha waste drums stored in building 119 in BNI 38, which offer inadequate safety guarantees.

STE 2 sludge

In recent years, processing of STE 2 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. These methods have now been determined and efforts are now being concentrated on the packaging itself.

The packaging system today adopted by AREVA NC consists in bituminisation using a process employed in the STE 3 facility. In 2002, AREVA NC was authorised to take samples from one of the silos. The result of the analysis conducted in 2003 by ASN and its technical support organisation, IRSN, 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 in 2005 to produce 3,000 drums in the first three years of operation, while continuing to investigate alternative solutions. ASN asked the licensee to validate the chosen scenarios, by carrying out a series of experiments. The feedback from this campaign led the licensee to propose further modifications to the sludge encapsulation process. This was examined by ASN, which did not authorise production of the planned 3,000 drums, in the light of the modifications made. However, in order to gain new insights, ASN in June 2007 asked the licensee to carry out a further series of experiments (3 x 36 drums) in the latest encapsulation conditions defined.

The licensee is also continuing its research into alternative processes. Cement encapsulation and the drying process (DRYPAC) were identified as being technically suitable. However, prior drying of the sludge requires further additional research.

HAO silo and SOC1

The HAO silo contains various waste comprising hulls, end-pieces, fines (dust produced mainly by shearing), resins and technological waste resulting from operation of the HAO facility from 1976 to 1997.

The decommissioning scenario, presented by the licensee in March 2005, comprises five phases. The first two consist in recovering and packaging the structural waste and the technological waste from the silo. The waste recovered in this way will be transferred to the ACC facility and packaged in CSD-C packages. The third phase comprises the recovery and packaging of fines and resins. The fourth phase, the last one concerning the silo, consists in recovering waste from the bottom of the silo by an appropriate mechanical system. The fifth phase comprises recovery of the SOC cursors before routing to the ACC facility.

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 has already been done. The detailed preliminary studies were extended into 2007 with the aim of simultaneous recovery of the fines and resins as well as the hulls and end-pieces.

Silo 130

Following the announcement of postponement of the creation of a graphite waste disposal route, the licensee stated that its strategy would have to change, but that in any case, the aim of recovering the waste from silo 130 was maintained. The operations will therefore require storage of the waste recovered.

The licensee's current project therefore comprises four phases. The first is to transfer the GCR waste before storage in the D/E EDS facility. The second is to empty and treat the water from the silo in the STE installations. The final phases will enable the waste to be recovered from the bottom of the silo along with the rubble.

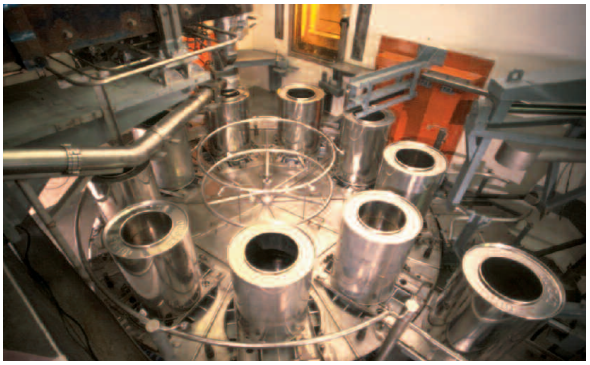
At the end of 2007, ASN undertook a review of the application for authorisation to carry out the preliminary development work, in particular the installation of silo waste recovery and removal cells.

The first on-site tests are now scheduled for 2010.

At the request of ASN, the licensee in 2007 forwarded a safety analysis study concerning the consequences and the management of a possible loss of containment of this silo.

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 containing molybdenum, the licensee has opted for cold crucible vitrification (see point 2|3|2).



AREVA NC La Hague – Drum filling equipment in the STE3 station

The first cold crucible should enter service on the La Hague site in 2011, for packaging of solutions between 2011 and 2017.

Emptying of building 119 in BNI 38

An overall strategy was implemented by the licensee for priority treatment of the existing drums of alpha waste, which are currently stored in building 119.

At the end of 2006, ASN thus authorised the licensee to receive, store in conditions of adequate safety and process in the D/E EB facility in BNI 118, the drums of alpha waste from the French MOX fuel manufacturing plants.

ASN examined an application made in July 2007 for extending this authorisation to cover drums of alpha waste produced at the La Hague site, so that the processing capacity be entirely dedicated to building 119, thus reducing the lifetime of this installation.

A further compacting facility, enabling a larger volume of alpha waste to be handled, will be commissioned in 2013.

3|2|2 Final closure of the UP2 400 plants in the STE 2 installation

On 30 December 2003, the licensee notified its decision to stop processing spent fuel in the UP2 400 facility as of 1 January 2004. This notification came together with a dossier presenting the operations scheduled for the final closure (CDE) phase of the various facilities concerned in this plant and the corresponding effluent treatment station. The licensee took the necessary organisational measures, setting up the ORCADE project to manage the final closure operations for the UP2 400 facilities and the legacy waste recovery programmes.

The CDE phase enables the licensee to carry out certain operations to prepare the installation for the decommissioning phase. These operations must be either covered by the operational framework, or be authorised by ASN. In the case of the HAO/South and MAPu facilities, the licensee submitted the safety analysis dossiers for dismantling of certain types of equipment (in particular glove boxes and shears) which are no longer needed. Some of these operations were carried out in 2005 and 2006. For 2007, the licensee asked that equipment dismantling be continued, particularly of the shearing machine frame. The licensing application is currently being reviewed by ASN.

ASN also firmly and repeatedly urged AREVA NC to submit the final shutdown and decommissioning dossier

(MAD/DEM) as rapidly as possible for the BNIs corresponding to the UP2 400 plant and the STE 2 installation, i.e. BNIs 33, 38 and 80. The licensee's current approach will involve the production of the MAD/DEM dossier in several stages, and the licensee therefore submitted a provisional version of the dossiers for BNI 80 in May 2007; transmission of the dossiers for the other BNIs (33, 38 and 47) is scheduled for the first quarter of 2008. BNI 80 will however continue to receive fuels that cannot be accepted by the UP3 and UP2 800 plant facilities until such time as the necessary modifications are made to allow reception of this waste in one of the two plants, and will then carry out transfers to the UP3 and UP2 800 ponds.

4 OUTLOOK

Manufacture of the fuel and its subsequent reprocessing after it has passed through the nuclear reactors constitute the fuel cycle. In 2007, the fuel cycle installations experienced no significant safety problems. However, in a context in which economic pressures are being increasingly strongly felt, ASN makes sure that nuclear safety remains the number one priority of the licensees.

The incorporation into the AREVA group of all the French fuel cycle licensees has increased the degree of consistency between the various installations, a fact that can only improve safety.

In this respect, the AREVA group continued in 2007 to transfer its activities to the Tricastin site, with the announced shutdown of former installations such as BNI COMURHEX or EURODIF. This installation will be replaced by a new centrifugation enrichment plant which will significantly boost safety, in particular owing to a reduction in the quantities of UF_6. ASN considers these changes to be positive steps.

On the Romans-sur-Isère site, the year 2007 was marked by the continued commissioning of new equipment associated with the renovation of the FBFC company's plant and by the safety review conducted on the facilities of the CERCA company. ASN expects confirmation of the progress already achieved in terms of safety and improved management of the site's waste storage facilities. It will be particularly attentive to the satisfactory running of these programmes as well as to the improvements actually observed.

With regard to the MÉLOX plant at Marcoule, ASN will be focusing its attention on two points: dosimetry management and the ability to prevent risks related to human factors. ASN will here be taking account of both the rise in production capacity without significant modification to the industrial tool, and changes to the materials used. These two points for surveillance will be at the heart of ASN's regulatory action in the coming years.

Finally, the efforts devoted every year to checking the installations on the La Hague site confirm ASN's opinion of the professional way in which the site is operated. However, ASN would like to see the same degree of stringency applied to the quality of the dossiers submitted to it, in particular those relating to the installations periodic safety reviews. ASN will also be particularly attentive to licensee compliance with deadlines for the recovery of legacy waste and the return of foreign waste to its country of origin. The shutdown and decommissioning of a number of old facilities in the UP2 400 plant are among the top priorities that are and will continue to receive close and sustained attention from ASN. In this respect, at the request of ASN, the Advisory Committee for plants will shortly be examining the BNI 80 decommissioning operations selected by AREVA NC. The aim will be to identify on the one hand anything that is unacceptable in terms of safety, radiation protection or waste and effluent management, and on the other those operations which, before they can start, could require a specific safety review if stipulated in the decree authorising final shutdown and decommissioning.

CHAPTER 14

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4 OUTLOOK

Nuclear research facilities and installations not directly linked to the nuclear electricity generating industry cover all the basic nuclear installations (BNIs) of the civil part of the French Atomic Energy Commission, the basic nuclear installations of other research organisations, and a few other basic nuclear installations which are neither power reactors, nor nuclear fuel cycle facilities.

1 ATOMIC ENERGY COMMISSION INSTALLATIONS

The facilities of the Atomic Energy Commission (CEA) Centres include various BNIs (experimental reactors, laboratories, etc.). Research is focused notably on the lifetime of operating plants, future reactors, fuel performance and nuclear waste.

The action of the Nuclear Safety Authority (ASN) may be considered at several levels:
– working with the General Administrator, ASN verifies CEA's compliance with its main undertakings, in particular with regard to planned new installations, upgrading older installations and waste management, especially in terms of compliance with the specified time-frames and handling of the safety and radiation protection issues;
– working with the Directorate for Nuclear Protection and Safety, reporting to CEA's general administrator, ASN develops a national overall approach to "generic" subjects concerning several installations or several centres;
– working with CEA Centres, ASN reviews the safety documents specific to each of CEA's BNIs, as and when necessary. The main contacts are the Centre manager and the head of the installation concerned.

Point 1|1 below lists the generic subjects which marked the year 2007. Point 1|2 describes topical events in the various CEA installations currently operating. The installations currently undergoing clean-out or decommissioning are dealt with in chapter 15 and those devoted specifically to the storage of waste and spent fuel are covered in chapter 16.

1|1 Generic subjects

Through inspection campaigns and analysis of the lessons of operating experience, ASN identifies generic topics on which it queries CEA. These topics can lead to requests on the part of ASN and possibly to a stance being adopted following review of a dossier. The subjects of particular interest to ASN in 2007 were the criticality risk, management of installation civil engineering operations, and the consideration given to human and organisational factors in safety management at CEA.

On 12 September 2007, the ASN Commission interviewed the CEA General Administrator, during which CEA's nuclear safety and radiation protection organisation and policy were discussed. ASN notified CEA of the points on which it felt that progress was necessary, in particular with regard to the legibility of its safety organisation and policy. The main significant events of 2006 were also discussed. CEA presented the contents of its risk management summary published in June and ASN explained its assessment of safety at CEA in its annual report, published in April. Finally, a number of topical points were addressed, in particular the creation or complete decommissioning licences currently being reviewed, and on which ASN should be issuing an opinion in the coming months.

1|1|1 Monitoring of CEA's compliance with its main nuclear safety and radiation protection commitments

In 2006, ASN stated that it wanted to see effective monitoring of CEA's compliance with its safety and radiation protection commitments, by means of an efficient control tool that offered transparency for the safety authority, in particular with regard to the decision-making process. CEA therefore presented ASN in 2007 with a list of fifteen major safety and radiation protection commitments. Monitoring of compliance with these commitments will be regular and will be shared by ASN and CEA. ASN considers this action to be particularly satisfactory.

These commitments in particular include:

For the experimental reactors
– upgrading of CABRI and construction of its new water loop;
– the MASURCA safety review, including major seismic conformity and fire protection work.

For the laboratories
– compliance with ASN requirements following commissioning of ATALANTE and its periodic safety review;
– compliance with the time-frames regarding removal from storage of fissile materials in MCMF and ATPu.

For waste storage and processing installations
– removal from storage of certain wastes and effluents and safe transfer to other installations (PEGASE, PARC, ZGEL, STEDS);

– commissioning of the installations scheduled to replace the older ones, in particular STELLA and AGATE.

1|1|2 Increased CEA responsibility as a nuclear licensee

ASN wished to see a system of enhanced internal supervision applied to certain modifications made to CEA installations, which it felt to be significant from the safety and radiation protection standpoints. It therefore authorised CEA to set up an "internal authorisations system" (see chapter 3, point 2|1|1).

ASN therefore asked the CEA Centre directors, with the assistance of the Centre safety units and, as applicable, safety commissions, to apply this "internal authorisations system" to certain operations that were particularly sensitive from the safety and radiation protection viewpoints, but which did not compromise the installation's safety case. The framework of this internal authorisations system and the procedures for updating the safety reference system for the installations concerned, were clarified in two ASN guides (SD3-CEA-01 and SD3-CEA-02).

ASN has been regularly monitoring the system since it entered service and it has proven to be satisfactory. However, ASN considers that CEA must further improve its awareness of the safety issues involved in the various modifications made to its installations. Continued efforts need to be devoted to justifying that the planned operations still comply with the safety case and to ensuring that the various files are consistent with the reference documents and operating experience.

In the light of the operating feedback and pursuant to the Act on Transparency and Security in the Nuclear Field ("TSN Act") and its implementing decree 2007-1557 of 2 November 2007, particularly its Article 27 which now regulates the "internal authorisations system", ASN is continuing its work to update this system for CEA's installations.

1|1|3 Periodic safety reviews of CEA 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. A schedule of periodic safety reviews for the coming 6 years has been approved by ASN. In 2002, ASN had informed the licensees that it considered a review of the safety of the older installations to be necessary approximately every 10 years. This provision is now contained in the TSN Act of 13 June 2006.

In 2005, ASN also detailed its expectations with regard to the safety reviews of CEA installations, in terms of responsibility, content and schedule, in the form of an ASN guide (SD3-CEA-05). These provisions were applied by CEA for the first time in the periodic safety review of the Orphée reactor in CEA's Saclay Centre, for presentation to the Advisory Committee for nuclear reactors in 2008.

The recent CEA laboratory periodic safety reviews concerned the Spent Fuel Testing Laboratory (LECI), the Active Fuel Examination Laboratory (LECA) and the ATALANTE installation.

For the LECI, ASN authorised commissioning of the new building in July 2006, with authorisation to continue operations in the old building.

For the LECA, for which the safety review was conducted in 2001, ASN authorised implementation of the renovated installation's safety reference system in July 2007, following completion of most of the upgrade work.

Finally, the ATALANTE installation on CEA's Marcoule site underwent a final commissioning in-depth periodic safety review in 2007. Following this review, ASN authorised final commissioning while stipulating additional requirements concerning completion of the seismic conformity work (decision 2007-DC-0050 of 22 June 2007).

For the research reactors, the latest periodic safety reviews concerned CABRI and MASURCA on the Cadarache site.

The CABRI periodic safety review and examination of the modification of its experimentation loop took place in 2004. The upgrade work is in progress and the installation will again be presented to the Advisory Committee in 2008 prior to restart.

In March 2006, the periodic safety review file for the MASURCA critical mock-up was reviewed by the Advisory Committee for nuclear reactors. In June 2006, ASN authorised the licensee to continue with renovation of its installation in accordance with the presented methodology.

These safety reviews often entail extensive upgrading work in areas where the regulations have changed significantly, in particular compliance with seismic loading requirements, fire protection and containment. ASN supervises all the work and the subsequent re-qualification procedures, in accordance with principles and a schedule that it itself approves.

1|1|4 Monitoring of sub-criticality at CEA

The prevention of the criticality risk at CEA has been closely monitored by ASN since 2004. The incidents, inadequacies and shortcomings detected during inspections or in dossiers with a "criticality" aspect, led ASN to ask CEA in 2005 to conduct a rigorous assessment of how it manages the criticality risk. CEA provided the results of this assessment in 2006, concluding that its organisation in this field was satisfactory.

However, a further significant event that occurred in 2006 calls these conclusions into question, as the steps taken by CEA for transfer of fissile materials between its installations are unable to guarantee complete reliability during the transfers.

ASN therefore intensified its regulation of this field by carrying out more in-depth criticality inspections in the Saclay and Cadarache Centres. ASN also entrusted an analysis of the criticality risk prevention organisation within CEA installations to an expert third party. Finally, ASN asked CEA to send it an action plan by the end of 2007 to ensure that the priorities identified by CEA headquarters are better implemented at centre and installation levels.

1|1|5 Management of sealed sources of ionising radiation at CEA

Since 2002, CEA has no longer enjoyed its traditional waiver of the need to obtain a licence to possess and use sources of ionising radiation. In order to ensure a transition towards an ordinary law regime, ASN asked CEA in 2002 to clarify the measures it intended to take to ensure implementation of the requirements of the Public Health Code. During the course of 2003, CEA submitted to ASN proposed arrangements for ionising radiation source management. ASN accepted the general principles of these arrangements.

As of 2004, CEA gradually applied the requirements of its arrangements in its centres. CEA thus sent ASN the source possession and use licence applications for each Centre, and they are currently being examined. At the request of ASN, CEA in 2007 updated the management rules for sources of ionising radiation; these new rules, applicable to all CEA installations, incorporate the regulations currently in force. CEA also submitted several individual centre dossiers to extend the sealed source operating life beyond 10 years. Other more generic files dealing with sources are still to be finalised. These mainly concern updating of the installations safety reference systems and formalising ionising source registration with IRSN.

1|1|6 Revision of water intake and discharge licences

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.

Water intake and effluent discharges from CEA's Grenoble site are regulated by the order of 25 May 2004.

Those on the Cadarache site are covered by 3 interministerial orders of 25 April 2006 and orders of the *préfet** dated 12 August and 12 September 2005 allowing consistent regulation of all radioactive and chemical discharges from the Centre.

The Saclay Centre submitted a file applying for renewal of its water intake and discharge licence in August 2006. The revision procedure continued in 2007, with a public inquiry in particular being held.

Other applications concerning individual BNIs are also being reviewed, either for installations being created or for modifications to the existing operating conditions.

1|1|7 Assessment of seismic hazards

On the occasion of the periodic safety review of the LEFCA installation in 2004, ASN made a number of requests concerning the seismic risk on the Cadarache site. In 2005, CEA presented a programme aimed at enhancing its knowledge of the question, in particular by means of a study of the particular site effects, under the supervision of a steering committee consisting of experts in the field. Periodic reports are issued concerning this study, with CEA's aim being to provide significant data in 2008.

Moreover, following problems detected during the course of inspections or during file reviews with regard to the strength of the civil engineering works in several installations, and at the request of ASN, CEA introduced 2nd level in-depth inspections entrusted to the "civil engineering" expertise centre and drafted a methodology guide specific to these operations with a view to improving their management. ASN considers these initial improvements to be satisfactory and will be closely monitoring their effects in the installations in order to assess their effectiveness.

*In a *département*, representative of the State appointed by the President.

1 | 1 | 8 Experimental reactor cores and devices

ASN is paying particular attention to the regular core configuration modifications made in the experimental reactors, as well as to the experiments conducted in them, owing to the particular risks that are sometimes involved.

ASN therefore drafted a guide (SD3-CEA-04) to cover the design, construction and licensing of experimental irradiation devices introduced into the cores of these reactors. This came into force in July 2004. In 2007, ASN finalised its updating in order to take advantage of the operating feedback from its implementation. To define the technical design requirements of a new experimental device, the ASN guide makes reference to a technical design guide produced by CEA. The update of this guide, produced for the same reasons and to take account of the ASN requests, was reviewed in 2007 by ASN and its technical support organisation. This review will be completed in 2008.

1 | 2 Topical events in CEA research facilities

This part only deals with research installations and the installations they require in order to operate. Installations currently undergoing clean-out and decommissioning are dealt with in chapter 15 while those devoted primarily to storage of waste and spent fuel are covered in chapter 16.

1 | 2 | 1 CEA Centres

a) Cadarache Centre

The Cadarache Centre is located at Saint-Paul-lez-Durance, in the Bouches-du-Rhone *département**. It employs about 4500 people (all contractors included) and occupies a surface area of 1600 hectares. As part of CEA's strategy of specialising its centres as "centres of excellence", Cadarache deals mainly with nuclear energy. It comprises about twenty BNIs, including two operated by AREVA (ATPu and LPC) and two others used by IRSN for its research programmes (CABRI and PHEBUS). The purpose of these installations is R&D to support and optimise existing reactors and design the new generation of systems. Research is also carried out into uranium and plutonium based fuels. The Centre, which also comprises a secret basic nuclear installation, is involved in a number of new projects, in particular the siting of the future Jules Horowitz experimental reactor in the Centre itself, and the ITER international facility nearby.

ASN believes that the following points in particular will need to be supervised at the Cadarache Centre:
– upgrading of the old installations;
– completion of new projects to replace older installations which are scheduled for final shutdown;
– inclusion of new civil engineering seismic strength requirements, including site effects.

b) Saclay Centre

The Saclay Centre is located about 20 km from Paris in the Essonne *département*. It occupies an area of 223 hectares, including the Orme des Merisiers annex. In 2006, CEA head offices moved from their Paris premises and relocated at CEA Saclay.

This centre of excellence has been devoted to material sciences since 2005 and therefore plays an active role in the Saclay plateau development as part of the Île-de-France regional development and planning master plan.

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 nuclear systems.

The Centre also houses an office of the National Institute for Nuclear Science and Techniques (INSTN), whose role is teaching, and two industrial companies: Technicatome, which designs nuclear reactors for naval propulsion systems, and CIS Bio International, specialising in medical technologies, especially radioactive marking of molecules, manufacturing of products used in nuclear medicine for therapy and imaging, as well as in vitro medical diagnosis and molecular screening.

ASN considers that the following points in particular would need to be supervised in the Saclay Centre:
– maintaining the nuclear safety performance of the BNIs in a centre focused primarily on non-nuclear activities,
– including nuclear safety in the decisions taken concerning the development of future activities in the Centre.
– controlling urban development around the Centre, in the context of development of the Saclay plateau, in line with the lifetimes envisaged by CEA for the BNIs in the Centre.

c) Rhone Valley Centre

The Rhone Valley Centre administratively groups the centres of Marcoule (Gard département) and Pierrelatte (Drôme département). The non-secret installations represent only a fraction of the installations in these centres.

*Administrative region headed by a *Préfet*.

Since 2006, the Marcoule Centre has been the responsibility of CEA and was thus identified as a centre of excellence for the back-end nuclear fuel cycle and in particular radioactive waste. It is playing a major role in the research being conducted pursuant to the Bataille Act of 1991 and the Planning Act of 28 June 2006 on the sustainable management of radioactive materials and waste. CEA's two main installations in Marcoule, Atalante (research laboratory) and Phénix (reactor), were called on to make a particularly significant contribution in this field.

ASN considers that the transfer of responsibility from the COGEMA Marcoule Centre to CEA took place in satisfactory conditions and that the Centre's organisation has not suffered. However, the inspections carried out in 2007, and in particular the enhanced inspection on the "on-site emergency response" topic, show that CEA needs to further improve the second-level oversight performed by the Centre's safety unit.

The steps to ensure closer cooperation between ASN and DSND, in order to obtain an improved overview of the Centre, as initiated in 2007 through an enhanced joint inspection, will be continued in 2008.

d) Fontenay-aux-Roses Centre

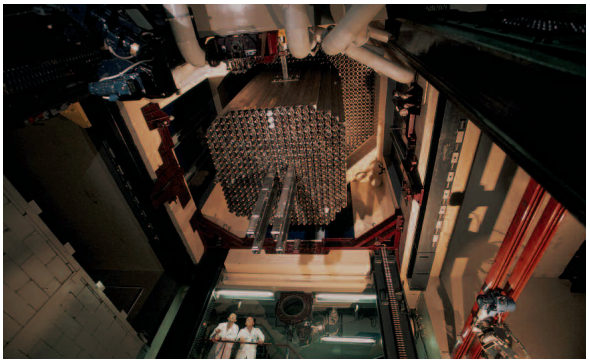
All the basic nuclear installations in this Centre are currently being decommissioned and cleaned out (see chapter 15).

e) Grenoble Centre

All the basic nuclear installations in this Centre are currently being decommissioned and cleaned out (see chapter 15).

1 | 2 | 2 Research reactors

Experimental nuclear reactors make an essential contribution to scientific and technological research and to supporting operation of the country's nuclear power plants. Each of them is an individual case to which ASN regulation must be tailored, while ensuring that safety practices and rules are improved. In this respect, a more generic approach has in recent years been adopted to the safety of these installations, based on the rules applicable to power reactors and in particular through the inclusion of operating situations and the classification of the associated equipment, which has led to considerable progress being made in terms of safety. This approach was in particular used for the periodic safety reviews on CABRI and MASURCA (2004 and 2006) and for the design of the Jules Horowitz reactor. Number 176 of the *Contrôle* magazine which came out in July 2007, gives a general picture of the problems associated with the regulation of research reactors.



Core of the MASURCA reactor in Cadarache

a) Critical mock-ups

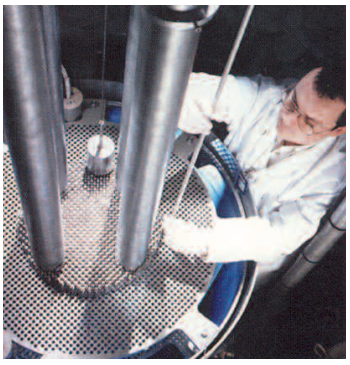
• MASURCA reactor (Cadarache)

The MASURCA reactor is mainly intended for neutronic studies of fast neutron reactor cores. This reactor can also be coupled to a particle accelerator for other types of research, as was the case for example with the transmutation of minor actinides.

The latest periodic safety review of the installation, which includes a major renovation programme, led to a meeting of the Advisory Committee for nuclear reactors in March 2006. Compliance with the requests formulated by ASN, and with the commitments made by the licensee following this meeting, must continue until at least 2009 and will be regularly checked by ASN.

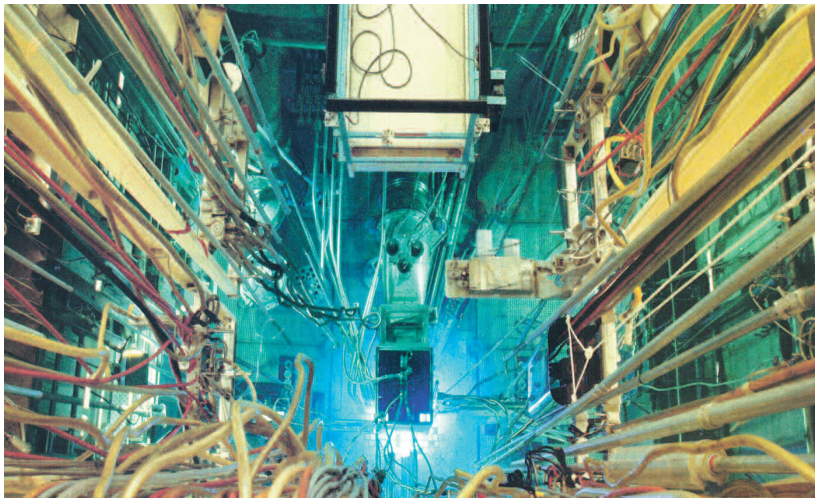
• ÉOLE and MINERVE reactors (Cadarache)

The ÉOLE reactor is intended for neutronic studies of light water reactor cores. On a very small scale, it can be used to reproduce a high neutron flux using experimental cores representative of pressurised or boiling water power reactors. The MINERVE reactor, located in the same building, is used for cross-section measurement by oscillation of samples.



Core of the EOLE reactor in Cadarache

CEA has indicated that it wished to continue long-term operation of the EOLE and MINERVE installations and in 2007 ASN reviewed the periodic safety review guidelines, which will lead to submission of a finalised dossier in



View of the OSIRIS reactor pool in Saclay

2008 prior to the meeting of the Advisory Committee for nuclear reactors at the end of 2009.

b) Irradiation reactors

• The OSIRIS reactor and its ISIS critical mock-up (Saclay)

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 radionuclides and doped silicon and for the irradiation of specimens for activation analysis. The ISIS reactor is a neutronic mock-up of the OSIRIS core. Its power rating is limited to 700 kWth and it can be used for neutron measurements and dosimetry. Following the shutdown of the ULYSSE reactor, ISIS has been used for training purposes since 2007.

ASN considers that in the light of its old design, operation of the installation could not be envisaged beyond a few years. CEA proposed a programme of renovation and safety improvement work so that operations could be carried on until 2015 at the latest. ASN will issue an opinion at the beginning of 2008 on the principles of the work envisaged and, as applicable, will adopt a stance in 2009 with regard to a time-frame for cessation of operations, based on a detailed file describing the scheduled work.

• The RJH (Jules Horowitz reactor) project (Cadarache)

With the support of a number of European partners, CEA deemed it necessary to build a new reactor owing to the age of the European irradiation reactors currently in service and their imminent or medium-term

RJH reactor project in Cadarache

shutdown. The first objective of the reactor, which is scheduled for start-up in 2014, is irradiation of materials and fuels to support the French and European nuclear power programmes. This reactor will also be able to produce artificial radionuclides used for medical purposes and for doping silicon for the electronics industry.

The licensing decree application (DAC), together with the water intake and effluent discharge licence application (DARPE) and the preliminary safety analysis report for the future installation, were sent to ASN at the end of March 2006. After reviewing them, ASN transmitted the DAC and DARPE files to the Bouches-du-Rhone *préfet's* offices so that they could undergo the public inquiry process (from 20 November to 21 December 2006). The results of the public inquiry were favourable to the project.

At the same time, ASN called on the Advisory Committee for nuclear reactors, which met four times in 2007 to examine a first series of technical subjects, including the seismic resistance of the installation and the handling of accidents. These meetings will continue in 2008, leading to a finalised technical opinion on the preliminary safety analysis report intended for ASN, with a view to obtaining the licensing decree.

c) Neutron source reactors

• ORPHÉE reactor (Saclay)

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 as "material probes" to conduct experiments in fields such as physics, biology and physical chemistry.

With the aim of ensuring long-term operation of the reactor, ASN asked for studies to be carried out prior to the installation's periodic safety review. ASN gave its opinion on the guidelines sent to it in 2007. The complete review file is expected by ASN for the end of the 3rd quarter of 2008, following which it will be able to convene the Advisory Committee for nuclear reactors at the end of 2009.

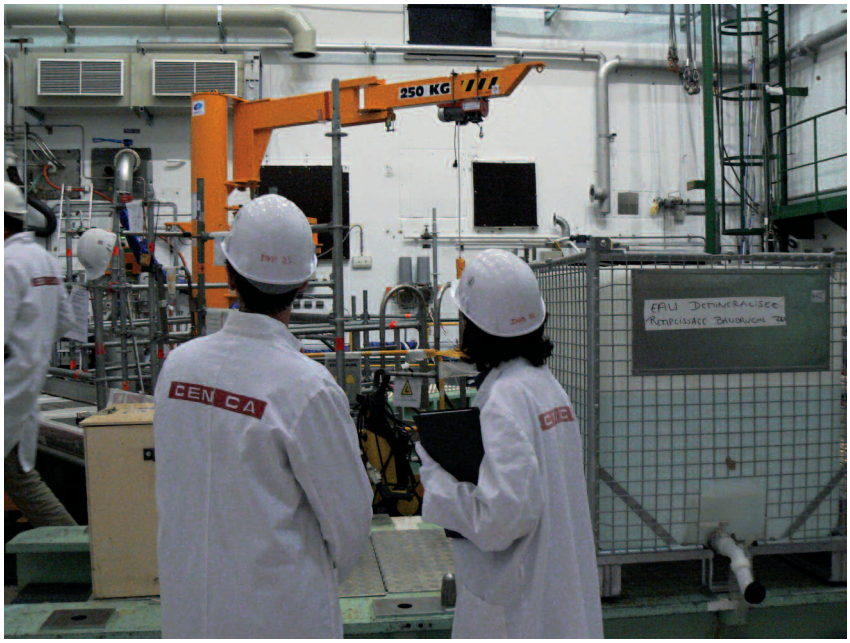
d) Test reactors

• CABRI reactor (Cadarache)

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 reactor is operated by CEA for the test programmes designed by IRSN.

For the purposes of a new research programme, work is under way to replace the reactor's sodium loop by a water loop. The "CABRI water loop" programme is designed to determine the behaviour of high burn-up fuels in accident situations representative of the conditions found in a PWR. The decree authorising modification of the installation was published in March 2006.

CEA also conducted a safety review of its entire installation in order to define the work needed to bring it into confor-



ASN inspection of the CABRI reactor in Cadarache

mity with current requirements, with a view to continuing reactor operations for about a further twenty years.

ASN regularly monitors the progress of the work, verifying compliance with its requests and with the licensee's 2004 commitments following the review of the preliminary safety analysis report for the modified installation. In 2007, it noted that the schedule initially determined for this work would not be met. Once this work is completed, ASN will adopt a stance on the safety of the modified installation, after review of the provisional safety analysis report by the Advisory Committee for nuclear reactors.

• PHÉBUS reactor (Cadarache)

The PHÉBUS reactor is one of CEA's tools for the study of possible PWR accidents.

The latest test in the "fission products" experimental programme, the purpose of which was to study the behaviour and the transport of fission products from the PWR fuel to the environment, in the event of core meltdown, took place at the end of 2004. Test data are currently being analysed by IRSN. At the same time, work to clean out and decommission the experimental systems will be continuing until 2009.

In 2007, ASN examined the changes contemplated for short and medium term operations, pending the licensee's decision on the future of the installation, which will be based in particular on the deliberations of the group of international experts regarding future PHEBUS research programmes. ASN asked CEA to define a safety review schedule appropriate to keeping the installation in working order until such time as a new test programme is defined.

e) Teaching reactors

• ULYSSE reactor (Saclay)

The 100 kWth ULYSSE reactor is mainly used for teaching purposes and practical applications. In August 2006, CEA informed ASN of its decision to cease operation of the reactor once and for all. In February 2007, the installation entered the final shutdown phase. ASN authorised transfer of the training activities to the ISIS reactor.

ASN will examine the final shutdown and decommissioning licence application file the licensee intends to submit in 2008 in order to obtain the corresponding decree.

f) Prototype reactors

• PHÉNIX reactor (Marcoule)

The PHÉNIX reactor, built and operated by CEA jointly with EDF, is a fast neutron demonstration reactor. It is located in Marcoule (Gard *département*). Its construction began in 1968 and first criticality occurred on 31 August 1973. Its rated power is 563 MWth.

The characteristics and performance of this installation are such that it is considered by CEA to be an indispensable tool for the completion of research programmes on plutonium combustion (CAPRA programme) and actinide incineration (SPIN programme). These research programmes come under Articles L.542-1 to L.542-14 of the Environment Code concerning radioactive waste research.

In 2002, following major reactor renovation work, ASN informed CEA that it considered the answers provided

Overview of the PHÉBUS reactor in Cadarache

PHÉNIX reactor platform in Marcoule

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 burn-up cycles still to be carried out (i.e. 720 EFPD). 2007 was devoted to continuing with the experimental irradiation programme. ASN considers that the licensee needs to be particularly attentive to the ageing of installation components and to the place given to human and organisational factors in reactor operations.

Furthermore, since 2005, CEA has been preparing its programme for final shutdown and decommissioning of the reactor, now scheduled for 2009. This programme will include the use of installations for processing the sodium from PHÉNIX and possibly other CEA installations.

1 | 2 | 3 Laboratories

a) The irradiated materials and spent fuel assessment laboratories

These laboratories, also called "hot laboratories", are key experimental tools for the main nuclear licensees. There used to be a large number of these laboratories but they are now concentrated in two centres: one, in Saclay, devoted to irradiated materials and the other, in Cadarache, dealing with fuel. From the safety viewpoint, these installations must meet the standards and rules of the large fuel cycle nuclear installations, but this approach has to be proportionate to the risks.

• Active fuel examination laboratory (LECA)

The LECA is a laboratory carrying out destructive and non-destructive testing on spent fuel taken from various types of nuclear power or experimental reactors and on irradiated structures and equipment from these technologies.

Following its safety review in 2001, an extensive upgrade programme, in particular comprising operations to improve the seismic resistance of the civil engineering works, was carried out at LECA. It should be completed in August 2009 with the dismantling of the "U02" building, thus reducing interactions between buildings.

Given the scale of and progress in the renovation work undertaken, ASN indicated that it had no objection to continued operation of the installation until 2015, with implementation of the new safety reference system. CEA also stated its intention of extending the LECA's operating lifetime beyond this date by carrying out additional anti-seismic reinforcement work. This option will be examined at the next safety review.

• The LECA's treatment, clean-out and reconditioning station (STAR) (Cadarache)

The STAR installation, designed to stabilise and recondition GCR spent fuel, also carries out destructive and non-destructive testing of PWR type spent fuel.

In addition to examining the installation's periodic safety review file which should be transmitted at the end of 2007, ASN will also review the numerous requests for the forthcoming installation modifications included in the CEA programmes (for example, redevelopment of cell 1 and the VERDON laboratory).

• Laboratory for research and experimental fabrication of advanced nuclear fuels (LEFCA)

The LEFCA is a laboratory responsible for performing basic engineering studies on plutonium, uranium, actinides and their compounds in all forms (alloys, ceramics

View of the LEFCA in Cadarache

Handling in one of the LECI cells in Saclay

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.

After the installation's safety review in 2005, LEFCA was authorised to continue operations for ten years.

Technical review of the data concerning building reinforcement works (in particular the innovative process involving application of strips of carbon fibre fabric bonded to the elements to be reinforced) ended in 2007 and the installation renovation programme should be completed in 2009.

In April 2007, ASN also authorised activation of the Titans line intended for development of new fuels.

• Spent fuel test laboratory (LECI) (Saclay)

LECI is an installation designed to analyse the various components of the spent fuel from nuclear reactors (components of the radioactive material, components of the assembly cladding, etc.), in order to determine how they behave under irradiation.

In June 2004, ASN authorised pre-commissioning of the LECI extension, subject to compliance with a number of requests resulting from the conclusions of the extension project review by the Advisory Committee for laboratories and plants, which met in April 2004. In 2005, ASN authorised partial precommissioning of the LECI extension (limited to certain types of samples). In 2006, ASN authorised commissioning of the LECI extension. Following the 10 March 2006 criticality incident, the LECI licensee in 2007 closely examined material transfers between installations (conventions were drafted) in order to make them more reliable. ASN considers that the new practices put into place in LECI should be extended to cover CEA's BNIs and will be particularly attentive to this.

b) Research and development laboratories

• Alpha facility and laboratory for transuranian elements analysis and reprocessing studies (ATALANTE) (Marcoule)

ATALANTE primarily contains CEA's R&D facilities for high-level radioactive waste and reprocessing. These activities were previously distributed over the three Fontenay-aux-Roses, Grenoble and Rhone Valley centres.

In the light of the numerous modifications made to the installation since its creation, ASN asked the licensee to submit a safety review file prior to final commissioning. Commissioning and the safety review were examined by the Advisory Committee for laboratories and plants in 2007 and ASN authorised installation commissioning, albeit with a number of requirements (decision 2007-DC-0050 of 22 June 2007).

ASN remains particularly attentive to the project for seismic reinforcement of the buildings, which should be completed in 2009.

• The CHICADE installation (Cadarache)

The CHICADE (chemistry, waste characterisation) installation carries out research and development work on low and intermediate level nuclear waste, primarily concerning:
– aqueous liquid waste treatment processes;
– decontamination processes;
– solid waste packaging methods;
– assessment and monitoring of waste packaged by the waste producers.

In 2006, the licensee began work to update the installation's safety case and general operating rules.

1 | 2 | 4 MCMF, MAGENTA, CIS Bio International and POSEIDON

• The central enriched uranium warehouse (MCMF) and the MAGENTA project (Cadarache)

The MCMF is a warehouse for storing enriched uranium and plutonium. Its main duties are reception, storage and shipment of non-irradiated fissile materials (U, Pu) pending reprocessing, whether intended for use in the fuel cycle or temporarily without any specific purpose.

In 2007, the licensee continued to remove fissile material from storage in the installation, reporting regularly to ASN.

ASN inspection at ATALANTE in Marcoule

In March 2006, CEA also submitted an application for the decree authorising creation of the MAGENTA facility, which is to replace the MCMF by 2010. To support its application, CEA sent ASN the preliminary safety analysis report for the installation, which was reviewed by the Advisory Committee for laboratories and plants in March 2007. The draft licensing decree was presented to the CIINB at the end of 2007 and received a favourable opinion from ASN (opinion 2007-AV-0043 of 21 December 2007). The draft decree was transmitted to the ministers for signature.

• The CIS Bio International facility (Saclay)

CIS Bio International is a key player on the French market for radiopharmaceutical products used for both diagnosis and therapy. In May 2006, Schering S.A. – which had been the 100% owner of CIS Bio International since December 2001 – sold the company to the consortium consisting of IRE (Institut national des radioéléments, based in Fleurus, Belgium) and IBA (Ion Beam Applications S.A.). Through this acquisition, IRE and IBA obtained a 80.1% and 19.9% stake in CIS Bio International respectively.

After checking that the IRE-IBA consortium had the necessary technical and financial capacity to continue in particular with the installation renovation project started by Schering S.A., ASN in April 2007 issued a favourable opinion on the decree transferring nuclear licensee responsibility from CEA to CIS Bio International (opinion 2007-AV-0023 of 4 April 2007). In its opinion, ASN stated that if the decree were to be published, it would regularly review elements enabling it to update its assessment of the technical and financial capability of CIS Bio International.

In July 2007, CIS Bio International asked ASN to suspend the licensee transfer procedure, pending settlement of the issue of used source recovery.

ASN again told CIS Bio that the current situation was unsatisfactory and that it wanted the nuclear licensee (as defined in the regulations) to be in control of all the resources necessary to guarantee safety and radiation protection in its installation. It will review the situation at the beginning of 2008 once the working group set up by the Government has submitted its conclusions. ASN is also attentive to ensuring that the used sources are actually recovered. From this viewpoint, it is in favour of having the source recovery process guaranteed by a robust, reliable organisation.

• POSEIDON irradiator (Saclay)

The operating principles of irradiators are explained in part 3|1 of this chapter. The POSEÏDON installation is primarily dedicated to studying the strength of the materials used in nuclear power plants and fuel cycle plants. This installation, which was originally owned by CIS Bio International, was incorporated into the CEA BNI inventory at the beginning of 2007.

1 | 2 | 5 Effluent and waste treatment facilities

CEA's radioactive effluent and waste treatment installations are distributed between the Fontenay-aux-Roses, Grenoble, Cadarache and Saclay centres. They are generally equipped with characterisation facilities to enable measurement-based 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 dispatch to the appropriate route. 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 other centres (CEA or others) owing to their specific nature.

The installations devoted specifically to storage of waste and spent fuels are dealt with in chapter 16 (point 7).

a) Cadarache Centre

The effluent and waste treatment station (STED) processes and packages liquid and solid radioactive waste from the Cadarache Centre. Following the periodic safety review of this installation in 1988, ASN had authorised continued operation for a limited period. CEA then proposed creating three new installations with a view to carrying out the duties performed by the STED: the Rotonde, for sorting of solid waste, CEDRA, for treatment of a part of the solid waste and AGATE for treatment of liquid effluent. The Rotonde sorting installation has been operational since September 2007 and primarily interfaces between the solid waste producers and the treatment, storage and disposal installations. Since the closure of the STED's 250-ton compacting press at the end of 2004, the waste from this technology is directly routed to Andra's waste repository in the Aube *département*, which compacts the packages. At the beginning of 2007, CEA supplied ASN with a file concerning the continued use of the 500-ton press in the STED, which will require seismic reinforcement of the installation.

Processing of liquid effluents contaminated with intermediate-level alpha emitters, referred to as "special" effluents, ceased on 1 July 2005. CEA is transferring these effluents to the liquid effluent treatment station on the Marcoule site (STEL).

In 2006, ASN authorised continued operation of the STED to process liquid effluents contaminated with beta-gamma emitters, until 1 March 2008. The decision to continue operations until commissioning of the AGATE installation will be taken on the basis of acceptance by the Defence Nuclear Safety and Radiation Protection Delegate (DSND), continued operation of the STEL in Marcoule and the progress of the AGATE project.

In 2005 CEA decided to restrict the configuration of the AGATE project, which would then be used to concentrate effluents contaminated by beta-gamma emitters produced in the Cadarache Centre. The concentrates would then be transferred to the Marcoule STEL for final treatment, provided that the STEL safety review does not bring to light any safety problems for the next few years. On this occasion, CEA envisages renovating the Marcoule STEL to take charge of the concentrates from Cadarache and the liquid effluents from Marcoule. The effluent bituminisation process would thus be replaced by a cement encapsulation process, like the process employed in the new STELLA installation at Saclay.

Finally, removal of the radioactive organic liquids (LOR) from the ZELORA building in the Cadarache STED, and their final treatment, remain a priority for ASN. A first shipment of LOR was thus made to the ATALANTE facility in 2006, for treatment by hydrothermal oxidation. Removal of the balance of the drums, which should have been completed in 2007, was impossible owing to the delay in commissioning the LOR storage facility in ATALANTE. ASN will be attentive to ensuring that this removal is finalised during the course of 2008.

b) Saclay Centre

The solid waste management zone handles treatment and storage of solid radioactive residues produced in the Centre by the reactors, laboratories and workshops. This installation provides the interface between the waste producers in the Saclay Centre and the treatment, storage and disposal installations for this waste. It also recovers waste from the small producers (scintillation liquid sources, ion exchange resins) and provides storage of radioactive sources.

In 2007, CEA continued the programme to recover from the fuel assembly blocks the spent fuel elements stored in the solid waste management zone. This programme consists in characterising old containers, stored in the fuel assembly block, so that they can be taken to the STAR installation in Cadarache for reconditioning before storage in CASCAD, pending a final solution (reprocessing or disposal).

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 routes. CEA conducted a safety review of the solid waste management zone, which will be assessed by the Advisory Committee for laboratories and plants, with ASN making its standpoint known in 2008.

On 10 September 2007, in order to correct the technical problem that occurred when pouring concrete into a

drum of waste in the concrete encapsulation unit of the solid waste management zone, an employee of the subcontractor in charge of these operations entered the unit, even though it was classified as a radiation protection prohibited area. ASN rated this incident level 1on the INES scale. This incident follows on from a number of problems during the course of operation of this installation, in particular with regard to subcontractor surveillance and the risks involved in handling of the fuel. The director of the Saclay Centre was called before the ASN Commission on 30 October 2007. He recognised the problems with the oversight of safety in this installation and presented an action plan which was the subject of a written undertaking on the part of CEA. ASN duly noted these commitments and will verify compliance within the announced time-line.

The radioactive liquid effluent management zone (STE) collects, stores and reprocesses the low-level aqueous effluents and stores aqueous and organic effluents. The radioactive aqueous effluents are evaporated and stored in RESERVOIR tanks pending treatment. By a decree of 8 January 2004, CEA was authorised to modify the STE by adding the STELLA extension.

In 2007, ASN submitted the complete safety file for the "former plant" part and for commissioning of the STELLA extension to the Advisory Committee for laboratories and plants and will issue a decision on these subjects at the beginning of 2008. The progress of the operations, first of all to recover stored legacy effluents awaiting treatment, and secondly to clean out the old installation buildings, are among CEA's priorities, along with commissioning of STELLA.

c) Fontenay-aux-Roses Centre

The main function of the radioactive effluent and solid waste treatment station (STED) is storage of solid and liquid waste prior to removal to the appropriate routes. As part of the site clean-out process, in addition to removal of the waste from storage, the STED will act as the support installation for managing the waste generated by decommissioning.

STELLA extension building in BNI 35 in Saclay

d) Grenoble Centre

The effluent and waste treatment station (STED) is continuing with removal of waste from storage and recovery of legacy waste, for complete decommissioning by 2010. This installation will from now on also be the support installation constituting the storage facility for the waste generated by decommissioning of the Grenoble site installations prior to removal to the appropriate disposal routes. The installation is also storing containers of sodium and a mixture of sodium and potassium, pending processing. In 2006, CEA submitted an application for authorisation to shut down and decommission the STED.

1 | 2 | 6 Installations being decommissioned

CEA is committed to final shutdown and decommissioning of certain installations, when they reach the end of their lives, or if it does not wish to continue operating them, or when they are located in the immediate vicinity of major urban centres (which is the case with the Fontenay-aux-Roses and Grenoble centres, which are in the process of complete delicensing). These aspects are dealt with in chapter 15.

2 NON-CEA NUCLEAR RESEARCH INSTALLATIONS

2|1 Electromagnetic radiation laboratory (LURE)

The Electromagnetic radiation laboratory (LURE), in Orsay (Essonne département), is an installation producing synchroton radiation (high-power X-rays) for a wide variety of research applications.

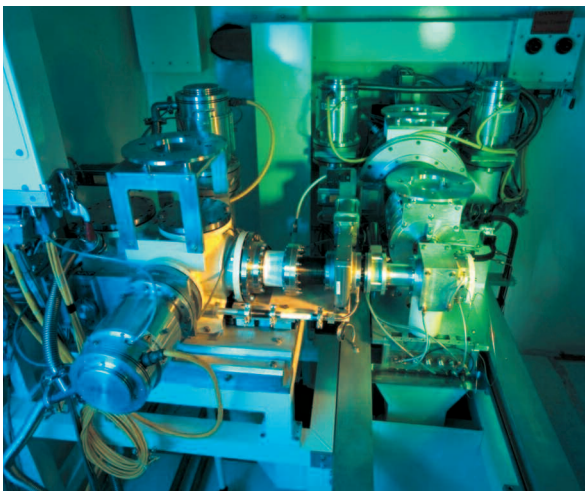
In June 2002, the licensee announced its intention to cease operation of this positron accelerator at the end of 2003, apart from the autonomous use of the CLIO laser. The shutdown phase, which began in 2004, should be completed by the end of 2008. At the end of 2006, the licensee submitted the final shutdown and decommissioning file for the installation. This file, which is currently being reviewed by IRSN, was the subject of a consultation by the various government departments.

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.

In order to adapt to the requirements of international research, GANIL issued a safety options file in May 2004 for a new project, called SPIRAL 2 (creation of new experimentation rooms with a more powerful beam). In July 2005, ASN approved the safety options proposed by the GANIL, provided that a certain number of requests were taken into account. At the same time, ASN asked the GANIL to proceed with the periodic safety review of the installation. In order to monitor the progress of these two matters (SPIRAL 2 project and safety review), periodic meetings were held between ASN and the GANIL in 2007. The safety issues regarding this installation mainly concern access control and fire protection.

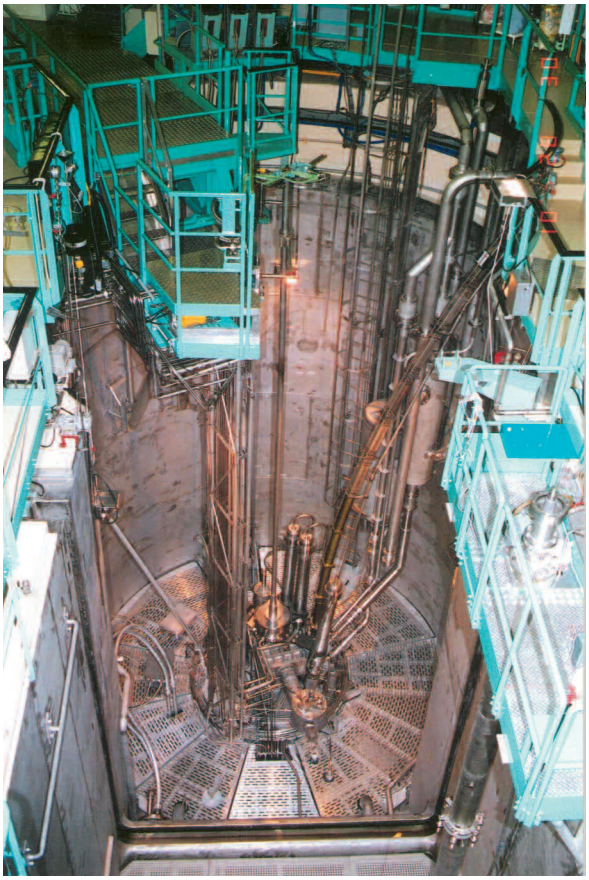


GANIL accelerator in Caen

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 authorised 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, ASN asked for seismic reinforcement work on the installation. This extremely important work was completed at the end of 2007 and was reviewed by the Advisory Committee for nuclear reactors, followed by a



View of the RHF reactor in Grenoble, with water drained out

visit to the installation in order to gain a clear picture of the scale of the work done. Following this review, ASN informed the Laue Langevin Institute that it considered the installation's safety review, which began in 2002, to be substantially completed, even if certain subjects still needed to be finalised, particularly for the gaseous effluent system.

The new water intake and discharge licence was signed on 3 August 2007 following ASN's approval (opinion 2007-AV-0028 of 11 May 2007).

Finally, against the backdrop of the complete delicensing of the CEA Grenoble Centre located in the immediate vicinity of the RHF, the question of the long-term presence of the RHF on the current site will need to be examined during the installation's next periodic safety review.

2|4 European Organization for Nuclear Research (CERN) installations

The European Organization for Nuclear Research (CERN) is an intergovernmental organisation 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 certain provisions of French legislation applicable to BNIs apply to the LEP and to the SPS, two rings which make up part of the CERN's installations. It also designates the Nuclear Installation Safety Directorate (DSIN, now ASN) as the French Government representative to deal with technical matters concerning the treaty. ASN also has a seat on the CERN's radiation protection committee, in charge of all radiation protection problems on the site.

The CERN has completed construction of a hadron collider (Large Hadron Collider, LHC) which should enable progress to be made in particle physics research, notably by producing proton-proton collisions at a beam energy of 7 TeV. In 2006, the CERN forwarded the LHC safety documents. On this basis, ASN indicated that it had no particular remarks to make concerning the safety of this installation, in a letter of 23 October 2007. Commissioning of the LHC is scheduled for early 2008.

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 deuteri-

ITER reactor project in Cadarache

um-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 international treaty creating the ILE (ITER Legal Entity) was initialled in May 2006 and ratified by all the parties in September 2007. The Headquarters Agreement, between ITER and the French Government, was signed on 7 November 2007.

The preliminary safety analysis report for the installation was transmitted in early 2008 in order to trigger the licensing procedure. Technical discussions are continuing and about fifteen meetings had been held by the end of 2007. They primarily concern the extent to which French safety requirements have been taken on board by the designers, a point on which ASN is particularly vigilant.

At the request of ASN, which had noted that the international organisation status of the ITER installation, and in particular the prerogatives linked to the corresponding privileges and immunities, were liable to create a number of problems with respect to the responsibility of the nuclear licensee, it was made clear that, as with the other French basic nuclear installations, there could be no immunity for individuals and there would be complete freedom of access to premises for the purposes of nuclear safety and radiation protection inspections.

3 IRRADIATION FACILITIES, MAINTENANCE FACILITIES AND OTHER NUCLEAR INSTALLATIONS

3|1 Industrial irradiation facilities

Industrial irradiation facilities provide gamma-ray (mainly cobalt 60 sources) treatment for medical equipment (sterilisation) or foodstuffs. An irradiation facility consists of a concrete bunker inside which the irradiation processes take place. The sealed sources are placed in a pool inside the bunker. They are remotely and automatically extracted from the pool during an irradiation operation. They are lowered into the pool after the operation and prior to any intervention by the operators in the bunker. There is thus no risk of irradiation inside the bunker.

The safety problems mainly concern access management, a point on which ASN is extremely attentive, in particular on the basis of the experience feedback from the operation of similar installations in Europe.

The installations currently being operated are located in Pouzauges (Vendée *département*), Marseille (Bouches-du-Rhone *département*), Sablé-sur-Sarthe (Sarthe *département*) and Dagneux (Ain *département*).

In June 2006, the ISOTRON France company sent ASN a licence application file for the creation of a basic nuclear installation (BNI) called GAMMATEC, on the Marcoule site. This file was submitted to a public inquiry from 22 January to 23 February 2007. At the same time, the various government departments were also consulted. Following these consultations, the préfet of the Gard *département* approved the licence application for the GAMMATEC BNI. The file is currently undergoing technical review. This new installation would be the second one in France for the ISOTRON group, the first being at present operated in Marseille.

3|2 Maintenance facilities

Three basic nuclear installations specifically handle nuclear maintenance activities in France:
– the SOMANU (Société de maintenance nucléaire) facility in Maubeuge (Nord *département*), which specialises in the repair, maintenance and evaluation of equipment taken mainly from PWR main primary systems and their auxiliaries, with the exception of fuel elements;
– the clean-out and uranium recovery installation of the Société auxiliaire du Tricastin (SOCATRI) in Bollène (Vaucluse *département*) which handles maintenance, storage and clean-out 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 storage of contaminated PWR equipment, except for fuel elements.

The surface treatment shop, located in the non-nuclear part of the SOCATRI installation in Bollène, gave rise to groundwater pollution by hexavalent chromium in 1998. The clean-out operations, required by order of the *préfet* on 26 November 1998 and consisting in pumping the groundwater for depollution by ion exchange resin treat-

ment, are still proceeding, until the thresholds set by the above-mentioned order are reached.

3 | 3 Chinon irradiated material facility (AMI)

This installation, located on the Chinon nuclear site (Indre-et-Loire *département*), is operated by EDF. Its main purpose is now to carry out review and assessment of activated or contaminated materials from PWR reactors.

2006 was marked by a change in strategy on the part of the licensee with regard to the future of the installation. As ASN considered that the renovation project presented in 2004 did not enable long-term continued operation to be envisaged, EDF presented a new strategy, in particular including final closure of the installation no later than 2015. The studies concerning the construction of a new assessment laboratory were initiated following this new strategy orientation. In 2007, EDF also presented ASN with the steps to be taken to guarantee the safety of the installation until final cessation of operations. ASN approved implementation of these measures.

In 2007, ASN also authorised commissioning of a facility for sorting and packaging legacy waste from 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 the Indre-et-Loire *département*. 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, located in Codolet near the Marcoule site (Gard *département*), is operated by SOCODEI.

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 very low-level waste repository opened. This strategy requires modification of the creation licence, revision of the SOCODEI water intake and effluent discharge licence (ARPE) and ASN approval of the new safety reference system. CENTRACO submitted an application for modification of its creation licence and its water intake and effluence discharge licence in 2006. These applications were submitted to a joint public inquiry from 24 October 2006 to 27 January 2007, with the various departments concerned being consulted at the same time. The *préfets* of the Vaucluse and Gard *départements* issued an opinion favourable to modification of the creation licence on 8 and 14 March 2007. This review process should lead to modification of the various statutory texts during the first half of 2008.

The licensee also submitted an application to the Ministry for Ecology, Sustainable Development and Spatial Planning, for definition of the conditions governing the acceptance of foreign waste and the reallocation of reprocessing residues from this waste.

4 OUTLOOK

The research and other installations regulated by ASN are extremely diverse and in particular comprise experimental reactors, hot laboratories, accelerators and irradiators. In addition to CEA, there are a large number of licensees which operate a small number of installations.

ASN notes with satisfaction that CEA in 2007 presented it with a tool allowing the highest level oversight of decisions concerning the upgrading of old installations and new projects, thereby ensuring greater transparency and giving ASN greater visibility of the processes that contribute to delaying the projects. This concerns about fifteen undertakings with major importance from the safety and radiation protection viewpoints.

Furthermore, at the request of ASN, CEA has initiated a process to manage the civil engineering work on its basic nuclear installations, which is also satisfactory.

However, certain incidents such as that of 12 September 2007 during which an operator entered a prohibited zone, fortunately with no radiological consequences, as well as the feedback from certain inspections, prove that even if CEA has adopted a safety policy, this policy is not yet implemented in full throughout its centres and installations.

The CEA safety management system and corresponding organisation would therefore seem to offer room for improvement: ASN expects CEA to implement in full the priorities defined by the General Administrator in the three-year safety plan for 2006-2008. This implementation must comprise precise and quantified objectives to be reached at all hierarchical and functional levels. An effective control system must also ensure that these priorities have been well understood and put into practice in the installations, including by the subcontractors.

ASN also expects CEA to provide improved skills management for the occupations that are important for safety, in particular the head of the installation, the safety engineer, the criticality engineer and the organisational and human factors specialist.

Finally, ASN points out that experience feedback shows that a lack of stringency in defining and implementing safety and radiation protection priorities is particularly prejudicial for the older installations, especially those in charge of radioactive waste and effluents.

To conclude, ASN considers that in 2007 CEA has undertaken some important work that needs to be continued, in particular concerning management of its commitments bearing on safety and radiation protection and control of the civil engineering operations in its basic nuclear installations. However, progress is still needed in defining and implementing the safety and radiation protection policy in its various centres.

ASN will pay particular attention to these subjects in 2008. It will in particular examine how CEA incorporates human and organisational factors into its safety management system. It will also closely monitor the major commitments made by CEA in recent years, in particular with regard to those installations in charge of waste and effluents.

SAFE FINAL SHUTDOWN AND DECOMMISSIONING OF BASIC NUCLEAR INSTALLATIONS

CHAPTER 15

1 TECHNICAL AND ADMINISTRATIVE DECOMMISSIONING PROVISIONS

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2 THE STATUS OF NUCLEAR INSTALLATIONS BEING DECOMMISSIONED IN 2007

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3 THE FINANCING OF DECOMMISSIONING AND RADIOACTIVE WASTE MANAGEMENT

3|1 The system created by Article 20 of the 28 June 2006 Act

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4 OUTLOOK

5 LIST OF BASIC NUCLEAR INSTALLATIONS DELICENSED AS AT 31.12.2007

6 LIST OF BASIC NUCLEAR INSTALLATIONS FINALLY SHUTDOWN AS 31.12.2007

As many nuclear installations were built between the 1950s and the 1980s, a large number of them have been gradually shutdown and then decommissioned over the past fifteen years. In 2007, about thirty nuclear installations of all types (electricity generating or research reactors, laboratories, fuel reprocessing plants, waste treatment facilities, etc), were shut down or were undergoing decommissioning. The safety and radiation protection of the decommissioning of these installations therefore gradually became major issues for ASN.

With the specific aspects of decommissioning activities (changing nature of the risks, rapid changes in the installation status, duration of the operations, etc.) ruling out implementation of all the regulatory principles that were relevant during the installation operating period, the nuclear installation decommissioning regulations have evolved gradually since the 1990s. This situation was recently clarified and supplemented by the TSN Act.

ASN is focusing on creating a clear and exhaustive regulation system for decommissioning operations. A large number of issues are therefore the subject of development work, such as:
– financing of decommissioning and management of the associated waste, within the framework created by the 28 June 2006 Planning Act on the sustainable management of radioactive materials and waste;
– a systematic review of the decommissioning strategies implemented by the licensees;
– harmonisation of practices in the field of decommissioning (final condition of installations after decommissioning, reuse of installations or sites, etc.);
– delicensing procedures for nuclear installations.

In order to ensure that the ongoing work is consistent with the best international practices, ASN is taking an active role in international actions and working groups on decommissioning and delicensing of nuclear installations (IAEA, OECD).

1 TECHNICAL AND ADMINISTRATIVE DECOMMISSIONING PROVISIONS

1|1 Decommissioning strategies

At an international level, three main decommissioning strategies have been defined by IAEA:
– deferred decommissioning: the nuclear installation is kept in a safe containment condition for several decades before decommissioning begins;
– safe containment: the installation is placed inside a reinforced containment structure (cocoon) for a period that is long enough to reach a radiation level that is low enough to enable the site to be opened up;
– immediate decommissioning: in this case, decommissioning of the installation begins as soon as operations cease, with no waiting period.

In accordance with IAEA recommendations, ASN would like to see the immediate decommissioning strategy applied to decommissioning of nuclear installations in France. This strategy in particular avoids placing the technical and financial burden of decommissioning on future generations. At the present time, the leading French licensees have all made a commitment to immediate decommissioning of the installations currently concerned by the decommissioning process.

ASN also believes that management of the waste produced by decommissioning is a crucial point that determines the correct running of the decommissioning programmes in progress (availability of disposal routes, management of waste streams). In this respect, the waste management procedures are systematically assessed as part of the review of the overall decommissioning strategies adopted by each licensee. Decommissioning operations can therefore only begin if appropriate disposal routes are available for all the waste liable to be created. The example of the decommissioning of EDF's first generation reactors is a good illustration of this problem (see point 2|1|3).

1|2 Risks involved in decommissioning

Diagram 1 presents the main risks encountered when decommissioning a nuclear installation and the periods during which these risks are highest.

The risks involved in waste management and which concern safety or radiation protection (multiplication of the number of waste storage sites, storage of irradiating waste) are present throughout the phases in which large amounts of waste are being produced and therefore in particular during the decommissioning phase.

The risks present during operation of the installation change as decommissioning progresses. Even if certain

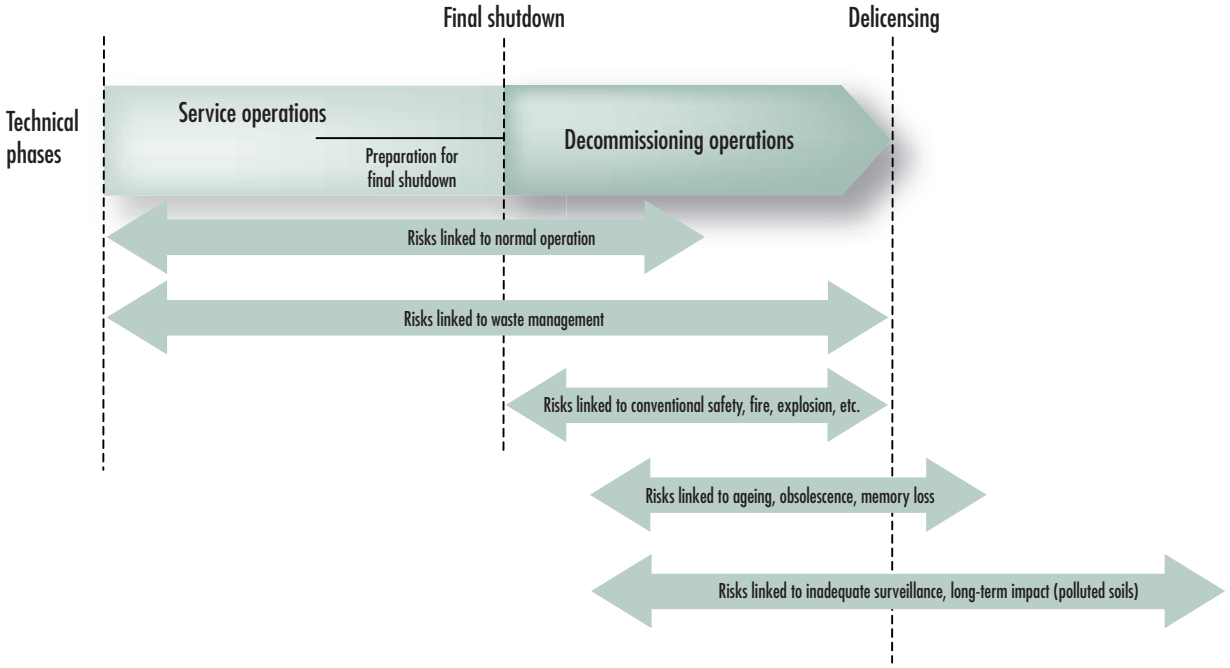


Diagram 1: main risks encountered during decommissioning

risks, such as criticality, quickly disappear, others, such as those related to radiation protection (gradual removal of containment barriers) or conventional safety (numerous contractors working together, falling loads, work at height, and so on) gradually become more important. The same applies to the risk of fire or explosion (hot spot" technique used in cutting up the structures), as well as, for example, to the risks related to human and organisational factors (organisational changes in relation to the operating phase, frequent reliance on outside contractors).

For complex nuclear installations such as nuclear power plant reactors, decommissioning work often lasts for more than a decade. It follows on from an operating period that often lasts several decades. There is consequently a very real risk of all memory of the design and operation of the nuclear installations being lost. It is vital to be able to collect and thoroughly document the knowledge and memories of the staff involved in the operating phase, particularly as the traceability of the design and operation of the older installations is not always as thorough and reliable as might be desired. The length of the decommissioning operations also involves taking account of the risks inherent in the obsolescence of certain equipment (electrical or monitoring networks for example). Depending on the stage reached in the operations, risks linked to the potential instability of partially dismantled structures must also be taken into account.

The sometimes rapid changes in the physical condition of the installation and in the risks present raise the issue of ensuring that the means of installation surveillance are adequate and appropriate at all times. It is often necessary, either temporarily or permanently, to replace the centralised operational monitoring and surveillance systems with other more appropriate resources, such as "field" radiation monitoring or fire detection devices, located as close as possible to the potential source of risks. Constantly checking the adequacy of surveillance for the rapidly and significantly changing status of the installation is a difficult exercise, and there is a very real risk of failing to detect the onset of a hazardous situation.

Following decommissioning, depending on the final condition achieved by the licensee and the specific characteristics of each installation (operational history, incidents, etc), there may be residual risks: unidentified soil pollution with a long-term impact, areas for which clean-out is technically impossible, etc. In this case, prior to delicensing of the installation, the licensee must present and justify the envisaged procedures for continued surveillance of the installation or site.

The technical decommissioning scenarios are chosen by the licensees on a case by case basis, generally as a result of comparative studies. The strategies today adopted by EDF or CEA are presented in points 2|1 and 2|2.

1|3 Decommissioning administrative and regulatory framework

The technical provisions applicable to installations to be shut down and 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, discharge to the environment of radioactive effluents and measures designed to reduce the risk of accidents and mitigate their consequences.

Safety issues, in other words protection of persons and the environment, can be significant, during active clean-out or decommissioning operations, and must never be neglected, including during passive surveillance phases.

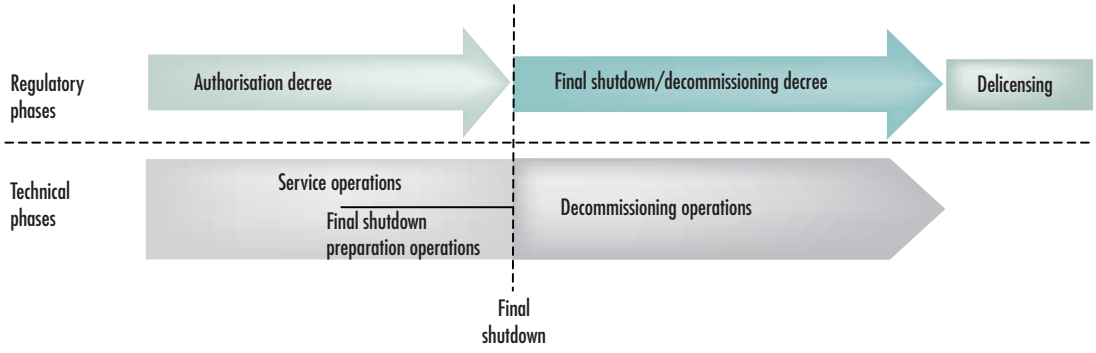
Once the licensee has decided to cease operations in its installation in order to proceed with final shutdown and decommissioning, it is no longer covered by the regulations set by the licensing decree nor the safety reference system associated with the operating phase. In accordance with the provisions of the TSN Act, final shutdown, followed by decommissioning of a nuclear installation, is authorised by a new decree, issued on the advice of ASN. The final shutdown and decommissioning authorisation procedure for a nuclear installation is described in chapter 2.

In order to avoid fragmentation of the decommissioning projects and improve their overall consistency, the file submitted to support the final shutdown and decommissioning application must explicitly describe all the planned work, from final shutdown to attainment of the target final condition and, for each step, must explain the nature and scale of the risks presented by the installation as well as the envisaged means of managing these risks. The final shutdown and decommissioning phase may be preceded by a final shutdown preparation stage, provided for in the initial operating licence. This preparatory phase in particular allows removal of all or part of the source term, as well as preparation for the decommissioning operations (readying of premises, preparation of worksites, training of staff, etc.).

Following decommissioning, a nuclear installation can be delicensed. It is then removed from the list of basic nuclear installations and no longer has BNI status. It became clear that it was necessary to retain a trace of the past existence of nuclear installations following their delicensing and, as applicable, to implement utilisation restrictions appropriate to the final condition of the site. In the past, public protection restrictions were issued by ASN, in conjunction with the entities concerned representing the State at local level. These restrictions are recorded with the land charges register to ensure that a permanent record is kept. Public protection restrictions of this type were systematically implemented on the occasion of recent nuclear installation delicensing operations (BNI 48 in 2005, BNIs 43 and 121 in 2006, BNIs 21 and 134 in 2007). The TSN Act now makes it possible to implement public protection restrictions after delicensing of a basic nuclear installation. These new procedures will be implemented for the forthcoming delicensing operations.

A 2003 ASN guide specified the regulatory framework for basic nuclear installation decommissioning operations, following major work designed to clarify and simplify the administrative procedure while at the same time improving the importance given to safety and radiation protection. A revision of this guide was started in 2007 in order to take account of the regulatory changes arising from the publication of the TSN Act and decree 2007-1557 of 2 November 2007 and the work done by the WENRA association (see chapter 16 point 1|3).

The contributions of the TSN Act to the field of decommissioning, which will be integrated and clarified by the



Phases in the life of a BNI

creation or revision of ASN guides, are in particular the following:
– consultation of the public is now systematic for any decommissioning project, regardless of the nature of the installation;
– the problem of decommissioning must be taken into account as of the installation creation stage and must be followed throughout the operating phase, via the drafting and regular updating of a document called the "decommissioning plan";
– depending on the final condition attained and the condition of the site after decommissioning, public protection restrictions may be implemented subsequent to decommissioning;
– ASN is empowered to intervene following delicensing of a BNI.

2 THE STATUS OF NUCLEAR INSTALLATIONS BEING DECOMMISSIONED IN 2007

2|1 EDF nuclear power plants

Since April 2001, and following a request from ASN, EDF decided for all its nuclear installations finally shut down (Brennilis, Bugey 1, Saint-Laurent A, Chinon A, Chooz A and Superphénix) to adopt a new decommissioning strategy, based on complete decommissioning of the reactors, with no waiting period. It thus foresees complete decommissioning of these reactors by 2025.

This new strategy was reviewed by the relevant advisory committee of experts in March 2004. ASN considers that there is nothing to compromise the feasibility of the complete decommissioning scenarios envisaged.

2|1|1 Operations subject to enhanced internal supervision by the licensee

ASN wanted to see a system of enhanced internal supervision applied to certain modifications made to EDF installations undergoing decommissioning, which it felt were significant from the safety and radiation protection standpoints. It therefore authorised EDF to set up an "internal authorisations system" in a letter of 9 February 2004. Setting up a system of this nature enables the licensee to carry out certain operations that are significant in terms of safety and radiation protection but which do not compromise the installation's safety case demonstrations.

ASN considers that the working of the internal authorisations system is on the whole satisfactory. ASN nonetheless considers that EDF should pay particular attention to the interaction between the internal authorisation systems used at headquarters and on the sites, in particular to ensure that the recommendations from the decommissioning safety committee (CSD), which is a key body reviewing the internal authorisation files, are taken into account when carrying out the operations concerned. Similarly, EDF must be attentive to ensuring that the experts on the CSD are fully independent from the staff in charge of the projects and with regard to all the problems raised (safety, radiation protection).

2|1|2 Monts d'Arrée plant

The EL4 nuclear reactor, which was commissioned 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 CEA and EDF. For the purposes of the partial decommissioning of this installation, the decree of 31 October 1996 authorised modification of the existing installation to transform it into a facility for storage of its own equipment left on the site, thus creating a new BNI, named EL4-D. On the basis of a study defining the various possible options for faster final decommissioning than initially planned, EDF submitting a final shutdown and complete decommissioning licensing application for the EL4-D installation on 22 July 2003. Complete decommissioning of the EL4-D installation was authorised by decree 2006-147 of 9 February 2006.

Following a request filed by the "*Sortir du nucléaire*" association, the *Conseil d'État** on 6 June 2007 cancelled the decree of 9 February 2006. The installation is therefore now subject to the provisions of the decree of 31 October 1996; decommissioning operations have thus ceased. In decision 2007-DC-0067 published in its Official Bulletin of 8 October 2007, ASN specified the regulations now applicable to the plant, pending the publication of a new decree authorising its final shutdown and complete decommissioning. EDF has agreed to submit a new application file for complete decommissioning before 31 July 2008. The ASN decision authorises EDF to take on the site the samples and

*France's highest administrative court.

View of the Monts d'Arrée site

measurements necessary for preparation of this file and requires that EDF remove a certain amount of legacy waste from the site, if necessary after repackaging.

The procedure to be implemented in order to obtain the new decree will also deal with the installation's water intake and effluent discharges.

Finally, ASN remains attentive to the results of the radioecology studies in progress, concerning a possible contamination outside the plant site.

2|1|3 Gas cooled reactors (GCR)

Performance of the gas-cooled reactors (GCR) decommissioning programme in accordance with the schedule reviewed during the 2004 advisory committee meeting is based on the availability of waste disposal routes. ASN ensures that no decommissioning operation is undertaken until the licensee has proposed sustainable management of the waste resulting from the operation. Therefore, opening of the GCR compartments is dependent on commissioning of the activated waste storage facility and the irradiated graphite disposal centre (CSG). The 28 June 2006 Act on the sustainable management of radioactive materials provides for opening of the graphite disposal centre in 2013, a timeframe that is compatible with the decommissioning programme as initially proposed by EDF. However, ASN remains vigilant on compliance with the timeframe associated with the decommissioning strategy. ASN asked EDF to assume its responsibility as waste producer, by immediately starting work on packaging of graphite waste that is acceptable for the future graphite repository, in close collaboration with ANDRA.

Chinon A1, A2 and A3 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, as amended on 25 November 2005. These installations are now kept under surveillance, with the main operations in 2007 concerning Chinon A3, involving demolition of the conventional buildings and the removal of legacy waste.

On 29 September 2006, EDF submitted an application for authorisation for final shutdown and complete decommissioning of the Chinon A3 installation. This request is currently being reviewed. A public inquiry was held in March 2007 and its conclusions were favourable.

Saint-Laurent-des-Eaux A1 and A2 reactors

The final shutdown operations currently being performed are covered by the provisions of the decree of 11 April 1994.

On 11 October 2006, EDF submitted an application for a complete decommissioning authorisation for the Saint Laurent A1 and A2 reactors. This application is currently being reviewed. A public inquiry was held in February 2007 and its conclusions are favourable.

ASN observes a drift in the time-frame for the final shutdown operations in progress and problems with the work, in particularly the recovery and packaging of sludges and treatment of pool water.

In 2006, ASN also observed a lack of subcontractor surveillance and monitoring on the Saint-Laurent A site.

ASN was thus particularly vigilant with regard to the operations carried out during the course of 2007.

Bugey 1 reactor

The decree authorising final shutdown operations was signed on 30 August 1996. In 2006, EDF completed the dossier enclosed with the application for authorisation for complete decommissioning submitted in 2005. Decommissioning of the Bugey 1 reactor is the first of the GCR decommissioning operations. The decommissioning application file transmitted by EDF was reviewed by the Advisory Committee for plants on 24 October 2007. The conclusions of this advisory committee enabled work to begin on drafting of a complete decommissioning decree for the installation.

2|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. For the purposes of partial decommissioning of the reactor, the decree of 19 March 1999 authorised modification of the existing installation, transforming it into an storage facility for its own equipment left on the site, thereby creating a new BNI called CNA-D. As a result of the changes to its decommissioning strategy, EDF on 30 November 2004 filed a final shutdown and decommissioning licensing application for the CNA-D installation. Decree 2007-1395 of 27 September 2007 authorising EDF to carry out final shutdown and complete decommissioning of the reactor was published in the Official Gazette on 29 September 2007. The installation must now be decommissioned within forty years from the date of publication of the decree. EDF has started the decommissioning preparatory work.

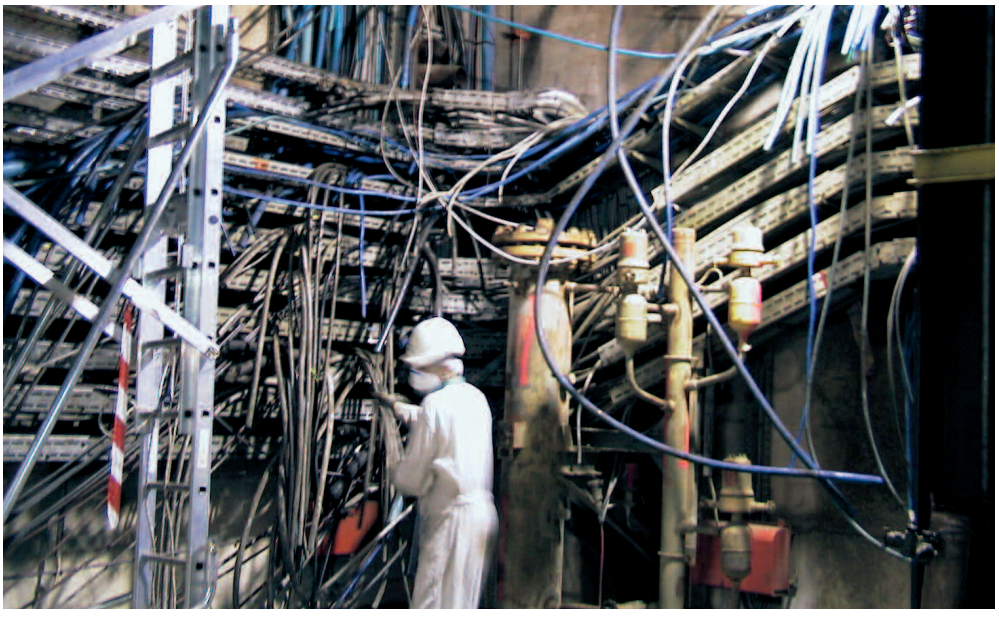
2|1|5 Superphénix reactor

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 undergoing final shutdown and decommissioning. This installation is associated with another BNI, the fuel evacuation facility (APEC), consisting mainly of a storage pool for fuel removed from the Superphénix reactor vessel.

Final shutdown of the reactor was authorised by decree 98-1305 of 30 December 1998.

In early 2003, all the fuel assemblies were 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 authorisation to conclude final shutdown and perform complete decommissioning of the reactor was given in decree 2006-321 of 20 March 2006. The new order authorising water intake and effluent discharge for the site was signed on 3 August 2007. The main work



Cable removal site at Saint-Laurent

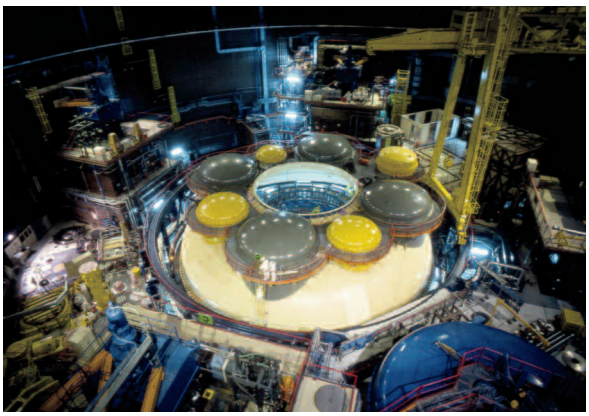
Decommissioning of the ventilation flue at Chooz

carried out on the site in 2007 was the construction of the sodium processing installation in the former turbine hall, initial decommissioning operations on the steam generators and the construction of a facility for cutting up the primary pumps and reactor intermediate exchangers.

Fuel evacuation 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.

The APEC modification was authorised by decree 2006-319 of 20 March 2006. The main modifications made are extension of the perimeter of the installation, so that it now contains the site's main electrical substation, the new water pumping station and the future storage area for the sodium concrete packages created by reprocessing of the sodium contained in the Superphénix reactor. The civil engineering works for this storage area began in 2007.



Dome of Superphénix

2|2 CEA installations

In December 2006, the Advisory Committees for plants and for waste issued its opinion on the overall decommissioning strategy for CEA's civil installations. This was considered to be on the whole satisfactory from the safety standpoint. The decommissioning schedules for the installations concerned are consistent with the strategy adopted. ASN considers that they should enable an acceptable level of safety to be maintained in these installations until they are delicensed. The documents outlining CEA's decommissioning strategy will be updated and reassessed every 5 years.

2|2|1 The Fontenay-aux-Roses centre

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**. It covers an area of 13.8 hectares.

The activities of the centre are moving away from nuclear activities to research in life sciences. With the aim of delicensing and cleaning out the centre, which should be completed in about 2015, CEA decided to group the nuclear activities in the "Fort" area, which required a modification of the perimeter of the four initial BNIs, thereby creating two new BNIs in place of the four original BNIs mentioned above. The two decrees authorising the creation of the new BNIs, BNI 165 (BNI Procédé) and BNI 166 (BNI Support) in place of BNIs 34 (Radioactive effluent and solid waste treatment station), 57 (Plutonium chemistry laboratory), 59 (plutonium fuel research laboratory) and 73 (radioactive solid waste storage facility), and authorised the final shutdown and decommissioning of these installations, were published in the Official Gazette on 2 July 2006 and came into force on 24 September 2007. The buildings which were to be excluded from the perimeter of BNIs 34, 57, 59 and 73 were delicensed between November 2006 and September 2007.

ASN considers that the BNI clean-out operations carried out so far, were on the whole satisfactory. Before administrative delicensing of the centre's BNIs, ASN will be required to adopt a stance on the overall radiation status of the site, for which the licensee has undertaken major work to identify radiation traces arising from past experimentation and to rehabilitate the soil.

The Procédé installation (BNI 165)

This installation is the first one to be decommissioned. It incorporates most of the buildings of former BNIs 57 and 59.

*Administrative region headed by a *Préfet*.

Until July 1995, the Plutonium chemistry laboratory (BNI 57) carried out R&D into the reprocessing of spent fuels and waste processing. After final shutdown began in July 1995, consisting in recovering, processing and evacuating the radioactive materials present in the installation, the equipment must be dismantled and the premises cleaned out. The operation to raise vessel B, authorised by ASN in October 2006, began in 2007 in satisfactory conditions of safety and will continue in 2008.

Of the plutonium based fuel research laboratory (BNI 59) there remains one building from which the radioactive material has been removed and which will be decommissioned.

The Support installation (BNI 166)

The purpose of this installation is initially to support the decommissioning operations of the Procédé BNI, before being decommissioned in turn. It encompasses the activities which were not shut down in the radioactive effluent and solid waste treatment station (BNI 34) and the solid waste storage facility (BNI 73) (also see chapter 16).

This BNI is used for storage and evacuation of radioactive effluents from the site as well as the treatment of solid waste, storage in a decay pit of irradiating drums pending evacuation and storage of drums of low and very low level waste awaiting shipment to a repository. In addition, pumping of the effluents contained in the CIRCE container should begin in 2008 after being authorised by ASN. This operation will benefit from operating feedback from pumping of the Pétrus B vessel.

2 | 2 | 2 The Grenoble centre

The Grenoble research centre (Isère *département*) 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.

This centre, whose activities were initially devoted to developing nuclear reactor technologies, now focuses on non-nuclear fundamental and applied research (condensed state physics, biology, electronics and materials). The centre also houses a unit of the INSTN (National Teaching Institute for Nuclear Science and Techniques).

ASN considers that the clean-out and decommissioning of the installations in the Grenoble centre are proceeding correctly, with the decommissioning worksites being properly managed.

Effluent and solid waste treatment station and decay storage

The effluent and solid waste treatment station (STEDS – BNI 36) is continuing with gradual shutdown of its activities, aiming for completion of decommissioning in 2012. The solid waste and liquid effluent treatment and packaging functions have ceased. The STEDS is still taking in and providing storage for waste, primarily that resulting from clean-out of the BNIs in the centre, before taking them away to alternative disposal routes. The removal from storage of the high-level bins in the decay storage installation (BNI 79) continued in 2007, as did recovery of the high-level packages stored in radioactive decay pits, for sorting and optimisation of the package contents prior to repackaging. This will enable some of the packages to be sent to ANDRA's Aube repository or

ASN inspection in the CEA centre at Fontenay-aux-Roses

to the CEDRA BNI for waste with sufficiently decayed radioactivity levels. For packages in which the radioactivity level is still too high for removal through the above-mentioned routes, CEA envisages storing them in ventilated pits in BNI 72 (STED at CEA Saclay).

CEA presented its final shutdown and decommissioning dossier for this installation in January 2006. A draft decree authorising final shutdown and decommissioning of BNIs 36 and 79 was prepared and submitted to the Interministerial Commission for Basic Nuclear Installations (CIINB) in June 2007. It was approved by ASN on 22 October 2007 (opinion 2007-AV-0031). The draft decree was forwarded to the relevant Ministers for signature.

Active material analysis laboratory (LAMA - BNI 61)

This laboratory ended its scientific research duties in 2002. It was used to receive experimental fuels of no further use, taken from the Siloé and Mélusine reactors following their shutdown. It takes part in the clean-out operations for the STEDS and is engaged in its own clean-out work.

CEA presented its final shutdown and decommissioning dossier for this installation in January 2006. A draft decree authorising final shutdown and decommissioning of BNI 61 was prepared and submitted to the Interministerial Commission for Basic Nuclear Installations (CIINB) in June 2007. It was approved by ASN on 22 October 2007 (opinion 2007-AV-0032). The draft decree was forwarded to the relevant Ministers for signature.

Siloette reactor

Siloette is a pool-type 100 kWth reactor, primarily used to train operational personnel for the nuclear power plants. The decree authorising final shutdown and decommissioning of the reactor was signed on 26 January 2005. With a view to delicensing of the installation, in accordance with the provisions of this decree, the radiation balance covering the works period, the inventory of waste produced during the operations and a detailed report presenting the operating feedback from these operations and attainment of the final target condition were approved on 15 May 2007. On 5 July 2007, the licensee – together with government representatives – signed a document creating public protection restrictions on the land located within the BNI perimeter. This restrictive document stipulates that in the event of a sale, the buyer must be informed that the land was previously occupied by a BNI. On 10 July 2007, ASN issued decision 2007-DC-0063 delicensing BNI 21. This decision was approved by an order of 1 August 2007. BNI 21 is thus removed from the BNI list.

Mélusine and Siloé reactors

Mélusine is a pool type reactor operated by CEA. Final shutdown was declared in 1994. The decree authorising CEA to modify the Mélusine reactor prior to its decommissioning and delicensing was published in the Official Gazette in January 2004. Decommissioning of the pool is now complete. The clean-out and decommissioning of the premises continued in 2007. Delicensing of the installation could be declared in 2008.

The Siloé reactor ceased operations on 23 December 1997. The decree authorising final shutdown and decommissioning of the reactor was signed on

ASN inspection for delicensing of SILOETTE in the CEA centre at Grenoble

26 January 2005. The pool cladding removal operations ended in 2007 and pool decommissioning is continuing.

2 | 2 | 3 The Cadarache centre installations being decommissioned

ASN considers that clean-out and decommissioning of the Cadarache centre installations is proceeding satisfactorily. The example of the decommissioning of the Harmonie reactor is an illustration of the feasibility of complete decommissioning. ASN nonetheless drew the licensee's attention to the management of the waste produced by the future decommissioning of certain installations, particularly Rapsodie (sodium waste). ASN is against prolonged storage of this waste in BNIs being decommissioned and CEA will have to either provide dedicated storage facilities prior to processing of this waste, or design and create the necessary processing installations.

Rapsodie reactor and Fuel assembly shearing laboratory (LDAC)

Final shutdown of Rapsodie, an experimental fast neutron reactor which ceased operations on 15 April 1983, was declared on 28 May 1985. The work designed to partially decommission the reactor, which began in 1987, was interrupted in 1994 following a fatal accident during washing of a sodium tank. This accident, which emphasizes the risks involved in decommissioning operations, necessitated rehabilitation and partial clean-out work, which was completed at the end of 1997. Since then, clean-out and decommissioning work limited to certain equipment items has been resumed, along with waste removal. Renovation and refurbishment work has also been carried out.

The LDAC, located within the same BNI as the Rapsodie reactor, was designed for inspection and examination of spent fuel from the Rapsodie reactor or other fast neutron reactors. This laboratory has been shut down since 1997. It has been cleaned-out, is under surveillance and awaiting decommissioning.

A revised version of the installation's safety reference system, transmitted to ASN at the beginning of 2006 and covering the operations preparatory to final shutdown, was approved in 2007. This new reference system will enable the licensee to carry out a certain amount of clean-out and disassembly work on reactor auxiliary equipment. At the end of 2007, CEA submitted a file applying for final shutdown and complete decommissioning, in order to obtain the corresponding authorisation by 2010. The reactor decommissioning operations should then take about 7 years.

Harmonie reactor

Operation of the Harmonie reactor ceased in 1996. It was a calibrated neutron source used primarily for calibrating detectors and studying the properties of certain materials. The decree authorising CEA to proceed with final shutdown and decommissioning was published on 8 January 2004. Following the operations to cut up the reactor block and take away the waste generated by decommissioning in 2005, the reactor slab, which had been activated by the neutron flux during operations, was subject to complete clean-out in 2006. 2007 was primarily dedicated to building demolition work. Administrative delicensing of the installation should take place in 2008.

Enriched uranium processing facilities (ATUE)

The ATUE provided conversion into sinterable oxide of the uranium hexafluoride from the isotopic enrichment

Harmonie reactor in Cadarache before demolition

Removal of gantry crane from the Harmonie reactor in Cadarache

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.

The decree authorising final shutdown and decommissioning of the installation was published in February 2006. The year 2006 saw completion of the decommissioning phase for the process equipment.

The civil engineering structures dismantling and complete clean-out phases continued satisfactorily in 2007.

The Plutonium technology facility (ATPu) and the Chemical purification laboratory (LPC).

The ATPu produced plutonium-based fuel elements, initially intended for fast neutron or experimental reactors and then, as of the 1990s, for PWRs using MOX fuel. The activities of the LPC were closely associated with those of the ATPu: physical and chemical checks and metallurgical examination of plutonium-based products, processing of effluents and waste contaminated with alpha emitters. Since 1994, AREVA NC has been the industrial licensee of the ATPu and the LPC. From a regulatory standpoint, CEA nonetheless remains the nuclear licensee for these installations.

Given that it was impossible to demonstrate that these installations were immune to the seismic risk, AREVA NC put an end to commercial activities within the ATPu in August 2003. Since then, CEA has been involved in a final shutdown and decommissioning process for the two installations. Examination of the corresponding application files, sent to ASN in 2006 and updated at the beginning of 2007, is continuing. The application will be the subject of a public inquiry in 2008.

Following the cessation of commercial production in 2003, AREVA NC initiated the recovery and packaging of the fabrication scrap and materials contained in the ATPu and LPC. This phase is necessary in order to reduce the risks inherent in these materials, prior to decommissioning of the installations. The initial schedule set 31 December 2006 as the date for the completion of scrap processing in the ATPu and LPC. As it became clear that it would be impossible to meet this deadline, CEA wished to postpone it to 31 December 2008. ASN considered that this was too long and that the final shutdown and decommissioning operations needed to be completed as rapidly as possible and it issued decision 2007-DC-0036 of 21 March 2007, setting 30 June 2008 as the deadline for processing and evacuation of the materials and scrap from the ATPu and LPC. ASN is therefore paying particularly close attention to the progress of these operations.

Moreover, following an incident on 6 November 2006 (the maximum authorised mass of nuclear materials in a crusher was exceeded), which was rated level 2 on the INES scale, AREVA NC committed itself in 2007 to implementing a major action plan aimed in particular at improving how human and organisational factors are taken into account. ASN, which is closely monitoring the steps taken by the licensee in this area, feels that it will be possible to produce a complete summary report during the course of 2008. However, initial data would seem to indicate that the organisation has considerably changed, offering a more structured response to the malfunctions observed. The expected improvements to the safety culture will need to be assessed on a longer-term basis.

2|2|4 The Saclay centre installations being decommissioned

ASN considers that the clean-out and decommissioning operations leading to delicensing of the two Saclay particle accelerators were carried out in compliance with satisfactory methodology and regulations, which should be extended to the other installations, particularly old installations or parts of installations, the decommissioning of which had been postponed for a long time.

High activity laboratory (LHA)

The high activity laboratory (LHA) comprises several units equipped for research and production assignments on various radionuclides. Clean-out work is in progress in three cells. Two cells are still active and the others are empty.

CEA forwarded an application file for final shutdown and decommissioning in April 2006, supplemented in February 2007. A draft decree to authorise final shutdown and decommissioning of the installation was submitted to the CIINB on 18 October 2007. It was approved by ASN on 4 December 2007 (opinion 2007-AV-0040). The draft decree was forwarded to the relevant Ministers for signature.

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 (LECI). The last fuel rods were removed in 1995 and a number of partial clean-out operations conducted until 1998. Decommissioning operations are scheduled from 2012 to 2015 jointly with those of EL3. In March 2007, CEA sent ASN an updated safety case for CELIMENE.

2|3 The La Hague installations being decommissioned

UP2 400 spent fuel reprocessing plant and associated facilities

The situation of UP2-400 is described in chapter 13, point 3|2|2. The former UP2 400 reprocessing plant and the associated facilities (BNIs 33, 38, 47 and 80), shutdown since early 2004, are slated for decommissioning. As preparations for final shutdown have already started, ASN wishes to see AREVA NC rapidly submit the decommissioning application files for the installations in the UP2-400 plant. The first final shutdown and decommissioning application file for BNI 80 (HAO), should be submitted at the beginning of 2008. As it is covered by the regulations implemented by the TSN Act, this file will be subject to a public inquiry.

In 2007, ASN felt that the data provided by AREVA NC concerning the final condition of the UP2-400 plant and associated facilities following decommissioning were insufficient, in particular with regard to the target clean-out levels, the procedures for management of the waste produced by civil engineering clean-out and the possible reuse of certain buildings or facilities. The ASN Chairman therefore asked the Chair of AREVA NC for a clear stance on these subject, within the framework created by the Acts of 13 and 28 June 2006.

In addition to the facilities operated since 1976 by AREVA NC on the La Hague site, two facilities were also operated by CEA: AT1 and Elan IIB. These facilities are now the responsibility of AREVA NC and will be incorporated into the decommissioning licensing application for the former reprocessing plant.

AT1 pilot reprocessing facility

The AT1 pilot facility reprocessed fuel from the Rapsodie and Phénix fast breeder reactors from 1969 to 1979. It is part of BNI 38 (STE-2).

Clean-out of this installation began in 1982, and was completed in 2001. In 2001, ASN duly took note of the end of clean-out, exclusive of civil works, and of transition to the surveillance stage. This installation is not however delicensed as its complete decommissioning will be part of the decommissioning application for the UP2-400 plant as a whole.

Caesium 137 and strontium 90 source fabrication facility (Élan IIB)

The Élan IIB (BNI 47) facility 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, radiation 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. Radiation reconnaissance work was carried out in 2005 and the licensee sent ASN the final shutdown dossier at the end of 2005. The licensee's provisional target is to complete decommissioning in 2013.

2|4 Other installations

2|4|1 The Strasbourg University reactor

Very similar in design and characteristics to the CEA Ulysse reactor at Saclay, the Strasbourg University reactor (RUS - BNI 44) at Louis Pasteur University was mainly used for experimental irradiations and the production of short-lived radioisotopes.

The decree authorising Louis Pasteur University in Strasbourg to proceed with final shutdown and decommissioning was published in the Official Gazette of 22 February 2006. The decommissioning work began in the second half of 2006 and should be completed at the beginning of 2008.

ASN considers that the work is progressing satisfactorily.

2|4|2 SICN plant in Veurey-Voroize

Two nuclear installations, BNIs 65 and 90, located on the site of the SICN company (AREVA group) in Veurey-Voroize, constitute this former nuclear fuel fabrication plant. Fuel fabrication ceased at the beginning of this century. Final shutdown operations took place between 2000 and the end of 2005. The decrees authorising final shutdown and decommissioning operations were published in February 2006, thus enabling the decommissioning work to begin.

In 2007, equipment decommissioning continued. At the same time, the licensee closed a pilot site used to finalise the techniques to be used for clean-out of the site buildings. Operating experience feedback from this site was integrated into the complete clean-out methodology for the installations, which was transmitted to ASN. The building involved in this work was delicensed in October 2007, with regard to waste zoning (nuclear waste zones were delicensed and became conventional waste zones). Complete clean-out was initiated on the other buildings in the installation.

Furthermore, the dossier presenting the management strategy for the site soil and earth, polluted by former activities, was supplemented and forwarded to ASN in 2007. According to the conclusions of the dossier review, currently still in progress, the licensee's strategy could be validated and steps will be taken to determine the nature of the public protection restrictions to be implemented subsequent to administrative delicensing of the BNIs.

2007 was also marked by ASN decision 2007-DC-0040 of 20 April 2007, which set a one-year deadline for evacuation of a large quantity (about 15 tons) of oils slightly contaminated with uranium, in satisfactory safety conditions. This waste, produced during the operating period, should have been evacuated before decommissioning began.

ASN considers that the decommissioning work is proceeding satisfactorily, in accordance with a methodology approved by itself, despite the technical contingencies inherent in this type of work. The licensee will nonetheless need to be vigilant with regard to the evacuation of the legacy waste from the installation.

2|4|3 The Miramas storage facility

The COGEMA Miramas establishment was created in 1983. It was 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. The decree authorising the final shutdown and decommissioning of the installation was published in February 2006, and enabled the licensee to proceed with cleaning and clean-out operations, which ended in September 2006. The installation was delicensed by ASN Commission decision 2007-DC-0039 of 20 April 2007. This decision was approved by the ministers responsible for nuclear safety, in a ministerial order of 1 August 2007.

ASN inspection for delicensing of building C at the SICN in Veurey-Voroise

3 THE FINANCING OF DECOMMISSIONING AND RADIOACTIVE WASTE MANAGEMENT

3|1 The system created by Article 20 of the 28 June 2006 Act

Article 20 of Programme Act 2006-739 of 28 June 2006 on the sustainable management of radioactive materials and waste, creates a system for securing the nuclear expenses involved in the decommissioning of nuclear installations and management of radioactive waste. This Article is clarified by decree 2007-243 of 23 February 2007 concerning the secure financing of nuclear costs and the order of 21 March 2007 concerning the secure financing of nuclear costs. These two texts were approved by ASN on 1 February 2007 (opinions 2007-AV-0013 and 2007-AV-0014).

The legal framework created by these texts aims to secure the financing of nuclear costs, through implementation of the "polluter-pays" principle. It is therefore up to the nuclear licensees to take charge of this financing, by setting up a portfolio of assets dedicated to the expected costs. This is done under the direct control of the State, which analyses the situation of the licensees and can prescribe measures, should it be seen to be insufficient or inadequate. In any case, the nuclear licensees remain responsible for the satisfactory financing of their long-term expenses.

It stipulates that the licensees must make a prudent assessment of the cost of decommissioning their installations or, for radioactive waste disposal installations, their final closure, maintenance and surveillance costs. They must also evaluate the cost of managing their spent fuels and radioactive waste (I of Article 20 of the Act of 28 June 2006).

These costs are divided into 5 categories (I of Article 2 of the decree of 23 February 2007):
– decommissioning costs, except for long-term management of radioactive waste packages;
– spent fuel management costs, except for long-term management of radioactive waste packages;
– cost of recovering and packaging legacy waste (RCD), except for long-term management of radioactive waste packages;
– cost of long-term management of radioactive waste packages;
– cost of surveillance following disposal facility closure.

These categories are detailed in the list contained in the order of 21 March 2007.

The costs involved must be assessed using a method based on an analysis of the options that could be reasonably envisaged for the operation, on a prudent choice of a reference strategy, on consideration of residual technical uncertainties, on consideration of performance contingencies and on consideration of operating experience feedback.

These cost assessments, if necessary, comprise a breakdown into variable and fixed costs and, if possible, a method explaining the breakdown of the fixed costs over time. They also and insofar as is possible, comprise an annual schedule of costs, a presentation and justification of the scenarios adopted and methods used and, if necessary, an analysis of the operations carried out, the deviations from the forecasts and consideration of operating experience feedback.

The licensees must also give a concise presentation of the assessment of these costs, the extent to which the work in progress is in line with forecasts, and the possible impact of the progress of work on the costs.

3|2 Review of the reports forwarded by the licensees

One year after publication of the Act, the General Directorate for Energy and Raw Materials (DGEMP), designated as the administrative authority, received a report from each licensee, presenting an assessment of these costs. Pursuant to Article 12 of the decree of 23 February 2007, the DGEMP referred the matter to ASN, for its opinion on the pertinence of the strategies chosen by the licensees with regard to nuclear safety (decommissioning operations and schedules, management of spent fuels and radioactive waste), and so that it could identify any errors that may have led to these costs being underestimated.

In its opinion 2007-AV-037 of 20 November 2007, ASN raised the following points in particular:
– this initial analysis exercise was on the whole satisfactory given the short amount of time (3 months) available to the licensees between publication of the decree and the date of transmission of the reports. The reports will therefore need to be supplemented on several points if they are to meet to the requirements of the decree of 23 February 2007 and the order of 21 March 2007;
– the reports clarify the strategies envisaged by the licensees with regard to either the anticipated lifetime of the installations, the dates envisaged for decommissioning or the target final condition. ASN is delighted that all the licensees have opted for the immediate

decommissioning strategy. It would however like to see a reconsideration of the target final condition of certain AREVA and CEA installations corresponding to buildings kept in place and for which the civil engineering materials contain very low level waste.

4 OUTLOOK

The regulations concerning the decommissioning of nuclear installations have changed considerably since the 1990s. The TSN Act and its implementing decree 2007-1557 of 2 November 2007 have given a formal context to the experience acquired in recent years. The regulatory context of decommissioning now:

– gives an exhaustive overview of the decommissioning of nuclear installations, from filing of the decommissioning licensing application up to delicensing;
– ensures the flexibility and reactivity necessary for performance of the decommissioning operations, with the stringency that this type of operation demands, in particular through the system of internal authorisations;
– throughout the life of the installations, ensures financing of their decommissioning and management of the associated waste.

In addition to the individual decommissioning of each installation, ASN ensures that the licensees' overall strategies are coherent in taking account of nuclear safety and radiation protection constraints. The scale of the decommissioning programmes in progress (several tens of installations concerned) requires rigorous planning taking account of all safety and radiation protection parameters: installation ageing, logical sequence of operations, choice of technical scenarios, safety priorities, etc. Other parameters, on which the decommissioning strategies are based, are also essential: availability of the waste disposal routes, management of waste flows (in particular depending on the capacity of each disposal route), management of uncertainties and technical contingencies, organisational and "project" risk management, etc.

ASN also asked EDF, CEA and AREVA NC to produce dossiers giving an overall description of the their strategy and schedule for decommissioning of their shut down installations, giving safety and radiation protection justifications. In 2004, ASN concluded the review of EDF's overall strategy for decommissioning of the first generation of reactors. In early 2007, ASN issued its opinion on the decommissioning strategy chosen by CEA. AREVA will transmit a file presenting its decommissioning strategy in 2008. This file will be examined in parallel with the review of the final shutdown and decommissioning application files for the UP2-400 plant, the scale of which requires the greatest possible attention on the part of ASN, which asked AREVA to make known its stance as rapidly as possible on the strategy chosen for the final condition of this installation after decommissioning.

ASN will strive to derive maximum benefit from the system set up by Article 20 of the 28 June 2006 Act on the financing of decommissioning and radioactive waste management costs. After reviewing the first reports forwarded by the licensees pursuant to this article, it observes that these reports are on the whole satisfactory, given the very short space of time in which they had to be prepared.

In 2008, ASN will continue and take further the work started following publication of the TSN Act and the Act of 28 June 2006 on the sustainable management of radioactive materials and waste. This work in particular concerns updating of the ASN guides for decommissioning and delicensing of nuclear installations and for assessment of the scenarios and hypotheses adopted by the licensees in estimating the cost of decommissioning and disposal of the associated waste.

5 LIST OF BASIC NUCLEAR INSTALLATIONS DELICENSED AS AT 31.12.2007

Installation Localisation	BNI	Type of installation	Commission-ed	Final shutdown	Final regulatory procedures	Current status
NÉRÉIDE FAR*	(former INB 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 11)	Reactor (250 kWth)	1948	1975	1978: 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	Démonté à FAR et remonté à Cadarache
EL 2 SACLAY	(former BNI 13)	Reactor (2.8 MWth)	1952	1965	removed from BNI list	Partially decommissioned, remaining parts confined
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
ALS	(former BNI 43)	Accelerator	1965	1996	2006: removed from BNI list	Cleaned up - public protection restrictions (***)
SATURNE	(former BNI 48)	Accelerator	1958	1997	2005: removed from BNI list	Cleaned up - public protection restrictions (***)
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
IRCA	(former BNI 121)	Irradiator	1981	1996	2006: removed from BNI list	Cleaned up - public protection restrictions (***)
FBFC PIERRELATTE	(former BNI 131)	Fuel fabrication	1983	1998	2003: removed from BNI list	Cleaned up - public protection restrictions (***)
SNCS OSMANVILLE	(former BNI 152)	Irradiation facility	1990	1995	2002: removed from BNI list	Cleaned up - public protection restrictions (***)
URANIUM WAREHOUSE MIRAMAS	(former BNI 134)	Uranium bearing materials warehouse	1983	2004	2007: removed from BNI list	Cleaned up - public protection restrictions (***)
SILOETTE GRENOBLE	(former BNI 21) 163	Reactor (100 kWth)	1964	2002	2007: removed from BNI list	Cleaned up - public protection restrictions (***)

(*) Fontenay-aux-Roses – (**) Attila: Reprocessing pilot located in the BNI 57 cell – (***) Public protection restrictions: conventional public protection restrictions were implemented on the plots concerned.

6 LIST OF BASIC NUCLEAR INSTALLATIONS FINALLY SHUTDOWN AS AT 31.12.2007

Installation Localisation	BNI	Type of installation	Commission-ed	Final shutdown	Final regulatory procedures	Current status
CHOOZ AD (FORMER-CHOOZ A)	163 (former BNI 1, 2, 3)	Reactor (1040 MWth)	1967	1991	2007: final shutdown and decommissioning decree	Decommissioning in progress
CHINON A1D (FORMER-CHINON A1)	133 (former BNI 5)	Reactor (300 MWth)	1963	1973	1982: Chinon A1 confinement decree and creation of the Chinon A1D storage BNI	Partially decommissioned, modified to BNI for storage of waste left on-site (museum)
CHINON A2D (FORMER-CHINON A2)	153 (former BNI 6)	Reactor (865 MWth)	1965	1985	1991: partial decommissioning decree for Chinon A2 and creation of the Chinon A2D storage BNI	Partially decommissioned, modified to BNI for storage of waste left on-site
CHINON A3D (FORMER-CHINON A3)	161 (former BNI 7)	Reactor (1360 MWth)	1966	1990	1996: partial decommissioning decree for Chinon A3 and creation of the Chinon A3D storage BNI	Partially decommissioned, modified to BNI for storage of waste left on-site
MÉLUSINE GRENOBLE	19	Reactor (8 MWth)	1958	1988	2004: decommissioning licensing decree	Decommissioning in progress
SILOÉ GRENOBLE	20	Reactor (35 MWth)	1963	1997	2005: decommissioning licensing decree	Decommissioning in progress
RAPSODIE CADARACHE	25	Reactor (40 MWth)	1967	1983		Decommissioning in progress
EL 4D (FORMER-EL4 BRENNILIS)	162 (former BNI 28)	Reactor (250 MWth)	1966	1985	1996: decree ordering decommissiong and creation of the EL-4D storage BNI	Partially decommissioned, modified to BNI for storage of waste left on-site
SPENT FUEL REPROCESSING PLANT (UP2) (LA HAGUE)	33	Transformation of radioactive materials	1964	2004	2003: boundary change	In the process of being shutdown
EFFLUENT AND SOLID WASTE TREATMENT STATION (STE2) AND SPENT NUCLEAR FUELS REPROCESSING FACILITY (AT1) (LA HAGUE)	38	Reprocessing of fast fuels	1969	1979		Cleaned up
HARMONIE CADARACHE	41	Reactor (1 kWth)	1965	1996	2004: final shutdown and decommissioning decree	Decommissioning in progress

6 LIST OF BASIC NUCLEAR INSTALLATIONS FINALLY SHUTDOWN AS AT 31.12.2007 (continuation)

Installation Localisation	BNI	Type of installation	Commission-ed	Final shutdown	Final regulatory procedures	Current status
STRASBOURG UNIVERSITY REACTOR	44	Reactor (100 kWth)	1967	1997	2006: final shutdown and decommissioning decree	Decommissioning in progress
BUGEY 1	45	Reactor (1920 MWth)	1972	1994	1996: final shutdown decree	Final shutdown in progress
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 processin g	1963	1997		Decommissioning in progress
LCPu FAR*	57	Plutonium chemistry laboratory	1966	1995		Final shutdown in progress
RM2 FAR*	59	Radio-metallurgy	1968	1982		Decommissioning in progress
LAMA GRENOBLE	61	Laboratory	1968	2002		Final shutdown in progress
HAO (HIGH LEVEL OXIDE) FACILITY (LA HAGUE)	80	Transformation of radioactive materials	1974	2004	2003: boundary change	Final shutdown in progress
SUPERPHENIX CREYS-MALVILLE	91	Reactor (3000 MWth)	1985	1997	1998: final shutdown decree	Final shutdown in progress

(*) Fontenay-aux-Roses

CHAPTER 16

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7 OUTLOOK

This chapter deals in a general way with management of objects and sites after they have been used for an activity involving radioactive materials, 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-out 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 intentionally concentrate 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 with consistently with polluted site practices.

Radioactive waste management is covered by the 28 June 2006 Act on the sustainable management of radioactive materials and waste. This Act lays down a roadmap for management of all radioactive waste, in particular by requiring the updating every 3 years of a National Plan for management of radioactive materials and waste.

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 materials are not used for their radioactive or fissile properties.

Certain industrial waste, considered to be hazardous, must be managed in specific routes.

Radioactive waste management begins with the design of installations using radioactive materials, 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, interim storage and final disposal. All operations associated with management of a category of waste, from production to disposal, constitute a waste management route, each of which must be appropriate to the type of waste concerned.

The operations within each route are interlinked and all the routes are interdependent. These operations and routes 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 routes

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 half-lives of the radionuclides 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 radionuclides (activity level halved in more than 30 years).

Table 1 shows the stage reached in implementation of the different waste management routes, notably the final disposal route adopted. It shows that for certain waste, there is at present no final disposal solution.

Very short-lived waste

Medical uses of radioactivity, whether for diagnostic or therapeutic purposes, generally involve very short-lived radionuclides (their radioactivity is halved in less than a few days). The waste generated by these diagnostic or

Table 1: Existing or future disposal routes for the main radioactive solid wastes

<table>
<tr><th>Activity \ Period</th><th>Very short-lived</th><th>Short-lived</th><th>Long-lived</th></tr>
<tr><td>Very low level</td><td rowspan="4">Management by radioactive decay</td><td colspan="2">Dedicated surface disposal
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<tr><td>Low level</td><td>Surface disposal (Aube repository)</td><td>Dedicated subsurface disposal under study</td></tr>
<tr><td>Intermediate level</td><td>except tritiated waste and certain sealed sources</td><td>Routes being examined under Article 3 of the act of 28 June 2006</td></tr>
<tr><td>High level</td><td colspan="2">Routes being examined under Article 3 of the act of 28 June 2006</td></tr>
</table>

therapeutic activities is collected and stored for a time allowing the radioactivity to decay by a factor of 1000 after waiting for about ten half-lives. This waste is then disposed of in the conventional hospital waste disposal routes.

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 decommissioning, from conventional industrial or research sites which use low-level radioactive materials, or from clean-out of sites polluted by radioactive materials. The quantity produced will grow considerably when the time comes for the large-scale complete decommissioning of the power reactors and plants currently in operation. The 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. The activity of this waste is between a few hundred Bq per gram to one million Bq per gram. 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. 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 route has been operational since 1969, when France was the first country to decide to cease its participation in the VLL waste immersion operations organized by the OECD. At that time, 14,300 m^3 of radioactive waste of French origin had already been immersed in the Atlantic Ocean.

Special case of short-lived intermediate and low-level waste for which no disposal route 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 ASN.

Most sealed sources fall into this category: a specific characteristic of these sources is that the radioactivity they contain is often highly concentrated. Consequently, even when the radioactive elements concerned have a relatively short 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 fate of used sources is dealt with in Article 4 of the act of 28 June 2006 which provides for "finalisation by 2008 of processes allowing the disposal of spent sealed sources at existing or to-be-built centres". 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 (GCRs). The activity level of graphite waste is between ten thousand and one hundred thousand Bq per gram, primarily long-lived beta-emitter radionuclides. Radium-containing waste mainly consists of long-lived alpha-emitter radionuclides with an activity of from a few tens of Bq per gram to several thousand Bq per gram.

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 level of intrinsic hazardousness could lead to subsurface disposal being envisaged at a depth of at least fifteen metres.

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 decommissioning of nuclear installations. The activity of this waste is about one million to one billion Bq per gram.

The high level waste generally originates from fission and activation products deriving from spent fuel processing. This waste, which is vitrified, 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 (French Atomic Energy Agency) research reactors, together with EDF spent fuel which is not to be reprocessed. The activity level of this waste is of several billion Bq per gram.

Vitrification of a solution of fission and activation products

For the time being, this waste is being stored in the nuclear installations. Research is being carried out into disposal in accordance with Article 3 of the act of 28 June 2006 (see point 6|2).

1|2 The regulatory framework for radioactive waste management

Radioactive waste management falls within the general framework defined by Act 75-633 of 15 July 1975 codified in chapter I of part IV of the Environment Code and its implementation decrees, concerning waste disposal and recovery of materials. The basic principles of this act 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. In 1991, it was supplemented by the Bataille Act, which set a framework for research into long-lived high level waste and conferred the status of independent establishment on ANDRA, which was in charge of research into geological disposal. The 28 June 2006 Act gives a legislative framework for management of all radioactive waste and materials. It provides for the drafting of a National Plan for management of radioactive materials and waste, to be updated every 3 years. The act also sets the new schedule for research into long-lived high level and intermediate level waste (see point 6|2). It recalls the ban on final disposal on French soil of foreign waste, by providing for the adoption of rules specifying the conditions for return of waste resulting from reprocessing in France of spent fuel or waste from abroad. The 28 June 2006 Act reinforces ANDRA's duties, in particular the public service duty to rehabilitate sites contaminated by radioactive materials and to collect waste for which the party responsible has defaulted. Finally, the 28 June 2006 Act sets a clear legal framework for securing the funds necessary for decommissioning and for the management of radioactive waste (see chapter 15).

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 to ASN for approval.

Production of radioactive waste in other activities using radioactive materials

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 the management of effluents and waste contaminated by radioactive materials originating from all nuclear activities intended for medical purposes, human biology or biomedical research and entailing a risk of exposure to ionising radiation, must be reviewed and approved by the authorities, in conditions and in compliance with technical rules which shall be the subject of a decision by the Nuclear Safety Authority, approved by the Ministers with responsibility for health and the environment. This decision is currently being finalised.

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. It will be replaced by the above-mentioned decision, which will be accompanied by an implementation guide.

Waste management route regulation

Regulation of the waste management routes 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.

The systems for traceability of waste, whether or not radioactive (registers, periodic notification to the administration and waste monitoring statements) are defined by decree 2005-635 of 30 May 2005 concerning regulation of the waste treatment circuits. The order of 30 October 2006, implementing the above decree, more specifically targets radioactive waste.

To avoid radioactive waste being introduced into waste treatment or disposal facilities that are not duly authorised, the steps taken by the authorities have led to the installation of radioactivity detection systems at site entrances (landfills, foundries, incinerators, etc.). These systems constitute an extra line of defence in the regulation of radioactive waste management routes.

1 | 3 European regulations harmonisation work within 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 decommissioning operations.

The reference levels for the interim storage of radioactive waste and spent fuel and for the decommissioning of nuclear installations were published on the websites of the WENRA member authorities websites at the beginning of 2006, in order to collect the opinions of the stakeholders before they are enshrined in national regulations by 2010. The comments received led the WGWD working group to revise these levels in order to deal only with the aspects more specific to the topic considered (interim storage and decommissioning) ensuring that a graduated approach was used in relation to the reference levels drafted by WENRA for reactors.

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 decommissioning operations require that the nuclear licensees produce decommissioning strategies for their sites, draft decommissioning plans, that the more important decommissioning phases be submitted to the safety authority and that decommissioning be designed into the nuclear installation in order to facilitate all the operations as and 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 decommissioning of nuclear installations will have to be updated. 2007 was devoted to reviewing the implementation of these

reference levels in the regulations of the WENRA member authorities.

1|4 Organisation and responsibilities

The waste producer remains responsible for the waste produced until its disposal in an installation authorised for this purpose. However, many different organisations also play an active part in waste management: the carriers (AREVA NC Logistics, BNFL SA), the processing contractors (SOCODEI, AREVA NC), the interim storage or disposal centre licensees (CEA, AREVA NC, 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.

ANDRA has a long-term assignment to manage repositories. ANDRA also has a public service duty to store waste for which no disposal route 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, ASN drafts regulations governing radioactive waste management, regulates 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, AREVA NC, CEA, hospitals, research centres, etc.) and of ANDRA. It regulates 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.

ASN has three main concerns:
– safety at each stage in radioactive waste management (production, treatment, packaging, interim storage, transport and disposal);
– safety of the overall radioactive waste management strategy, ensuring overall consistency;
– the setting up of routes 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 January 2006, ANDRA published the latest version of 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. 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 2009.

Tables 2 and 3 present some data extracted from the national inventory published in 2006. The largest volumes (~ 92% of the total volume) 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, or ~ 2% of the total volume and ~ 96% of the total activity.

1|6 The national plan for the management of radioactive materials and waste (PNGMDR)

The preceding paragraphs show the various technical and regulatory aspects of radioactive waste management: categories (according to the disposal method), inventory, regulation 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. The need for an overall framework became apparent because, for all the radioactive waste and regardless of the producer, this would guarantee safe and coherent management and financing, in particular with definition of priorities.

In response to a request from the Parliamentary office for the assessment of scientific and technological options in

Tables 2 and 3: stocks of waste and spent fuels, both existing and anticipated by 2010 and by 2020 as a result of operation of the installations

Waste categories	Existing volumes in 2004 disposed of or stored (m^3)	Anticipated volumes in 2010 disposed of or stored (m^3)	Anticipated volumes in 2020 disposed or for stored (m^3)
Very low level	144,498	300,279	581,144
Low and intermediate level short-lived	793,726	928,989	1,193,001
Low level – long-lived	47,124	48,432	104,997
Intermediate level – long-lived	45,518	49,464	54,884
High level	1,851	2,511	3,611

Types of fuels	Existing quantity in 2004 (t)	Existing quantity in 2010 (t)	Existing quantity in 2020 (t)
EDF uranium oxide spent fuel waiting for processing	10,700	11,250	10,850
PWR reactor MOX fuels	700	1,300	2,350

(source: national inventory of radioactive waste and reusable materials – ANDRA 2006)

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 ASN's website for consultation purposes on 13 July 2005, and will be available until the end of 2005. In its opinion to the Government dated 1 February 2006, ASN had recommended adoption of the principle of such a plan as part of the draft act required by the Bataille Act in 1991, and formulated a certain number of concrete recommendations for certain waste categories.

The act of 28 June 2006 requires that the Government draw up a national plan for the management of radioactive materials and waste every 3 years. The provisions of the plan are specified by a decree. The first edition of the PNGMDR was produced at the beginning of 2007 and transmitted to the Parliamentary Office for the Assessment of Scientific and Technological Options, for its opinion. The French Parliamentary Office for the Assessment of Scientific and Technological Options (OPECST) published its assessment report on the National Plan for the management of radioactive materials and waste in April 2007, and made eight recommendations (see box). One of them concerns the powers given to the High Committee for transparency and information on nuclear security to create a standing section specialising in information about radioactive waste management. 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 routes for long-lived high-level waste, in accordance with the provisions of Article L. 542 of the Environment Code, are also specified.

Recommendations of the Parliamentary Office for the Assessment of Scientific and Technological Options concerning the first version of the PNGMDR

1. The second version of the PNGMDR planned for 2009 could present objectives with dates and figures, along with information on the financing allocated to the various research areas, projects or studies.

2. The PNGMDR should draw up a forecast of reusable material requirements for start-up of the 4th Generation reactors, as their technical definition studies progress.

3. France could take an international initiative for setting up continental centres placed under international control, for the fabrication and supply of nuclear fuels to new nuclear licensees, along with the reprocessing-recycling of the corresponding spent fuels, provided that the States concerned recover their ultimate radioactive waste.

4. The licensees of basic nuclear installations are required to make an immediate contribution to the French research programme on Sodium and Gas FNRs and on the corresponding fuel cycle, under the terms of agreements concluded with the research organisations, pursuant to the Act of 28 June 2006.

5. ANDRA must accord particular importance to studies into the disposal project operational safety studies and the safety of the related transport and handling operations.

6. Publication of the decree concerning the provisions of the PNGMDR, planned for April 2007, should be accelerated by advancing its preliminary review by CEA.

7. The High Committee for transparency and information on nuclear safety could set up a standing section specialising in information about radioactive waste management.

8. A summary of the PNGMDR could be produced and widely distributed by the public consultation bodies, particularly by the local information committees and the High Committee for transparency and information on nuclear safety.

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 European countries have adopted a policy of exempting VLL waste on the basis of an activity threshold, an option that is allowed by European Council radiation-protection Directive 96/29/Euratom 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 amended order of 31 December 1999. Pursuant to said order, each licensee of a basic nuclear installation must therefore send ASN a "waste study" which, for each zone, presents the risk of contaminated, activated, or non-radioactive waste being produced in the installation. This installation "zoning", subject to ASN approval, thus enables a distinction to be made between two types of zones. 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 routes. The waste from the other zones is, after checking that there is no radioactivity, routed to conventional waste routes (non-specific or special industrial waste). ASN has published a guide, revised in September 2002, for the production of BNI waste studies. It is available from the ASN website.

ASN has at present no plans to propose a draft order to the Minister for Health allowing reuse of contaminated or potentially contaminated waste in consumer goods or construction materials. Waste from nuclear waste zones may only be reused in a nuclear installation.

2|2 The particular case of clean-out when decommissioning installations

The problem of the safety of final shutdown and decommissioning of nuclear installations is dealt with in chapter 15. The following section only deals with operations designed to separate the nuclear parts (which could have been activated, extensively contaminated, or in contact with radioactive materials) from conventional parts (which could not have been in contact with radioactive materials).

Basic nuclear installations

The clean-out method today preferred by 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.

Guide SD3-DEM-02, published in March 2006, specifically covers complete clean-out operations for civil engineering structures making up nuclear waste zones. "Complete" clean-out of a nuclear installation consists in total removal of the civil engineering structures considered to be nuclear waste, including inside the thickness of the structures (concrete shells for example). In this case, the installation's waste zoning must be updated, in order to take account of the activation or migration phenomena likely to have occurred in the civil engineering structures. A new limit between nuclear waste zone and conventional waste zone must be defined, using an approach based on successive and independent lines of defence.

The first line of defence to be employed is based on an in-depth review of the state of the installation and an understanding of the physical phenomena involved (activation, migration of contamination, etc.). Modelling these phenomena defines a minimum clean-out thickness, to which a fixed safety margin must be added to cover any calculation uncertainties. The total clean-out thickness thus obtained then corresponds to the limit between a nuclear waste zone and a conventional waste zone.

After the complete clean-out operations, 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 (second line of defence). It then submits a proposal to ASN for final delicensing of this zone so that it becomes a conventional waste zone. After approval of this final waste zoning modification, the remaining conventional waste is disposed of in conventional routes and can be dealt with in the same way as normal industrial waste.

In 2006, ASN examined the first files from the nuclear installation licensees presenting the clean-out methodologies used for final shutdown and decommissioning operations. In 2007, ASN delicensed the first premises to which the complete clean-out process had been applied. The licensees, for whom this approach is a relatively new one, are beginning to receive initial feedback from implementation of complete clean-out operations.

Medical, industrial and research installations

There are as yet few dossiers concerning clean-out of medical, industrial and research installations. In 2004, a dossier for complete decommissioning of a former pharmaceutical laboratory owned by Aventis-Pharma was submitted to ASN for its opinion by the *préfet** 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-out and decommissioning methodology chosen is similar to that used for nuclear installations: the premises were divided into waste zones, mainly based on the history of activities on the site, allowing differentiation between nuclear and conventional waste. On the basis of the clean-out objectives set by ASN, the clean-out operations were carried out and some of the waste removed to authorised disposal routes. The preliminary studies and the operations themselves are carried out together with ANDRA, which provides the owner with assistance. After a joint inspection to confirm that the final condition specified by the licensee had been reached, the building was demolished in 2007.

2|3 Morvilliers VLL waste repository

The VLL waste management rationalisation process, initiated by ASN in 1994, showed that it was necessary to

* In a *département*, representative of the State appointed by the President.

VLL waste disposal facility in Morvilliers

create a repository for this type of waste. At the request of the nuclear licensees, technical studies had been conducted by ANDRA and by the "ultimate" waste and polluted earth processing and disposal company (SITA FD) as of 1996 with a view to creating a repository intended for very low level radioactive waste. The Morvilliers site, not far from the Aube repository, was therefore chosen. This installation classified on environmental protection grounds (ICPE), licensed by order of the *préfet* dated 26 June 2003, offers a disposal capacity of 650,000 m^3 and has been in service since August 2003. After two years of operation, ANDRA asked the Aube *préfet* for authorisation to increase its annual disposal capacity volume from 24,000 m^3 to 37,000 m^3 and to change some of the operating conditions (slope of the covering, leachate pumping rule). This request was granted by order of the *préfet* dated 21 July 2006 and enables ANDRA to deal with the rising flow of VLL waste originating from the decommissioning work in progress.

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 olume or harmfulness and, whenever possible, to recover exploitable materials. These treatments can produce secondary waste. After processing, the waste is packaged and then, depending on its nature, placed in an interim storage facility or sent to a waste repository.

ASN requires that in the design of new installations, the licensees meet an objective to reduce the quantity of waste produced.

The following sections examine the situation of the basic nuclear installations.

3|1|1 CEA waste management

CEA has treatment, packaging and interim storage facilities for most of the waste its activities produce. In general, each CEA site has treatment and packaging installations for the waste and radioactive effluents it produces (see chapter 13). The solid wastes for which there are operational routes (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 CEA in installations with a lifespan limited to a few decades, pending creation of a long-term disposal route. Very low level waste, a significant volume of which is generated by CEA, particularly owing to decommissioning of its former installations, is stored on site and then taken away to the Morvilliers VLL waste repository. Liquid waste is treated, solidified and packaged in drums. Depending on their activity, the resulting packages are either disposed of in ANDRA's Aube waste repository, or stored by CEA pending final disposal.

CEA also possesses legacy solid and liquid waste for which there can be certain treatment difficulties, or for which there is no operational disposal route. Nuclear fuel without further use from the civil sectors of CEA is placed in interim storage, either dry (in a decay pit) or in a pool, pending definition of a disposal route (reprocessing or storage).

One of the challenges for CEA in radioactive waste management is the commissioning of new treatment installations within a time-frame compatible with its commitments to shutting down the older installations, which no longer meet modern safety standards.

ASN observes that CEA is experiencing persistent problems in successfully replacing certain waste management routes, particularly with regard to the new safety rules. ASN finds it regrettable that this situation was not anticipated during the safety reviews for this type of installation.

For 2007, ASN observes that certain projects continued to make regular progress in line with the commitments (AGATE, STELLA, PEGASE). However, CEA encountered difficulties with the recovery of legacy waste, such as the waste in trenches at Cadarache, and in the removal of organic liquid waste from the Cadarache effluent and waste treatment station. At the beginning of the year, CEA announced a further change in strategy, this time concerning the Saclay packaging and interim storage installations, even though ASN has to examine the safety review file for the solid waste management zone forwarded by the licensee in 2005 and 2006.

Management of CEA civil waste and spent fuels was examined in 1999 on the occasion of a meeting of the advisory committees for plants and waste. In the light of recent developments, both in terms of organisation (decommissioning of the UP1 plant in Marcoule and abandonment of certain projects), ASN wishes to examine all CEA activities linked to its BNI and secret BNI waste and to spent fuels. Together with the Delegate for Nuclear Safety and Radiation Protection for National Defence Installations and Activities (DSND), ASN asked CEA to forward a file concerning its management strategy for 2008. ASN and the DSND would then be able to adopt a joint stance on management of CEA waste and spent fuel following examination of the file by the advisory committees of experts and the secret BNI supervisory bodies, by the year 2009.

3|1|2 AREVA NC waste management

The AREVA 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 for the nuclear power plant licensees and on the other, the waste linked to operation of the installations. Most of this waste is the property of the plant licensees. The issue of recovering the legacy waste stored at La Hague is dealt with in chapter 13.

Interim storage of low-level waste packaged in metal drums awaiting treatment at CEA/Saclay

The waste generated by the spent fuels includes:

– Fission products and minor actinides (high level)
The solutions of fission products and minor actinides resulting from spent fuel reprocessing are calcined then vitrified in the R7 and T7 facilities. The vitrified waste is poured into stainless steel containers. After the glass has solidified, the containers are transferred to an interim storage installation pending availability of a long-term management solution or until they are sent to AREVA's customers.

– 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 stainless steel container in the ACC facility. The final package can also contain metal technological waste. The packages are temporarily stored on the site.

Waste linked to operation of the installations comprising:

– Waste from radioactive effluent treatment
The La Hague site has two radioactive effluent treatment stations (an older one, STE2, and the more recent one, STE3). The effluents used to be treated by chemical co-precipitation (and still is in the STE3, but in small quantities owing to the change in process used for effluents at La Hague). The sludges produced in STE3 are evaporated and encapsulated in bitumen, with the final encapsulated product then being poured into stainless steel drums in this facility. The drums are then stored on the site. The licensee envisages using the STE3 bituminisation process for packaging the old STE2 sludges contained in silos 550-14 and 550-15. ASN in 2007 authorised the production of 108 drums on the basis of a dossier submitted by the licensee. This run is accompanied by a 15-parameter quality control plan and drum instrumentation for real-time monitoring of the temperature within the encapsulated products. At the same time, ASN asked AREVA to continue to look for an alternative to bituminisation.

– Waste from organic effluents
The La Hague plant has an installation for interim storage of organic effluents (MDSA). The effluents stored there are subsequently treated using a mineralisation process involving pyrolysis in the MDSB facility. This installation produces cemented packages that can be disposed of in the Aube repository.

– Ion exchanger resins
The water in the fuel unloading and interim storage pools is continually purified by means of ion exchanger resins. Once used, these resins constitute waste that is treated using a cementation 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. Those that do not, are temporarily stored on the site.

With regard to the technological waste containing organic materials and stored in building 119, and the waste from the MELOX plant, AREVA NC proposes building a

compacting process and installation in addition to the existing one. This strategy also includes the use of STE3 storage compartments for this type of drum pending the availability of the new installation. In spring 2006 a working group consisting of AREVA, ANDRA, ASN and its technical support organisation (IRSN) was set up to examine the characteristics of the packages that would be produced by the proposed process. The working group examined all the design parameters (criticality, gaseous releases (hydrochloric acid and hydrogen), containment, void fraction) both in the light of current knowledge and with regard to continued study of the phenomena. At a meeting of the working group in July 2007, AREVA presented data leading to the conclusion that the quantity of hydrogen released, which was the last parameter ruling out disposal in a deep geological site, was below ANDRA's requirements. This same model will be applied to release of HCl, even though its value remains far below the quantity liable to impair the robustness of the package.

3|1|3 EDF waste management

The waste produced by EDF nuclear power plants comprises the following: activated waste (from reactor cores) and waste resulting from plant operation and maintenance. To this can be added the legacy waste and the waste from dismantling of power plants being decommissioned.

It should be noted that EDF is also the owner of long-lived high level and intermediate level waste from its share of the spent fuels reprocessed in the AREVA plant at La Hague. This waste is described in point 3|1|2 above.

Activated waste

This waste comprises control rod assemblies and poison rod assemblies used for reactor operations. This is long-lived intermediate level waste and the quantities produced are small.

It is currently stored in the plant pools pending interim storage in the future ICEDA centralised installation.

Operating and maintenance waste

This concerns ion exchanger resins (water treatment), filters, evaporator concentrates, servicing waste (rags, vinyl sheets and bags, gloves, and so on). Some refit and maintenance waste can consist of large items (vessel heads, steam generators, fuel interim storage racks, etc.).

Some of the waste produced is dealt with in the CENTRACO plant in Marcoule (metal melting or incineration of liquids, resins or other incineratable 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 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 waste repository and some particularly low level waste in the VLL waste centre. It contains beta and gamma emitters but few or no alpha emitters.

Fuel assembly hulls, ACC facility at La Hague

EDF legacy waste
This is structural waste (graphite sleeves) from fuel used in the old gas cooled reactors (GCRs). This is long-lived low level waste.

This waste is primarily stored in semi-buried silos at Saint Laurent des Eaux. The improved safety of these silos and the long-term management of this type of waste are mentioned in point 4|2 below.

Dismantling waste from plants being decommissioned
This is mainly very low level waste. There will also be graphite waste (stacks still present in the GCRs).

EDF waste management policy
EDF fuel use policy (see chapter 12) has consequences for the cycle installations (see chapter 13) and for the quantity and quality of the waste produced. This subject was examined by the advisory committees for reactors, for plants and for waste from the end of 2001 to early 2002. ASN asked that the file be updated by mid-2007. In April 2007, EDF informed ASN that the file would not be ready before the end of the first quarter of 2008. At the insistence of ASN, EDF shortened the delay, bringing transmission of the file forward to 31 December 2007.

With a view to ensuring general use of M5 alloy and zirlo fuel cladding, ASN asked EDF for information about the impact of such a move on the characteristics of the resulting waste.

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, 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 and to look for routes for disposal of the activated waste stored in the pits, of chemical waste and of graphite waste. ASN at the same time asked EDF for clarification of its waste management organisation.

In 2004, EDF forwarded a clarification of its waste management organisation. It also carried out waste management safety analyses in its nuclear auxiliary and effluent packaging and treatment auxiliary buildings, and forwarded them to ASN (see chapter 12 point 4|3).

With regard to ASN's other requests in 2002, EDF asked for creation of a centralised interim storage facility for its activated waste in 2005 (ICEDA). In 2007, technical review of the dossier submitted by EDF continued and EDF was asked for a certain amount of additional data. For the Saint Laurent graphite sleeves, ASN also asked EDF to improve the safety of the interim storage silos pending the construction of a final disposal facility (see points 4|2 and 6|1|4).

3|1|4 Other licensees

The waste management by other BNI licensees is reviewed by 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 effluents

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 effluents.

Sealed sources are mainly used for radiotherapy (telegammatherapy and brachytherapy) and for measurement. Given their characteristics (usually radionuclides with half-lives 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 CIREA. These sealed sources are not likely to produce radioactive effluents 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 effluents: 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 effluents 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 which nosocomial diseases (secondary infections contracted in the health care establishments) are possible.

3 | 2 | 2 Management and disposal of radioactive waste and effluents produced by biomedical research and nuclear medicine

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 regulation 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 effluents.

The collection and management of radioactive waste and effluents produced by biomedical research and nuclear medicine activities are based on 4 principles, which must be incorporated into the management plan which has been mandatory since July 2003:

– the waste is 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;
– effluents 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 ANDRA (presence of radionuclides with a half-life of more than 100 days);
– the radioactivity of the waste and effluents is systematically checked before disposal;
– removal of waste and effluents through the appropriate routes. The waste originating from the use of radionuclides with a half-life of less than 100 days can be eliminated, after decay, in the household waste route, provided that there is no infectious or chemical risk. Otherwise, the waste from health care activities is routed to a specialised route. Aqueous liquid effluents containing radionuclides with a half-life of less than 100 days may, after decay, be sent to the public sewerage network.

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 is then temporarily stored, pending local disposal after radioactive decay, or recovery by ANDRA.

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 routes, 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) For liquid effluents, there are 3 main types of controlled discharges:

– waste from laboratories handling and preparing unsealed sources from mother solutions. Only aqueous effluents from handling of radionuclides with a half-life of less than 100 days can be discharged into the sewerage system. Marked non-aqueous effluents (scintillation liquid, etc.) must be collected and follow a dedicated disposal route involving ANDRA;
– sanitary facilities of protected rooms reserved for hospitalisation of patients who have received therapeutic doses of iodine 131 of up to 4,000 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 outpatients.

As with solid waste, the disposal of radioactive liquid effluents is only possible after a check on its residual radioactivity. This check is conducted after analysing a sample of effluents taken from the tank to be drained. The effluent collection and inspection procedures are as follows:

– effluents 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-out of the effluents compatible with its discharge into the main waste water

Buffer tanks

network. The activity concentration requirement for tank drainage is 10 Bq/l;
– liquid effluents 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. The activity concentration requirement for tank drainage is 100 Bq/l;
– discharges 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 these effluents (primarily technetium 99m which has a half-life of 6 hours) passing through this tank contributes to their radioactive decay.

Activity concentration guideline values are given for effluents at the outflow from the health establishment; these values are 1000 Bq/l of 99mTc and 100 Bq/l of 131I.

A decision by ASN, approved by the ministers responsible for health and the environment and concerning the management of waste and effluents contaminated or potentially contaminated by radionuclides and produced outside BNIs, is to be issued to implement Article R. 1333-12 of the Public Health Code. A working group supervised by ASN was active from the end of 2004 until 2006 to examine more closely how the two-fold infectious and radioactive risk was taken into account in the management of waste and effluents, along with experience feedback to be gained from implementation of the above-mentioned circular and the regulatory requirements to be put into place. ASN has prepared a draft text which was sent out to the professionals concerned for their opinion. Following the comments received, in particular from the French Society of Nuclear Medicine, a fresh draft was sent out for opinions in August 2007. It incorporates the key provisions of circular DGS/DHOS 2001/323 of 9 July 2001 and in particular contains requirements concerning:
– drafting and approval of the waste and effluent management plan;
– the waste and effluent decay management conditions;
– the possibility of discharging effluents contaminated with carbon 14 or tritium;
– installation discharge outlet monitoring conditions;
– conditions requiring use of a radioactivity radiation portal monitors at site exits.

The draft decision will be examined by the ASN Commission at the beginning of 2008. It will then need to be approved by the ministers responsible for health and the environment. This decision will be accompanied by an implementation guide defining good practices in the management of effluents and waste.

Finally, it should be noted that despite increasingly stringent management procedures in the nuclear medicine departments, radioactivity detection gates situated at the entrance to conventional waste treatment installations are still frequently triggered, primarily due to the waste produced by patients returning home following treatment. The Ministry for the Environment (Directorate for the Prevention of Pollution and Risks - 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 an order 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.

3 | 3 Management of Technologically Enhanced Naturally Occuring Radiation (TENORM) waste

In the environment, there is already measurable background radiation due to the presence of radionuclides which have been or are still being produced by various physical processes. As a general rule, this radioactivity leads to no significant risk, which means that there is no point in taking any particular precautions. In France, exposure to natural radioactivity varies from region to region but is about 1 mSv/year.

Some professional activities using raw materials which naturally contain radionuclides but which are not used for their radioactive properties, may lead to an increase in the specific activity of the radionuclides present. We then talk of Technologically Enhanced Naturally Occurring Radioactive Materials (TENORM).

Waste containing TENORM may be accepted in various types of installations, depending on its specific activity:
– in a disposal centre authorised by order of the *préfet*, if it can be proven that its activity is negligible from a radiation protection viewpoint. The DPPR circular of 25 July 2006 clarifies the conditions for acceptance of this waste. This circular is accompanied by a methodological guide drafted by IRSN under the supervision of a steering committee made up of representatives of industry, disposal centre operators, environmental protection associations, experts and the Administration. The DPPR stated that the provisions of the circular should not result in the disposal centres authorised by order of the préfet becoming disposal routes for TENORM waste.
– in ANDRA's very low level waste disposal facility,
– in an interim storage facility. Some of this waste is waiting for a disposal route, in particular the commissioning of a long-lived very low level waste disposal centre. The Act of 28 June 2006 on the sustainable management of radioactive materials and waste sets 2013 as the time-frame for commissioning of this facility.

The Act of 28 June 2006 requires that an inventory of short and long-term solutions for TENORM waste be produced in 2009.

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) with a total average specific activity of 44 Bq/g (including 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;
– ore with a high average content (about 1 ‰ to 1% in French mines) having a total average specific activity of 312 Bq/g (including 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 installations classified on environmental protection grounds (ICPE). The national inventory of uranium mining sites is a part of the MIMAUSA (History and impact of uranium mines: Summary and Archive) programme, under the supervision of the Ministry for Ecology, Sustainable Development and Spatial Planning. ASN is part of the steering committee for this programme. The inventory is available from the following website: www.irsn.fr. An e-mail contact address (mimausa@irsn.fr) was created at the end of 2007. An updated version of the MIMAUSA inventory appeared at the end of 2007. The modifications concern the addition of a glossary and a chapter covering topical events (the Act of 28 June 2006, the revision of the ICPE list, the mining risk prevention plan, the Limousin region pluralistic experts group (GEP)), improvements to pictograms and to mapping of sites, to enable them to be more easily situated and clarification of the site historical and administrative sections.

The next step is to set up a MIMAUSA IT application for the Government's departments and for the public.

Article 4.5 of the 28 June 2006 Act requires that by the end of 2008, an inventory be produced of the long-term impact of uranium mining residue disposal sites and the implementation if necessary of a reinforced radiological surveillance plan for these sites. The PNGMDR draft decree specifies what is required of the licensee, AREVA:
• a study of changes in the mechanical and geochemical behaviour of the stored residues,
• an analysis of the long-term performance of the disposal site retention dykes,
• a study of the long-term impact of the residue disposal sites, taking account of both a normal development scenario and degraded development scenarios.

Analysis of these studies could lead to a tightening up of the public exposure risk prevention measures being recommended.

These studies involved meetings between ASN and AREVA and visits to former mining sites in the Limousin region, in Forez and Saône et Loire in 2007. By the beginning of 2008, ASN should validate the modelling methodology adopted by AREVA for assessing the long-term impact of the residue disposal sites, with a normal development scenario and four degraded development scenarios as follows: loss of covering, construction of residential buildings above the repository, construction of a road, presence of children playing on the backfill. This modelling should be applied to about 9 former mining sites.

A generic modelling study of the potential impacts in order to assess exposure linked to the use of tailings in the public domain should also be carried out by the end of 2008.

3|3|2 Waste resulting from other activities

Other activities, particularly those leading to mining treatment residues (mines operated for the extraction of rare earths, phosphate ore treatment residues from the superphosphate fertiliser industry, and so on), can lead to problems similar to those from uranium mine treatment residues (point 3|3|1): large quantities of waste produced, often managed in-situ, and for which no appropriate disposal route is currently available.

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. ASN is working together with relevant departments of the ICPE (Installations Classified on Environmental Protection Grounds) inspectorate. ASN aims to ensure that this waste is sorted and packaged so that it is always routed to the appropriate route. It should be noted that given the absence of a long-lived low level waste repository, the only route currently available for the most active waste is interim storage.

In 2004, ASN asked the *Robin des Bois* association to conduct a study into the effects of naturally occurring radioactivity enhanced by human activities, and the

Case of the Limousin region uranium mining sites

On 24 December 2004, the Regional Directorate for Industry, Research and the Environment (DRIRE) received AREVA NC's operating results, which although they meet all the requirements nonetheless need some additional work. The DRIRE therefore asked the licensee to have a third-party assessment carried out. In order to bolster the dialogue and consultation concerning the Limousin region's uranium mining sites, the Ministry for Ecology and Sustainable Development, the Ministry Delegate for Industry and the Ministry 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. ASN contributes to funding the working of the GEP. Three working sub-groups have been set up: source term and discharges, environmental and health impacts, and long-term regulatory framework. In January 2007, IRSN submitted a report corresponding to the 1st step in its third-party assessment and the GEP submitted the interim report on the first phase of its work (June to December 2006). These reports are available on the IRSN's website. The GEP report was presented to the CLIS on the Bellegarde site on 14 March 2007 and to the Haute-Vienne CODERST on 16 March 2007. AREVA took due note of the recommendations and created an action plan. Work continued on the other sites and river basins and a 2nd interim report was submitted at the end of 2007.

The former mining site at Bellezane (Haute-Vienne) before its redevelopment

The former mining site at Bellezane after its redevelopment

correspondingly polluted sites in France. This study covers industrial activities involving 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. The final version of the study report was submitted to ASN in December 2005. This extremely comprehensive report provides detailed information on the potential sources of exposure of workers and the public to ionising radiation and was transmitted to the local, regional and national administrations. In 2008, ASN will be continuing to work with the *Robin de Bois* association on the subject of TENORM, as required by the PNGMDR (see section 1.6) which stipulates that ASN must produce a study of the solutions for management of TENORM waste by 2009.

Case of the Mallièvre concession

Tailings at the former mining site of La Mallièvre

At the request of the DRIRE, Géodéris conducted a study into the environmental risks related to the Mallièvre mining concession (Deux-Sèvres and Vendée départements*). ASN was asked to state its position in September 2007 further to the Géodéris interim report. The main concern was the assessment of the impact from the mine tailings. Tailings are crushed rocks which have undergone no particular chemical treatment. When ore is mined, large quantities of tailings are also extracted. The average radiological content of the tailings is generally close to the local natural background level, although isolated blocks may occasionally be more radioactive. The Géodéris study confirmed that the tailings present in the public domain all contain less than 0.03% of uranium. The tailings are often used as surfacing material for paths. Under the Act of 28 June 2006, a generic study will allow an assessment of the potential dosimetric impact of use of these tailings in the public domain by the end of 2008.*

**Administrative region headed by a Préfet.*

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-aux-Roses (BNI 73) and Grenoble (BNI 79) (see chapters 14 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 73 and 79, CEA is involved in a programme to recover this waste as part of the process to delicense the Grenoble and Fontenay-aux-Roses sites.

In BNI 72, fuel is also stored in concreted fuel blocks. Recovery of this fuel is currently being reviewed, for subsequent reconditioning in the START installation in Cadarache and then interim storage in the CASCAD installation, also in Cadarache.

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 decommissioning 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 warehouses, and on the other to recover waste stored in the old pits (Fosséa project).

4|1|2 CEDRA

Decree 2004-1043 of 4 October 2004 authorised CEA to create the CEDRA basic nuclear installation (packaging and storage of radioactive waste) on the Cadarache site. On 20 April 2006, the Ministers for Industry and the Environment authorised start-up of CEDRA unit 1.

CEDRA unit 1 will in particular be used to store:
– blocked waste packages resulting from recovery of packages currently stored in the BNI 56 warehouses and pits, in order to improve their interim storage conditions;
– packages arising from routine BNI 37 production.

With regard to unit 2 (intermediate building) CEA decided on a change of direction for the project. The "PbSO4 hull" type waste containing radium, will be repackaged in order to limit the release of radon gas. CEA envisages service entry of unit 2 between the 3rd quarter of 2013 and the 2nd quarter of 2014.

The CEDRA installation will eventually replace in particular BNIs 37 and 56.

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.

Given the scale of the work needed to continue with operation of PEGASE, CEA in December 2004 proposed final shutdown of the installation, which should close in 2010.

Removal from storage began in January 2006 with consignment of OSIRIS Oxydes type fuels to the CARES (secret BNI) interim storage facility, but these operations were interrupted as a result of an incident. Pending the authorisation to resume, removal from storage of the OSIRIS Siliciures elements began.

In 2006, CEA set up a project to recover drums containing plutonium for interim storage in CEDRA. This project, which is running according to schedule, should enable CEA to meet its commitment to remove this waste no later than the end of 2010 (action considered to be a priority by ASN).

The CASCAD installation is dedicated to dry storage of spent fuel. The fuel is placed in containers before being stored in sealed pits located in a concrete structure and cooled by natural air convection.

4|2 Interim storage of legacy waste

4|2|1 Recovery of waste from trenches in CEA's BNI 56

The Cadarache interim storage facility (see point 4|1) partly consists of 5 trenches which, between 1969 and 1974, were filled with a variety of low and intermediate

level solid waste, then covered with earth. The facility was at the time an experimental waste disposal facility. Waste recovery from the trenches, for clean-out and rehabilitation of the site, began in 2005 but had to be suspended in September 2006 for safety reasons.

After consolidation of the walls, CEA intends to finish waste recovery from trench T2. For the other trenches, a new process will be used.

In its old pits, BNI 56 also stores intermediate level waste in conditions which no longer meet current safety standards. The FOSSEA project provides for the recovery and repackaging of all packages stored in the pits, for interim storage in CEDRA, after additional characterisation and repackaging when necessary. After deciding to halt the recovery project started in 2004, CEA examined a new recovery and processing scenario for this waste. A new dossier concerning pit F3 was submitted to ASN in 2007.

4 | 2 | 2 EDF's Saint-Laurent (BNI 74) silos

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 GCRs, plus technological waste.

As this installation no longer complied with current safety criteria, ASN asked EDF to empty the silos before 2010. The solution proposed by EDF was based on the availability of a final disposal route for the graphite waste by 2010, however the delay in the search for a host site is likely to put this deadline back to at least 2013. After examining alternative strategies, at the request of ASN, pending the availability of a disposal facility for graphite waste, EDF proposed building a containment barrier around the silos. This solution will require prior authorisation by ASN and EDF therefore submitted an updated version of the authorisation application in July 2007.

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

Article 14 of the 28 June 2006 Act on the sustainable management of radioactive materials and waste (Article L 542-12 of the Environment Code) states that ANDRA is

Trench recovery site at BNI 56 in Cadarache

particularly responsible for the collection, transport and handling of radioactive waste and the rehabilitation of sites polluted by radiation, on request, and at the expense of the person responsible, or further to public requisition when the parties responsible for this waste or these sites have defaulted. The last paragraph of Article 15 stipulates that ANDRA shall receive a subsidy from the State, which contributes to funding the missions of general interest entrusted to it. For this purpose, ANDRA's board in April 2007 set up a National Funding Commission for Radioactive Matters, CNAR.

A circular explaining ANDRA's public service duties, the procedures for taking charge of certain radioactive waste and the management of sites subject to radioactive pollution will shortly be replacing the government circular of 16 May 1997 on the management of sites contaminated by radioactive materials.

Furthermore, the public authorities, more particularly the *préfets*, can ask ANDRA, CEA or IRSN to take charge, at least temporarily, of radioactive waste. The conditions in which the préfets refer to these organisations are specified in government circular DGSNR/DHOS/DDSC n° 2005/1390 of 23 December 2005 concerning the principles for intervention in the case of an event liable to lead to a radiological emergency, outside the situations covered by an emergency or response plan. ANDRA is the natural destination for waste for which the party responsible has defaulted and which is handled by the State.

4|3|2 The types of waste concerned and specil 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 authorities had created a number of financing systems to help those in possession of this type of waste (in particular private individuals):
– the radium fund: this fund was set up in June 2001 and is used to provide up to half the cost of clean-out 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-out process and 100% for making sites contaminated by radium safe;
– the agreement between the nuclear power sector producers and ANDRA: this is implemented in order to secure a site contaminated by radioactive materials in accordance with the provisions of the circular of 16 May 1997 aforesaid.

These two measures did not guarantee the medium-term financing needed to deal with waste for which the

The National Funding Commission for Radioactive Matters (CNAR)

On 24 April 2007, the board of Andra created a National Funding Commission for Radioactive Matters (CNAR). This commission is required to issue an opinion on the use of the public subsidy mentioned in Article 15 of the 28 June 2006 Act, concerning both the funding priorities and the strategy for treatment of polluted sites and the principles governing the procedures for taking charge of the waste. This commission also issues an opinion on individual matters brought before it.

It is chaired by the Director General of the Agency and comprises representatives of the supervisory ministries (DGEMP, DPPR, DGS), ASN, IRSN, the Association of Mayors of France, environmental protection associations and qualified personalities.

CNAR secretarial services are provided by ANDRA.

The Commission held its inaugural meeting on 3 July 2007 and met again on 19 September 2007 and 3 December 2007 to tackle operational subjects such as implementing the strategy for taking charge of waste, management of polluted sites considered to be priorities, such as Gif-sur-Yvette, Bandol, Isotopchim.

This commission is the equivalent of ADEME's National funding Commission dealing with management of sites polluted by non-radioactive materials.

licensee is defaulting and the agreement between ANDRA and the producers in the nuclear electricity generating sector came to an end in May 2005. The size of the radium fund had for its part been tailored to precise situations and could only be used when the contaminating radionuclide was radium. The two systems were replaced by ANDRA's public service duties described in the previous section. The 1.5 million euros initially allocated to ADEME for the radium fund were therefore transferred to ANDRA. In 2007, the CNAR validated the policy of funding of recovery of radioactive objects as required by the Act of 28 June 2006. In practice, these radioactive objects are no longer needed by the owners or those in possession of them. They may for example be natural radioactive salts, ore samples, objects containing radium for medical purposes (such as needles), radioactive lightning conductors, radium fountains and so on. The parties in possession of these objects may vary widely: private individuals (sometimes as a result of an inheritance), teaching institutions, local authorities, fire brigades, etc.

4 | 3 | 3 Public service storage facilities

ANDRA does not operate any interim storage facilities. It signs agreements with other nuclear licensees so that they provide it with interim storage capacity. For example, the SOCATRI company was authorised by decree in 2003 to provide interim storage on behalf of ANDRA for long-lived low level waste, CEA at Cadarache for interim storage of radium lightning conductors, and CEA at Saclay for interim storage of used radioactive sources for which there are currently no disposal routes.

5 SITES POLLUTED BY RADIOACTIVE MATERIALS

5 | 1 The legal framework of action by the public authorities

According to the 1997 circular, a site polluted by radioactive materials is any site, either abandoned or in operation, on which natural or artificial radioactive materials 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 *préfets*, describes the administrative procedure applicable to sites polluted by radioactive materials and specifies that the treatment and rehabilitation operations are performed and financed directly by those responsible, as defined by the act of 19 July 1976 concerning installations classified on environmental protection grounds (ICPEs). A new circular should very shortly be replacing that of 1997. It will cover ANDRA's public service duties and will clarify the procedures for management of radioactive polluted sites covered by the regime applicable to installations classified on environmental grounds or the Public Health Code. This new circular will thus make it possible to deal with legacy radioactive contamination of sites due to past craft or industrial activities involving radioactivity (for instance the clock-making industry using radium, radium mining works of the 1920s to 1930s, the early 20th century laboratories carrying out research into radioactivity, and so on), sites which are not generally classified on environmental protection grounds. For installations classified on environmental protection grounds, the new circular will also refer to the circular published on 8 February 2007 by the Ministry for Ecology and entitled "Cessation of activity by an installation classified on environmental protection grounds – Chain of responsibility – Defaulting by the parties responsible".

ASN considers that the new regulations on sites polluted by radioactive materials should enable a clear and applicable context to be given to the inspectors in charge of regulating these sites on behalf of the *préfet*, ensuring compliance with international recommendations (IAEA) on the subject. These regulations should clarify the provisions of Article R. 1333.90 of the Public Health Code dealing with a confirmed risk of chronic exposure.

The methodology guide for management of industrial sites potentially contaminated by radioactive materials, published in October 2000 (version 0), describes the applicable approach to dealing with various situations liable to be encountered during rehabilitation of sites (potentially) contaminated by radioactive materials and should soon be updated to take account of the forthcoming abrogation of the circular of 16 May 1997 and to allow an approach consistent with management of chemically polluted sites and soils.

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, 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 materials. The January 2006 edition is available on the ANDRA website, www.andra.fr. The next edition is planned for 2009.

5 | 2 | 2 The databases of the Ministry for Ecology, Sustainable Development and Spatial Planning

The Ministry for Ecology and Sustainable Development has 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, whatever 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. A summary of the inventory is accessible on the Ministry for Ecology, Sustainable Development and Spatial Planning website, 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. The information collected is input into a database managed by the BRGM and available on the website, www.basias.brgm.fr. www.basias.brgm.fr.

5 | 3 Actions performed and dossiers in progress

5 | 3 | 1 General

ASN has carried out a wide range of actions since 2002 on sites polluted by radioactive materials, in response to the variety of encountered situations. In some cases, the pollution can be due to legacy activities where the former industrial operator has since 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 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 *préfet* to propose allocation of technical and financial aid for the simpler cases. A property was purchased at the end of 2005 and the site was made safe by ANDRA in 2006, rehabilitation work with the ultimate aim of demolition of the house began in 2007 and will continue in 2008. Nonetheless, 3 dossiers have still not been resolved, even if proposals were submitted to the owners in mid-2006.

The Essonne *sous-préfet* for his part sent the Gif-sur-Yvette town hall a 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 ASN for its opinion. The Mayor of Gif-sur-Yvette incorporated these provisions into the update of the town's Local Urban Development Plan (PLU) approved by the Town Council on 9 May 2007.

b) 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 (Alpes de Haute-Provence *département*). 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. Since December 2002, ANDRA has been conducting site clean-out operations, in particular to remove the bottles containing concentrated solutions to an appropriate and financed disposal route. The option of transferring this very small volume of solutions to CEA Marcoule for treatment was examined in 2006. The intervention procedures were finalised and the necessary licences obtained (DSND approval for treatment of the products in Marcoule, special transport arrangements approved by ASN, etc.). The operation should take place at the beginning of 2008. ASN noted significant mobilisation by CEA during 2006 to help the public authorities rehabilitate the site.

c) 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

Site of the Danne property in Bandol

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.). Brush was cleared, fencing repaired and the waste made safe during the summer of 2006, thanks to financing through ANDRA's public service duties. Removal of the hot spots and of the waste took place in November 2007. The next step is the possible rehabilitation of this site through a redevelopment project.

Following information of the public by ASN, the safety of a neighbouring plot of land was checked in October 2007. Four contamination spots were also cleaned up in November 2007. ASN had an assessment made of the exposure suffered by the residents as a result of these contamination spots. A meeting was held on 27 November 2007 at the Town Hall to envisage a more widespread reassurance programme throughout the *commune**.

d) Etablissements Charvet on the Île Saint-Denis (Seine-Saint-Denis):

From 1910 to 1928, this site housed a plant extracting radium from uranium ore and a laboratory for Marie Curie. It was partially demolished in 1948, but until August 2006, buildings still existed on the site. Since 1966 they had been occupied by various companies handling butcher's waste transit activities. The Charvet company, which is the current owner of the site, carried out the same activities from the 1990s to mid-2005. The site, which has been closed since the business ceased operations, was illegally occupied from December 2005 to June 2006. Access to the site is now prohibited, with the entrances blocked off by demolition rubble. On 29 August 2006, ASN visited the site to decide on how to remove the waste contaminated by radium and envisage the future fate of the site. During the course of its inspection on 10 May 2007, ASN observed that the condition of the site was comparable to that observed during its visit on 29 August 2006, which is unsatisfactory. A number of letters were sent to the licensee demanding that it remedy the situation and ASN remains particularly vigilant with regard to the future of this site.

e) Pierre et Marie Curie School in Nogent sur Marne (Val de Marne):

This school (kindergarten and primary school) was built on the site of a former radium mine works active in the 1920s. The school was closed in 1998 following the detection of a radon level higher than the thresholds authorised for establishments open to the public. In

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

Former Pierre et Marie Curie school in Nogent-sur-Marne

mid-September 2007, ASN held meetings with the Val de Marne *sous-préfecture* and the Nogent Town Hall to discuss the future of the site. The Town Hall's site redevelopment dossier was presented on 20 November 2007 and ASN will submit its opinion on this dossier at the beginning of 2008.

5 | 3 | 3 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 operating feedback from the incidents that have occurred since 2003, involving radioactive contamination in establishments in which no radioactivity is normally used, revealed the need to be able to inform the head of the establishment rapidly of his responsibilities and the risks regarding radioactive contamination. Therefore in 2003, ASN drafted a guide which is to be quickly sent out to all heads of establishments in which unexpected radioactive contamination is detected.

6 LONG-TERM MANAGEMENT OF RADIOACTIVE WASTE BY DISPOSAL

6 | 1 Long-term management by surface or subsurface disposal of radioactive waste

Most intermediate and low level waste with a short half-life (less than 30 years) is sent for final disposal to the ANDRA's surface waste repositories. These repositories operate on a principle whereby waste is confined and sheltered from hazards, notably water circulation, during what is known as the surveillance phase, fixed by convention to last 300 years, until such time as their activity level has decayed sufficiently to 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 was operated until July 1994. It entered the surveillance phase in January 2003 (decree n° 2003-30 of 10 January 2003).

ANDRA has for a number of years been detecting the persistent presence of tritium in the groundwater and in the Grand Bel stream. Following enquiries from environmental associations (ACRO – Association for the Control of Radioactivity in the West) and ASN, ANDRA will be examining whether or not it would be advisable to install a pumping system to divert and treat the groundwater. The results of this modelling study are expected in 2008.

Isolated problems with the covering were identified and required limited consolidation work. However, only in January 2009 will ANDRA be required to rule on whether or not it would be beneficial to fit a new covering to ensure the long-term passive safety of the repository. At the same time, ANDRA will be required to submit the final safety report concerning the installation as a whole.

6|1|2 The low and intermediate level short-lived waste (LL-ILW-SL) repository

In 1992, the low and intermediate level waste repository (CSFMA) took over from the Manche repository, taking full advantage of operating feedback gained from it. This installation, located in Soulaines-Dhuys (Aube *département*) was licensed by a decree of 4 September 1989 and offers a capacity of 1 000 000 m^3 of waste located in 400 structures. This service is supplemented by waste packaging services, such as injection of mortar into metal containers of 5 to 10 m^3 and compacting of 200 litre drums.

Waste containment is built around a system of three consecutive barriers: the package, the covering structure and the geological formation. The centre's activities generate a very small quantity of radioactive effluents.

Manche repository

These discharges are regulated by the order of 19 September 2006 implementing decree 95-540 of 4 May 1995, leading to a modification of the authorisation decree dated 10 August 2003.

In 2007, the CLI began a series of environmental analyses around the centre.

In June 2006, the Advisory Committee of experts for waste evaluated the repository's operating conditions and declared itself in favour of continued operation and extension to the zone not yet in service (known as zone B). In 2006, ASN issued an opinion in favour of extension of the disposal activities to the zone not yet used and asked that additional safety studies be conducted into the risks of explosion and fire, and that the impact of long-lived radionuclides and chemically toxic substances be estimated.

6|1|3 Package acceptance rules

In May 1995, ASN defined requirements for approval of radioactive waste packages intended for the surface repository (RFS III.2.e). This basic safety rule determines the roles of the producers and of ANDRA, the radioactive or non-radioactive content requirements for each package, the approval procedures and the required characteristics.

In this respect, ANDRA draws up general and particular specifications particular to each type of package (dimensional, physical, chemical, radioactive and other characteristics). For its part, by means of technical tests and organisational procedures, the producer demonstrates the measures taken to ensure compliance with these specifications. This system undergoes initial evaluation, followed by periodic assessment by the producer, ANDRA and ASN, which may lead to approval suspension or revocation.

An evaluation of ANDRA's specifications is scheduled for 2008, with a revision of RFS III.2.e to follow, in order to incorporate the results of the June 2006 discussions by the Advisory Committee of experts.

6|1|4 Surface or subsurface disposal projects

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 current interim storage facilities are not felt to be particularly satisfactory.

Aube repository

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 decommissioning, produce waste containing graphite and significant quantities of long-lived radionuclides. This waste consists mainly of graphite stacks and sleeves, activated by neutron irradiation.

ANDRA is examining the feasibility of creating a radium waste and graphite waste repository on the same site. This type of sub-surface repository (a few tens of metres) could be dug into a hillside or excavated on flat ground. The studies proposed to date are considered to be acceptable but are based on theoretical geological models. ASN asked ANDRA for additional studies on actual sites, with Article 4 of the 28 June 2006 Act providing for commissioning of such a repository in 2013.

To facilitate the final siting choice, ASN and IRSN have over the past two years been working together on a draft guide for the safety of the operational phase and following closure of a repository for long-lived low-level solid radioactive waste.

6|2 Disposal of long-lived high level waste: implementation of the provisions of chapter II of part IV of the Environment Code, resulting from Planning Act 2006-739 of 28 June 2006 on the sustainable management of radioactive materials and waste

Following the public debate held from September 2005 to January 2006, and taking account of the recommendations made in the March 2005 report from the Parliamentary Office for the Assessment of Scientific and Technological Options, the Government sent Parliament a report during the first half of 2006, along with a bill on the management of radioactive materials and waste, in accordance with the provisions of the Bataille Act of 1991. The report and the bill, referring to the conclusions of the national assessment committee in its February 2006 report and of ASN in its opinion of 1 February 2006 on ANDRA research into the Bure laboratory site, confirmed the need for studies to continue in the three areas of research initiated by the Bataille Act, so that in particular an operational solution for deep

Graphite assembly in gas reactor

geological disposal is available by the year 2025. The bill also presented provisions concerning the ban in France on the disposal of foreign waste. As mentioned in point 1.6, the bill provided for adoption every 3 years of a national radioactive materials and waste management plan, which should comprise a "research" part. Finally, this bill contained provisions concerning the secure financing of radioactive materials and waste management and decommissioning of basic nuclear installations, as presented in chapter 15.

After adoption by the National Assembly on 15 June 2006, the bill passed into law on 28 June 2006.

Articles L. 542-1 to L. 542-14 of the Environment Code were modified further to this Act. They set the broad outlines for research and study into radioactive waste management:

– sustainable management of radioactive materials and waste of all types, in particular resulting from the operation or decommissioning of installations using radioactive sources or materials, and carried out with the aim of protecting human health, safety and the environment;
– the search for and implementation of the means necessary for definitively making radioactive waste safe are undertaken in order to prevent or mitigate the burden to be borne by future generations;
– the producers of spent fuel and radioactive waste are responsible for these materials, without prejudice to the liability of those in possession thereof, given their responsibility for nuclear activities.

With regard to long-lived high level waste, research and studies are being carried out into:

– the separation and transmutation of long-lived radioactive elements, so that by 2012 an assessment of the industrial prospects of these routes will be available, with commissioning of a prototype installation before 31 December 2020;
– reversible disposal in deep geological layers for selection of a site and design of a repository so that, on the basis of the results of the studies conducted, the authorisation application specified in Article L. 542-10-1 of the Environment Code can be examined in 2015 and, subject to this authorisation, the facility can be commissioned in 2025;
– interim storage, so that no later than 2015, new interim storage installations can be created or existing facilities modified, in order to meet the needs, especially in terms of capacity and duration, identified by the plan specified in Article L. 542-1-2 of the Environment Code.

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 separately recover certain long-lived transuranians or fission products. These radionuclides, after repackaging, are intended for transmutation by fission to give short-lived nuclides, or by capture into stable isotopes. Ongoing studies in this area are complementary to those performed by 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 would be capable of producing energy by incinerating their own waste and that of the previous generation of reactors. The industrial feasibility of these projects still however has to be explored, in particular in the field of transmutation, which implies further extensive research.

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, ASN informed CEA in January 2003 that it had no objections to resumption of operation, which took place in July 2003. ASN however only authorised continued operation of the Phénix reactor for a period corresponding to 720 equivalent full power days, which means that the reactor will be stopped in about 2009, depending on the various outages. Research into transmutation will have to be carried out on other reactors. A review should be carried out in 2012 allowing examination of the implications of possible industrial application of the separation and transmutation processes. 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 Deep geological disposal

Work to examine the disposal of waste in deep geological formations is currently being done in the Bure underground laboratory (Meuse *département*), authorised by decree in 1999.

ANDRA received approval of the shaft sinking conditions on 7 August 2000 from the Ministers for Industry and the Environment. In December 2007, the access shaft and the main laboratory drifts were completed and fitted out. In the main shaft, at a depth of 445 m, an experimentation niche 40 m long was built, with fitting out work starting in September 2004. It has been operational since December 2004. From this niche, 40 bores were drilled to obtain results on the mechanical behaviour of the rock and the composition of the fluids in the clay, and to carry out a tracer diffusion experiment. A multi-experiment drift was equipped in October 2005 and the results of the KEY experiment into the feasibility of drift sealing are currently being analysed. The drilling in 2003-2004 of 5 directional boreholes confirmed the homogeneity of the host rock.

Through inspections at ANDRA head office and on the Bure site, 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 steps have been taken to limit hydraulic and mechanical disturbances in the shaft environment.

Finally, ASN has prepared the draft decree authorising continued operation of the Bure laboratory beyond 31 December 2006. This decree, dated 23 December 2006, extends the operating period by 5 years.

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, ASN - in association with IRSN and ANDRA - set up a working group responsible for updating RFS III.2.f on deep geological disposal of radioactive waste. The requirements concerning the deep geological formation disposal option will be updated in 2008. 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 ASN on 5 November 2004 under the chairmanship of 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.

The Advisory Committee of experts met to review the draft amendment of RFS III.2.f on 19 and 26 June 2007. Following this review, the Advisory Committee issued two recommendations as follows:

– in the sub-chapter of the rule dealing with radiation protection criteria, recall the fact that assessment of the acceptability of the radiological impact of the repository is determined above all by the efforts made by the designer of the repository to ensure that individual exposure is as low as reasonably achievable in the light of current economic and social factors;

– modify the parts of the rule dealing with the recommended principles applicable to the design of waste packages liable to be disposed of in a deep geological repository, specifying the conditions for acceptance of the packages already produced.

With regard to the second point, ASN set up a working group comprising the producers (EDF, AREVA and CEA) along with IRSN and ANDRA. On completion of its work, the group proposed a new version of chapters 4|2 and the package-related part of appendix 1, which was presented to the Chairman of the Advisory Committee.

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. This working group drafted a report presenting a joint approach to the safety review of a nuclear waste repository in a deep geological formation, which was presented to the nuclear safety authorities involved in the geological repository project on 19 April 2007. The conditions in which the European authorities involved in the safety of a radioactive waste repository could work together on such a subject still need to be examined, like the work already undertaken by WENRA concerning the interim storage of radioactive waste and spent fuel and the decommissioning of nuclear installations.

6 | 2 | 3 Long-term storage

The purpose of the research into long-term storage is to design a system guaranteeing long-term containment of radioactivity, while also allowing retrieval of the packages and ensuring compatibility with possible subsequent disposal.

CEA in 2005 sent the Government its report on the packaging and long-term storage of high-level, long-lived waste. The report presents the research work carried out along with the results.

It would appear that the long-term interim storage promoted by certain stakeholders, is an essential phase prior to any final management solution. However, the interim storage installations have to be maintained in order to ensure the integrity of the barriers designed for containment of the radioactivity present inside the waste packages. ASN considers that it would not seem reasonable to count on this type of solution for managing waste over half-lives of time exceeding several centuries.

The act of 28 June 2006 now gives ANDRA responsibility for continuing interim storage studies.

6 | 2 | 4 Specifications and approval certificates for waste packages unsuitable for surface disposal

Since 1996, 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.

ANDRA, together with the waste producer, has chosen a progressive procedure whereby initially, and until 2001, the only specifications required were those related to knowledge. It also defined requirements concerning qualification of the process and management of production applicable to all waste producers, so that surveillance can be implemented and nonconforming packages identified. In 2003, most level 1 approvals (compliance with first package requirements for inclusion in the deep geological formation disposal design specifications) were granted. The performance specifications for level 2 waste packages stipulate the package properties which, as things currently stand, would seem to determine the design or impact assessment of a possible repository. ANDRA anticipates a change in this approach in order to link the specifications drafting process to that for production of an application for authorisation to create a geological repository, which could be submitted in 2014.

Since 1998, the setting up of this procedure has been closely followed by ASN, in particular through inspections at ANDRA and on the premises of the waste producers.

In 2006 and 2007 the regulatory context changed owing to:

– the fourth paragraph of Article 14 of the 28 June 2006 planning Act on the sustainable management of radioactive materials and waste, which specifies that, in compliance with nuclear safety rules, ANDRA must submit specifications for radioactive waste disposal and provide the competent government authorities with a recommendation concerning the waste packaging specifications;
– the draft RFS III.2.f "concerning the final disposal of radioactive waste in deep geological formations", chapter 4|2 of which presents the package safety functions and appendix 1 of which issues guidelines.

In order to take account of these changes, ASN resumed work on the conditions for approval of changes to the production of packages for waste that cannot be disposed of in surface or sub-surface repositories (known as "N3S" packages). The aim of this work is to meet a twofold objective:

– operational implementation of the changing context, by describing the package approval process and thus explicitly describing the role of the parties involved at each stage in the process;
– centralisation of practices: as things currently stand, the packages produced at La Hague are submitted to ASN for approval, while for those produced on the other sites there is no such explicit provision.

7 OUTLOOK

The management of radioactive waste is governed by the 28 June 2006 Act on the sustainable management of radioactive materials and waste. This Act defines a roadmap for management of all radioactive waste, in particular by requiring the updating every 3 years of a National Plan for the Management of Radioactive Materials and Waste (PNGMDR). This Plan organises research into radioactive waste for which there is at present no operational long-term management solution. This is in particular the case with long-lived high and intermediate level waste resulting from the reprocessing of nuclear power plant spent fuels, but also long-lived low level waste, some of which will be produced during decommissioning of the first generation reactors.

In 2007, ASN continued with its actions aimed at ensuring that radioactive waste is managed safely, right from the moment it is first produced. ASN thus regulates its management within the nuclear installation, but also periodically assesses the management strategies put in place by the licensees. ASN thus in 2006 took a stance on the possibility of recovering waste from past practices in the AREVA NC plant at La Hague. It would seem that even if AREVA NC has sufficient means to implement its recovery strategy, the safety of a number of interim storage installations such as the HAO silos (oxide high activity facility) is unsatisfactory and ASN will have to ensure that AREVA NC complies with the recovery schedules presented. The safety of the CEA waste and spent fuel treatment and interim storage installations was assessed at the end of the 1990s, following which CEA envisaged creating new installations and renovating certain others. ASN observes that on the whole, CEA is experiencing difficulty in meeting its commitments, particularly in terms of completion times, with the result being that it periodically reviews its strategy. ASN observes that certain projects have been successfully completed, such as the CEDRA interim store or the STELLA installation, but that others are encountering difficulties, such as recovery of waste from the Cadarache interim storage area. The implementation of strategies to recover waste from the older installations always comes up against the issue of CEA's ability to provide the envisaged replacement installations, for which the schedules are sometimes extremely tight. This is particularly the case with the DIADEM installation, a new irradiating waste interim storage facility project in Marcoule.

Since 2002, ASN has been in charge of regulating management of sites polluted by radioactive materials. The corresponding administrative procedures are to a large extent based on the regulations applicable to installations classified on environmental protection grounds, in particular the 1997 circular, for which the revision process is well advanced. Now that it has radiation protection inspectors at its disposal, ASN is able to assist the préfets in managing these situations. The National Funding Commission for Radioactive Matters set up within ANDRA as part of its public service duty, is also able to review projects for rehabilitation of contaminated sites for which the party responsible has defaulted. ANDRA has public subsidies enabling it to manage priority issues more quickly.

In 2008, ASN will continue to take part in drafting the regulations implementing the 28 June 2006 act and ensuring compliance with its requirements, in particular by continuing with co-supervision of the working group in charge of drafting and monitoring the PNGMDR. ASN will also take part in revision of the regulations concerning sites polluted by radioactive materials. In 2008, ASN will finalise the regulations concerning management of radioactive effluents and waste pursuant to Article R. 1333.12 of the Public Health Code. Finally, ASN will closely supervise the measures taken by AREVA NC to recover the legacy waste from La Hague and by CEA to create and renovate its waste and spent fuel treatment and interim storage facilities.

LIST OF BASIC NUCLEAR INSTALLATIONS* (at 31.12.07)

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 decommissioning and delicensing: 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 decommissioning decree of 26.01.05 (O.G. of 02.02.05)
22	FACILITY (PÉGASE) AND SPENT NUCLEAR FUEL DRY STORAGE INSTALLATION (CASCAD) (Cadarache) 13115 Saint-Paul-lez-Durance	CEA	Disposal of radioactive materials	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			Modification: decree of 20.03.06 (O.G. of 21.03.06)
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 materials	27.05.64			
32	PLUTONIUM TECHNOLOGY FACILITY (ATPu) (Cadarache) 13115 Saint-Paul-lez-Durance	CEA	Fabrication or transformation of radioactive materials	27.05.64			
33	SPENT FUEL REPROCESSING PLANT (UP2) (La Hague) 50107 Cherbourg	AREVA NC	Transformation of radioactive materials	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)
35	LIQUID EFFLUENT MANAGEMENT ZONE (Saclay) 91191 Gif-sur-Yvette Cedex	CEA	Transformation of radioactive materials	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 materials	27.05.64			

* 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 been authorised as new basic nuclear installations.

The BNIs notified are those which are not subject to licensing under decree 63-1228 of 11 December 1963 concerning nuclear installations and Articles 33 and 62 of Act 2006-686 of 13 June 2006 on Transparency and Security in the Nuclear Field.

As of 31.12.07 there are 121 installations with BNI status.

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
37	EFFLUENT AND SOLID WASTE TREATMENT STATION (Cadarache) 13115 Saint-Paul-lez-Durance	CEA	Transformation of radioactive materials	27.05.64			
38	EFFLUENT AND SOLID WASTE TREATMENT STATION "STE2" AND SPENT NUCLEAR FUELS REPROCESSING FACILITY (AT1) (La Hague) 50107 Cherbourg	AREVA NC	Transformation of radioactive materials	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 decommissioning decree of 08.01.04 (O.G. of 09.01.04)
42	ÉOLE (Cadarache) 13115 Saint-Paul-lez-Durance	CEA	Reactor		23.06.65	28 and 29.06.65	
44	RÉACTEUR UNIVERSITAIRE DE STRASBOURG 67037 Strasbourg Cedex	Université Louis Pasteur	Reactor		25.06.65	01.07.65	Final shutdown and decommissioning decree of 15.02.06 (O.G. of 22.02.06)
45	BUGEY NUCLEAR POWER PLANT (reactor 1) 01980 Loyettes	EDF	Reactor		22.11.68	24.11.68	Boundary change: decree of 10.12.85 (O.G. of 18.12.85) Reactor shutdown on 27.05.94 Final shutdown decree of 30.08.96 (O.G. of 07.09.96)
46	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	AREVA NC	Transformation of radioactive materials		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 materials	08.01.68			Extension: decree of 22.02.88 (O.G. of 24.02.88)

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
50	SPENT FUEL TEST LABORATORY (LECI) (Saclay) 91191 Gif-sur-Yvette Cedex	CEA	Use of radioactive materials	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 materials	08.01.68			Final shutdown and decommissioning decree of 08.02.06 (O.G. of 15.02.2006)
53	ENRICHED URANIUM AND PLUTONIUM WAREHOUSE (Cadarache) 13115 Saint-Paul-lez-Durance	CEA	Radioactive materials storage	08.01.68			
54	CHEMICAL PURIFICATION LABORATORY (Cadarache) 13115 Saint-Paul-lez-Durance	CEA	Transformation of radioactive materials	08.01.68			
55	ACTIF FUEL EXAMINATION LABORATORY (LECA) AND SPENT FUEL REPROCESSING, CLEAN-UP AND REPACKAGING STATION (STAR) (Cadarache) 13115 Saint-Paul-lez-Durance	CEA	Use of radioactive materials	08.01.68			Modification: decree of 04.09.89 (O.G. of 08.09.89) (creation of STAR)
56	RADIOACTIVE WASTE STORAGE AREA (Cadarache) 13115 Saint-Paul-lez-Durance	CEA	Disposal of radioactive materials	08.01.68			
61	ACTIVE MATERIAL ANALYSIS LABORATORY (LAMA) 38041 Grenoble Cedex	CEA	Use of radioactive materials	08.01.68			
63	FUEL ELEMENTS FABRICATION PLANT 26104 Romans-sur-Isère	FBFC	Fabrication of radioactive materials	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 materials	27.10.67			Final shutdown and decommissioning decree of 15.02.2006 (O.G. of 22.02.2006)
66	MANCHE WASTE REPOSITORY (CSM) 50448 Beaumont-Hague	ANDRA	Disposal of radioactive materials		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)

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
68	DAGNEUX IONISATION PLANT Z.I. Les Chartinières 01120 Dagneux	IONISOS	Use of radioactive materials		20.07.71	25.07.71	Increase in maximum activity of ionisation source: decree of 15.06.78 (O.G. of 27.06.78) Change in 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 materials storage		14.06.71	22.06.71	
73	STORAGE OF SOLID RADIOACTIVE WASTE 92265 Fontenay-aux-Roses Cedex	CEA	Radioactive materials storage		14.06.71	22.06.71	
74	STORAGE OF IRRADIATED GRAPHITE SLEEVES (Saint-Laurent-des-Eaux) 41220 La Ferté-Saint-Cyr	EDF	Radioactive materials storage		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 IRRADIATION FACILITIES (Saclay) 91191 Gif-sur-Yvette Cedex	CEA	Use of radioactive materials		07.08.72	15.08.72	
78	BUGEY NUCLEAR POWER PLANT (reactors 2 and 3) 01980 Loyettes	EDF	Reactors		20.11.72	26.11.72	Boundary change: decree of 10.12.85 (O.G. of 18.12.85)
79	DECAY STORAGE FACILITY 38041 Grenoble Cedex	CEA	Radioactive materials storage		20.12.72	01.02.73	
80	HAO (High level oxide) FACILITY (La Hague) 50107 Cherbourg	AREVA NC	Transformation of radioactive materials		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	

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
85	DAMPIERRE NUCLEAR POWER PLANT (reactors 3 and 4) 45570 Ouzouer-sur-Loire	EDF	Reactors		14.06.76	19.06.76	
86	BLAYAIS NUCLEAR POWER PLANT (reactors 1 and 2) 33820 Saint-Ciers-sur-Gironde	EDF	Reactors		14.06.76	19.06.76	
87	TRICASTIN NUCLEAR POWER PLANT (reactors 1 and 2) 26130 Saint-Paul-Trois-Châteaux	EDF	Reactors		02.07.76	04.07.76	Boundary change: decree of 10.12.85 (O.G. of 18.12.85)
88	TRICASTIN NUCLEAR POWER PLANT (reactors 3 and 4) 26130 Saint-Paul-Trois-Châteaux	EDF	Reactors		02.07.76	04.07.76	Boundary change: decree of 10.12.85 (O.G. of 18.12.85) Boundary change: decree of 29.11.04 (O.G. of 02.12.04)
89	BUGEY NUCLEAR POWER PLANT (reactors 4 and 5) 01980 Loyettes	EDF	Reactors		27.07.76	17.08.76	Boundary change: decree of 10.12.85 (O.G. of 18.12.85)
90	PELLET FABRICATION FACILITY 38113 Veurey-Voroize	SICN	Fabrication of radioactive materials		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) Final shutdown and decommissioning decree of 15.02.06 (O.G. of 22.02.06)
91	SUPERPHÉNIX REACTOR 38510 Morestel	EDF	Fast breeder 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) Modification: decree of 10.01.89 (O.G. of 12.01.89) Final shutdown and change in licensee: decree of 30.12.98 (O.G. of 31.12.98) Final shutdown (last step) and decommissioning: decree of 20.03.06 (O.G. of 21.03.06)

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
92	PHÉBUS (Cadarache) 13115 Saint-Paul-lez-Durance	CEA	Reactor		05.07.77	19.07.77	Modification: decree of 07.11.91 (O.G. of 10.11.91)
93	GEORGES BESSE PLANT FOR URANIUM ISOTOPE SEPARATION BY GASEOUS DIFFUSION (Eurodif) 26702 Pierrelatte Cedex	EURODIF Production	Transformation of radioactive materials		08.09.77	10.09.77	Boundary change: decree of 22.06.84 (O.G. of 30.06.84) Modification: decree of 27.04.07 (O.G. of 29.04.07)
94	IRRADIATED MATERIALS FACILITY (Chinon) 37420 Avoine	EDF	Use of radioactive materials	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 materials		02.03.78	10.03.78	Modification: decree of 20.03.06 (O.G. of 22.03.06)
99	CHINON INTER-REGIONAL WAREHOUSE 37420 Avoine	EDF	Storage of new fuel		02.03.78	11.03.78	Modification: decree of 04.06.98 (O.G. of 06.06.98)
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 INTER-REGIONAL WAREHOUSE 01980 Loyettes	EDF	Storage of new fuel		15.06.78	27.06.78	Modification: decree of 04.06.98 (O.G. of 06.06.98)
103	PALUEL NUCLEAR POWER PLANT (reactor 1) 76450 Cany-Barville	EDF	Reactor		10.11.78	14.11.78	
104	PALUEL NUCLEAR POWER PLANT (reactor 2) 76450 Cany-Barville	EDF	Reactor		10.11.78	14.11.78	
105	URANIUM HEXAFLUORIDE PREPARATION PLANT (COMURHEX) 26130 Saint-Paul-Trois-Châteaux	COMURHEX	Transformation of radioactive materials				Classified secret until 31.12.78 (delicensing decision of 10.07.78)

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:	OBSERVATIONS
106	LABORATORY FOR THE USE OF ELECTROMAGNETIC RADIATION (LURE) 91405 Orsay Cedex	CNRS	Particle accelerator	22.03.79			Change in licensee: 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	
116	REPROCESSING PLANT FOR SPENT FUEL ELEMENTS FROM LIGHT WATER REACTORS "UP3 A" (La Hague) 50107 Cherbourg	AREVA NC	Transformation of radioactive materials		12.05.81	16.05.81	Commissioning postponement: decree of 28.03.89 (O.G. of 07.04.89) Modification: decree of 18.01.93 (O.G. of 24.01.93) Modification: decree of 10.01.03 (O.G. of 11.01.03) Boundary change: decree of 10.01.03 (O.G. of 11.01.03)

LIST OF BASIC NUCLEAR 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
117	REPROCESSING PLANT FOR SPENT FUEL ELEMENTS FROM LIGHT WATER REACTORS "UP2 800" (La Hague) 50107 Cherbourg	AREVA NC	Transformation of radioactive materials		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	AREVA NC	Transformation of radioactive materials		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	
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) Modification: decree of 02.11.07 (O.G. of 03.11.07)
123	LABORATORY FOR THE EXPERIMENTAL DESIGN AND FABRICATION OF ADVANCED NUCLEAR FUELS (LEFCA) (Cadarache) 13115 Saint-Paul-lez-Durance	CEA	Fabrication of radioactive materials		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	

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
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 materials storage		11.10.82	16.10.82	Former reactor shutdown on 16.04.73
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	EDF `	Reactor		29.02.84	03.03.84	
138	URANIUM CLEAN-UP AND RECOVERY FACILITY (Tricastin) 26130 Saint-Paul-Trois-Châteaux	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	

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
141	FUEL EVACUATION FACILITY (Creys-Malville) 38510 Morestel	EDF	Radioactive materials storage		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 Modification: decree of 20.03.06 (O.G. of 21.03.06)
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	ISOTRON FRANCE	Ionisation installation		30.01.89	31.01.89	
148	ATALANTE CEN VALRHO Chusclan 30205 Bagnols-sur-Cèze	CEA	R&D laboratory and study of actinides production		19.07.89	25.07.89	Commissioning postponement: decree of 22.07.99 (O.G. of 23.07.99)
149	AUBE WASTE REPOSITORY (CSA) Soulaines-Dhuys 10200 Bar-sur-Aube	ANDRA	Radioactive materials surface repository		04.09.89	06.09.89	Change in licensee: decree of 24.03.95 (O.G. of 26.03.95). Modification: decree of 10.08.06 (O.G. of 11.08.06)
151	NUCLEAR FUELS FABRICATION PLANT (MELOX) BP 2 - 30200 Chusclan	AREVA NC	Fabrication of radioactive materials		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), 04.10.04 (O.G. of 05.10.04) and 26.04.07 (O.G. of 27.04.07)

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
153	CHINON A2 D 37420 Avoine	EDF	Radioactive materials storage		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	AREVA NC	Transformation of radioactive materials		07.07.92	11.07.92	Modification: decree of 15.09.94 (O.G. of 24.09.94)
156	CHICADE (Cadarache) BP 1 13108 Saint-Paul-lez-Durance Cedex	CEA	R&D laboratory		29.03.93	30.03.93	
157	TRICASTIN OPERATIONAL HOT UNIT (BCOT) BP 127 84504 Bollène Cedex	EDF	Nuclear maintenance		29.11.93	07.12.93	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	Modification: decree of 09.02.06 (O.G. of 12.02.2006)
161	CHINON A3 D 37420 Avoine	EDF	Radioactive materials storage		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 materials storage		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) Final shutdown and decommissioning decree of 09.02.2006 (O.G. of 12.02.2006) – Cancelled by a decision of the Conseil d'Etat of 6 June 2007

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
163	ARDENNES NUCLEAR POWER PLANT CNA-D 08600 Givet (Chooz)	EDF	Radioactive materials storage		19.03.99	21.03.99	Former reactor shutdown on 17.03.93 Modification: decree of 27.10.04 (O.G. of 28.10.04) Final shutdown and decommissioning decree of 27.09.07 (O.G. of 29.09.07)
164	CEDRA (Cadarache) 13115 Saint-Paul-lez-Durance Cedex	CEA	Packaging and storage of radioactive material		04.10.04	05.10.04	
165	PROCEDE 92265 Fontenay-aux-Roses Cedex	CEA	Research installation being decommissioned		30.06.06	02.07.06	Decree 2006-772 of 30.06.06 (O.G. of 02.07.06) authorising CEA to create a basic nuclear installation no. 165, named Procédé, to replace basic nuclear installations 57 and 59, and carry out final shutdown and decommissioning of this installation located in Fontenay-aux-Roses
166	SUPPORT 92265 Fontenay-aux-Roses Cedex	CEA	Effluent treatment and decommissioning waste storage installation		30.06.06	02.07.06	Decree 2006-771 of 30.06.06 (O.G. of 02.07.06) authorising the CEA to create a basic nuclear installation no. 166, named Support, to replace basic nuclear installations 34, 57 and 73, and to carry out final shutdown and decommissioning of this installation located in Fontenay-aux-Roses

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
167	FLAMANVILLE NUCLEAR POWER PLANT (reactor 3 - EPR) 50830 Flamanville	EDF	Reactor		10.04.07	11.04.07	Decree 2007-534
168	GEORGES BESSE 2 PLANT FOR URANIUM ISOTOPE SEPARATION BY CENTRIFUGATION 26702 Pierrelatte Cedex	SET	Transformation of radioactive materials		27.04.07	29.04.07	Decree 2007-631

ACC	hulls and end-pieces compaction facility (AREVA NC – La Hague)
ACO	Orsay collider ring (LURE – CNRS – Orsay)
ACR	resins conditioning facility (AREVA NC – La Hague)
ACRO	Association for the Control of Radioactivity in the West
ADEME	French Environment and Energy Management Agency
ADF	Assembly of *départements* of France
ADNR	Agreement on the transport of dangerous substances on the Rhine
ADR	European Agreement concerning the International Carriage of Dangerous Goods by Road
AERB	Atomic Energy Regulatory Board (Indian regulatory body)
AFCEN	French Association for NSSS Equipment Construction Rules
AFSSA	French Agency for Food Safety
AFSSAPS	French Health Product Safety Agency
AFSSE	French Agency for Environmental Health Safety- became AFSSET in September 2005
AFSSET	French Agency for Environmental and Occupational Health Safety – since September 2005
AGATE	effluent advanced management and processing facility (CEA installation project – Cadarache)
ALARA	As Low As Reasonably Achievable (radiation protection principle also called "optimisation principle")
ALCADE	nuclear fuel management method (EDF)
ALS	Saclay linear accelerator (CEA)
ALQA	Lorraine Air Quality Association
AMI	irradiated materials facility (EDF – Chinon)
ANAES	French National Agency for Health Care Accreditation and Assessment
ANCLI	National Association of Local Information Committees
ANDRA	French National Agency for Radioactive Waste Management
ANSTO	Australian Nuclear Science and Technology Organisation
APE	state-based approach (principle governing incident or accident situation operating strategies)
APEC	fuel evacuation facility (EDF – Creys-Malville – Isère)
AP-HP	Public Health Service – Paris Hospitals
AQG	Atomic Questions Group (European Union)

ARC	skills adaptation and renewal – EDF project
ARE	steam generator feedwater system (PWR)
AREVA	industrial group active in the nuclear fuel cycle and construction of nuclear installations
AREVA NC	fuel cycle licensee (AREVA group)
AREVA NP	designer and builder of nuclear power plants (AREVA group)
ARH	Regional Hospitalisation Agency
ARPE	water intake and discharge licence (for BNIs)
ASG	steam generator emergency feedwater system (PWR)
ASN	French regulatory body
ASR	refuelling outage
ASSET	Assessment of Safety Significant Events Team (IAEA expertise)
AT1	Former pilot reprocessing plant for spent fuel from fast neutron reactors (CEA – La Hague)
ATALANTE	Alpha facility and laboratory for transuranian elements analysis and reprocessing studies (CEA – Marcoule)
ATPu	plutonium technology facility (AREVA NC – Cadarache)
ATUE	enriched uranium processing facility (CEA – Cadarache)
AVN	technical support organisation for the Belgian regulatory body and the approved organisation for regulation 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	auxiliary waste buildings
BAG	glovebox
BAM	German Federal Institute for Materials Research and Testing
BAN	auxiliary nuclear buildings
BASIAS	French former industrial sites and department activity database
BASOL	French database of polluted sites and soils requiring action by public authorities
BCCN	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 – SI unit of radioactivity (see also Bq below)
BEIR	Committee on the Biological Effects of Ionizing Radiations (United States Academy of Science Committee)
BMU	German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety
BNFL	British Nuclear Fuels Limited
BNI	Basic Nuclear Installation
BO	Official Bulletin
Bq	becquerel (SI unit of radioactivity)
BRGM	French Geological and Mining Research Office
BTE	effluent treatment building
BWR	Boiling Water Reactor
CABRI	research reactor (CEA – Cadarache)
CADA	Committee of Access to Administrative Documents
CAPE	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)
CBNI	Classified Basic Nuclear Installation
CBRN	Chemical, Biological, Radiological and Nuclear (CBRN) hazard
CCAP	French Central Committee for Pressure Vessels
CCINB	BNI Consultative Committee
CCP	Command and Control Post (evaluation of consequences and measures
CCS	component cooling system (PWR)
CDE	final shutdown
CDH	Departmental Health Council (replaced by the CODERST in 2006)
"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	French Atomic EnergyCommission
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)
CENTRACO	low-level waste processing and packaging centre (CEA – Marcoule)
CEPN	Nuclear Protection Evaluation Centre
CERCA	Company for the Design and Fabrication of Atomic Fuel
CERN	European Organization for Nuclear Research
CETEN-APAVE	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)
CH	Hospital Centre
CHICADE	Chemistry, waste characterization (CEA Cadarache)
CHSCT	Committee for Health, Safety and Working Conditions
CHU	University hospital (treatment, education and research)
CHUV	Vaudois region university hospital (Lausanne)
CIA	incident or accident response procedure (PWR)
CICNR	French Interministerial Committee for Nuclear or Radiological Emergencies – since 2003
CIDEN	Engineering Centre for Dismantling and Related Environmental Issues – EDF
CIGEET	(Tricastin major energy facility information committee – name of the CLI on the Tricastin site
CIINB	French Interministerial Commission for Basic Nuclear Installations
CIPN	Engineering Centre for Operating Plants
CIREA	French Interministerial Commission for Artificial Radionuclides (activities taken over by ASN in 2002)
CIRIL	Interdisciplinary ion laser research centre – CNRS & CEA – Caen
CIS-Bio International	company specialising in biomedical technologies, especially radiopharmaceuticals
CISN	French Interministerial Committee for Nuclear Security – replaced by the CICNR in 2003
CITMD	French Interministerial Commission for the Carriage of Dangerous Goods
CLE	Local Environment Committee – name of the CLI at the FBFC plant in Romans s/Isère

CLI	Local Information Committee
CLIO	free electron laser (LURE – CNRS – Orsay)
CLIS	Local Committee for Information and Follow-up – name of the CLI for underground laboratories
CLS	Local Surveillance Committee – name of the CLI at the Fessenheim plant
CMIR	mobile radiological intervention unit
CMS	maximum design flood level (flood protection)
CNA	Ardennes first French PWR – Chooz A reactor – EDF
CNA-D	Equipment storage facility during decommissioning of the Chooz A reactor (EDF – Chooz)
CNAM	French National Health Insurance Fund
CNAR	French National Funding Commission for Radioactive Matters
CNDP	French National Public Debates Commission
CNEN	National Centre for Nuclear Equipment – EDF
CNEPE	National Electricity Generating Equipment Centre – EDF
CNPE	Nuclear Power Generation Site – EDF
CNRA	Committee on Nuclear Regulatory Activities (NEA)
CNRS	French National Centre for Scientific Research
CNS	Council for Nuclear Safety (South African regulatory body until 1999)
CNSC	Canadian Nuclear Safety Commission
CODERST	Departmental Council for the Environment and for Health and Technological Risks (since 2006)
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
CODIS-CTA	Departmental Fire and Emergency Response Operations Centre – Alert Processing Centre
Cofrac	French Accreditation Committee
Cofrend	French Non-Destructive Testing Confederation
COGEMA	*Compagnie générale des matières nucléaires* (AREVA group, now known as AREVA-NC
COGEMA LOGISTICS	nuclear materials packaging and transport company (COGEMA subsidiary)

COGIC	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 regulatory bodies from eastern and western European countries)
Contrôle	magazine published by ASN
CoRWM	Committee on Radioactive Waste Management (high level group of British experts on radioactive waste management)
COWAM	Community Waste Management ("concerted action" by the European Union's 5th framework R&D programme concerning local decision-making with regard to nuclear waste)
CO_2	carbon dioxide
CP	Command Post
CP0	first series of 900 MWe PWRs (EDF)
CP1	1st subdivision of the CPY series
CP2	2nd subdivision of the CPY series
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)
CRIIRAD	Committee for Independent Research and Information on Radioactivity
CRPPH	Committee on Radiation Protection and Public Health (NEA)
CSA	Aube waste repository (ANDRA) (former name of the CSFMA)
CSD-C	standard compacted waste package
CSFMA	low and intermediate level waste disposal facility (ANDRA)
CSHPF	French High Public Health Council – replaced in 2007 by the HCSP
CSLU	Laboratories and Plants Safety Commission (reporting to the DSND, having competence for defence-related nuclear laboratories and plants)
CSN	Consejo de Seguridad Nuclear (Spanish Regulatory Body)
CSNI	Committee on the Safety of Nuclear Installations (NEA)
CSP	– containment spray system (PWR) – French Public Health Code – main secondary system (PWR)

CSPI	Special and Permanent Information Committee for the AREVA NC La Hague facility – name of the La Hague CLI
CSS	– Commission on Safety Standards (IAEA) – containment spray system (PWR)
CSSIN	French High Council for Nuclear Safety and Information
CSTB	Building Industry Scientific and Technical Centre
CT	Labour Code
CTC	Technical Emergency Centre
CTCAE	Common Terminology Criteria for Adverse Events (criteria used to rate the side-effects of cancer treatments)
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	ffluent discharge and water intake licence application (for BNIs until 2006)
DARPMI	Directorate for Regional Action and Small and Medium-sized Enterprises – French Ministry of the Economy, Finance and Industry – until 2005
DARQSI	Directorate for Regional Action, Quality and Industrial Safety – Ministry for the Economy, Finance and Employment; concerning nuclear safety and radiation protection activities, also placed under the authority of the *Ministre d'Etat*, Minister for Ecology, Sustainable Development and Spatial Planning and the Minister for Health, Youth and Sport)
DCN	– Nuclear Power Plants Division (ASN) – Nuclear Fuels Division (EDF)
DDAC	Community law adaptations bill
DDASS	Departmental Health and Social Action Directorate
DDSC	– Director of Civil Security and Defence – Directorate for Civil Security and Defence (Ministry of the Interior, Overseas France and Territorial Communities)
DDTEFP	Departmental Labour, Employment and Professional Training Directorate
DEM	decommissioning
DEP	Pressure Vessels Division (ASN)
DEU	Environment and Emergency Situations Division (ASN)
DFD	Franco-German Steering Committee for Nuclear Safety Issues

DFK	Franco-German Committee for Nuclear Plant Safety Issues
DfT	Department for Transport (United Kingdom)
DGAC	General Directorate for Civil Aviation – Ministry for Transport
DGCCRF	General Directorate for Competition Policy, Consumer Affairs and Fraud Control – Ministry for the Economy, Finance and Employment
DGEMP	General Directorate for Energy and Raw Materials – Ministry for Ecology, Sustainable Development and Spatial Planning
DGMT	General Directorate for Sea and Transport – Ministry for Ecology, Sustainable Development and Spatial Planning
DGS	General Directorate for Health – Ministry for Health, Youth and Sport
DGSNR	– Director General for Nuclear Safety and Radiation Protection (until November 2006) – General Directorate for Nuclear Safety and Radiation Protection (ASN central structure until the November 2006 reform)
DGT	– Director General for Labour – General Directorate for Labour (Ministry for Labour, Social Relations and Solidarity – replaced the DRT in August 2006)
DG TREN	Directorate-General for Energy and Transport (European Commission)
DHOS	Directorate for Hospitalisation and Health Care Organisation – Ministry for Health, Youth and Sport
DIDEME	Directorate for Energy Demand and Energy Markets – Ministry for Ecology, Sustainable Development and Spatial Planning
DIS	Ionising Radiation and Health Division (ASN)
DIN	– Nuclear Engineering Division – EDF – Nuclear Installation Department – replaced by the DSNR in 2002
DIT	Industrial Activities and Transport Division (ASN)
DNA	deoxyribonucleic acid
DOE	Department of Energy (United States)
DOS	Safety Case File
DPI	Production Engineering Department (EDF)
DPMA	Personnel, Modernisation and Administration Directorate – Ministry of the Economy, Finance and Industry
DPN	Nuclear Generating Division (EDF)
DPPR	– Director for the Prevention of Pollutions and Risks – Directorate for the Prevention of Pollution and Risks – Ministry for Ecology, Sustainable Development and Spatial Planning

DRASS	Regional Health and Social Action Directorate
DRD	Research and Waste Installations Division (ASN)
DRI	International Relations Division (ASN)
DRIRE	– Regional Director for Industry, Research and the Environment – Regional Directorate for Industry, Research and the Environment
DRL	Diagnostic Reference Level
DRT	– Director for Labour Relations (until August 2006) – Directorate for Labour Relations) (until August 2006)
DRTEFP	Regional Labour, Employment and Professional Training Directorate
DRYPAC	sludge drying process
DSIN	– Director for the Safety of Nuclear Installations (until 2002) – Nuclear Installations Safety Division (ASN central structure replaced by the DGSNR in 2002)
DSND	Delegate for Nuclear Safety and Radiation Protection for National Defence Installations and Activities – Ministers of Defence and of Industry
DSNR	Nuclear Safety and Radiation Protection Division (name of the ASN regional divisions until the November 2006 reform)
DSS	Social Security Directorate- Ministry for Health
DTPA	diethylene-triamine-penta-acetate (substance used in nuclear medicine)
DUP	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
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
EFPD	effective full-power day
EGRA	Expert Group on the Regulatory Application of Authorisation (sub-group of the NEA's CRPPH)
EIS	element important for safety

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
ELAN II B	former sealed source fabrication installation (CEA – La Hague)
ENS	European Nuclear Society
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 AREVA NP)
EPRD	revenue and spending forecast (public establishment "budget")
ERNET	Emergency Response Network
ERP	establishment open to the public
ESP	pressure vessel
ESPN	Nuclear Pressure Vessel
ESR	event significant for radiation protection
ESS	event significant for safety
EST	event significant for transport
EU	European Union
EURATOM	European Atomic Energy Community
EUROCLI	European Association of Local Information Committees and European dialogue forums
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
FANC	Belgian Federal Agency for Nuclear Control
FAO	Food and Agriculture Organization (UN)

FBFC	Franco-Belgian Fuel Fabrication Company
FBR	fast breeder reactor
FDG	fluorodeoxyglucose (substance used in nuclear medicine)
FISA	Fission Safety (biennial conferences on nuclear reactor safety organised by the European Union)
FMA-VC	short-lived low or intermediate level waste
FMEA	Failure Modes and Effects Analysis
FOD	Field Operations Directorate (HSE directorate)
FOPH	Federal Office of Public Health (Switzerland)
FOSSEA	CEA project for recovering waste stored in old pits
FP	fission products
FRAMATOME	French NSSS builder (now known as AREVA NP)
FRAMATOME-ANP	Framatome – Advanced Nuclear Power (company set up by AREVA and SIEMENS to develop the new EPR reactor type – now known as AREVA NP)
FRAREG	Framatome Regulators (Association of regulatory bodies in countries operating power plants of French design)
FTE	Full-Time Equivalent
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)
GALICE	nuclear fuel management method (EDF)
GAMMATEC	ionisation installation project by the ISOTRON France company in Marcoule
GAN	Russian regulatory body
GANIL	Large National Heavy Ion Accelerator (Caen)
GB I	Georges Besse Plant I – EURODIF
GB II	Georges Besse Plant II (under construction)
GBq	gigabecquerel (thousand million becquerels)
GCTC	turbine bypass to condenser system (PWR)
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	serious accident action guide
GP	(or GPE) Advisory Committee (reporting to ASN)
GPD	Advisory Committee for waste
GPMED	Advisory Committee for medical exposure
GPR	Advisory Committee for nuclear reactors
GPRAD	Advisory Committee for radiation protection (non-medical)
GPT	Advisory Committee for transport
GPU	Advisory Committee for nuclear laboratories and plants
GV	steam generator
GWd	gigawatt day (unit of energy)
GWd/t	gigawatt day per ton (volume energy unit)
Gy	gray (unit of absorbed dose)
HAO	oxide high activity facility (AREVA NC – La Hague)
HARMONIE	former fast neutron source reactor (CEA – Cadarache)
HAS	French National Authority for Health – since 2005
HLG	High Level Group (set up by the European Commission to deal with nuclear safety and waste management)
HCSP	French High Public Health Council)
HCTISN	French High Committee for Transparency and Information on Nuclear Security (created by the 13 June 2006 Act)
HFD	Defence High Official
HFDS	Defence and Security High Official
HLLLW	high level long-lived waste
HSE	Health and Safety Executive (United Kingdom)
HSK	Swiss Federal Nuclear Safety Inspectorate (Swiss regulatory body)
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 Organization
ICAPP	International Congress on Advances in Nuclear Power Plants
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 regulatory body with respect to the Chernobyl site)
ICEDA	activated waste packaging and interim storage installation (EDF interim storage project)
ICGR	International Conference on Geological Repositories
ICL	Loire Cancerology Institute)
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
ICRU	International Commission on Radiation Units and Measurements
IDSP	weighted scanner dose index
IEC	International Electrotechnical Commission
IFSI	Nursing Training Institute
IGAS	General Inspectorate of Social Affairs
ILE	ITER Legal Entity (international body to be created to operate ITER)
ILL	Laue-Langevin Institute – Grenoble
ILO	International Labour Organization (UN
IMDG Code	International Maritime Dangerous Goods Code
IMS	integrated maintenance service (EDF)
IN	Nuclear Inspectorate (EDF)
INCa	French National Cancer Institute
INERIS	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) – French National Institute for Agricultural Research

INSAG	International Nuclear Safety Advisory Group (IAEA)
INSERM	French National Health and Medical Research Institute
INSTN	French National Institute for Nuclear Science and Technology – CEA
InVS	French Health Monitoring Institute
IPA	Instrument for Pre-Accession Assistance (replaces PHARE as of 2007)
IPN	French Nuclear Physics Institute – Orsay
IPSN	French Institute for Nuclear Safety and Protection – replaced by the IRSN in 2002
IRE	National Radioelements Institute, Fleurus – Belgium
IRCA	Cadarache irradiator (CEA)
IRPA	International Radiation Protection Association
IRRS	Integrated Regulatory Review Service (regulatory body organisation audit performed by the IAEA)
IRRT	International Regulatory Review Team (former name of the IRRS)
IRSN	French Institute for Radiation Protection and Nuclear Safety – since 2002
ISIS	research reactor (CEA – Saclay)
IS Ouest	*Institut de Soudure Ouest*
ISO	International Organisation for Standardization
ISOE	Information System on Occupational Exposure (OECD)
ISOTRON	company operating ionisation installations
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	Joint Aviation Requirements-Operations (rules drafted by the JAA concerning aircraft operations)
JFR	French radiology days (annual conference organised by the SFR)
JNES	Japan Nuclear Energy Safety Organization (technical support organisation for the Japanese regulatory body)
JO	French Official Gazette

JST	Japan Science and Technology Agency (Japan)
K1	equipment qualification category (PWR)
KAERI	Korea Atomic Energy Research Institute (CEA's counterpart in South Korea)
KEY	experimental sealing of drifts by pouring an "anchoring key" (ANDRA – Bure)
K€	kiloeuros (thousand euros) see Meuros
kW	kilowatt
KEPCO	Kansai Electric Power Company (Japanese electricity production utility)
KER	Nuclear Island Liquid Effluent Monitoring and Discharge System (PWR)
KINS	Korea Institute of Nuclear Safety (technical support organisation for the South Korean regulatory body)
KKU	Unterweser nuclear power plant (Germany)
LAMA	Active Materials Analysis Laboratory (CEA – Grenoble)
LCC	Central Product Quality Control Laboratory (AREVA NC – 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 experimental fabrication 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)
LLILW	long-lived intermediate level waste
LLW-LL	low level long-lived waste (LL – LL waste)
LOLF	French constitutional bylaw on budget acts
LPC	Chemical Purification Laboratory (AREVA NC – Cadarache)
LUDD	Laboratories, Plants, Waste and Decommissioning
LURE	Electromagnetic Radiation Laboratory (CNRS – Orsay)

M€	*mégaeuros* (million euros)
M5	name of a zirconium and niobium based alloy
MAD	final shutdown
MAD/DEM	*Mise à l'Arrêt Définitif et DÉMantèlement* (Final shutdown and decommissioning – BNI procedure)
MAGENTA	cellular nuclear materials storage facility project (CEA)
MAGNUC	nuclear viewdata magazine (replaced by the ASN website, with publication halted in 2006)
MAL	maximum allowable levels (for radioactive contamination of foodstuffs or livestock feedingstuffs)
MAPu	medium level plutonium (MAPu facility: AREVA NC – La Hague)
MARN	Nuclear Risk Management Aid Committee – 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: AREVA NC – La Hague)
MBq	megabecquerel (million becquerels)
MCMF	central fissile material warehouse (CEA – Cadarache)
MDB	River authority
MDEP	Multinational Design Evaluation Programme (multinational initiative for which the NEA is secretary and which is designed to pool the knowledge of the regulatory bodies who will be responsible for regulatory assessment of new reactors)
MDS	organic solvent mineralisation facility (AREVA NC – La Hague)
ME	Minister for the Environment
MEAH	National mission for hospital appraisal and audit
MEDAD	Ministry for Ecology, Sustainable Development and Spatial Planning (since May 2007)
MELOX	MOX fuel fabrication plant (Marcoule)
MELUSINE	research reactor (CEA – Grenoble)
MEM	Moroccan Ministry of Energy and Mining
METI	Japanese Ministry of Economy, Trade and Industry
Meuros	Million euros
MHPE	Maximum Historically Probable Earthquake

MI	Minister of Industry
MIBI	methoxy isobutyl isonitrile (substance used in nuclear medicine)
MIMAUSA	History and impact of uranium mines: summary and archives – Programme for an inventory of uranium mining sites
MINEFE	Ministry for the Economy, Finance and Employment (since May 2007)
MINEFI	Ministry of the Economy, Finance and Industry
MINERVE	research reactor (CEA – Cadarache)
MIR	inter-regional fuel stores (EDF – Bugey and Chinon)
MMS	– mobile emergency equipment – Main Steam System (PWR)
MOST	Korean Ministry of Science and Technology (South Korean regulatory body)
MOX	mixed uranium and plutonium oxide fuel
MRI	magnetic resonance imaging
MSNR	Nuclear Safety and Radiation Protection Mission (DARQSI)
mSv	millisievert (thousandth of a sievert)
MWe	megawatt electrical (unit of electrical power)
N4	1450 MWe nuclear reactor series (EDF)
Natura 2000	All the natural sites protected by various European directives concerning birdlife and "natural habitats"
NEA	Nuclear Energy Agency (OECD)
Necsa	Nuclear Energy Corporation of South Africa (South-African public entity carrying out R&D in the nuclear power field)
NEOC	National Emergency Operations Centre (division of the Swiss Federal Office for Civil Protection: the Confederation's technical organisation for unusual events such as a rise in radioactivity or various other technological accidents)
NERSA	*"centrale nucléaire européenne à neutrons rapides SA"* company (former operator of Superphénix)
Nf	naegleria fowleri (species of amoeba)
NF	French standard
nGy	nanogray (thousandth millionth of a gray)
NII	Nuclear Installations Inspectorate (HSE – United Kingdom)
NISA	Nuclear and Industrial Safety Agency (METI – Japan)

NNEMA	National Nuclear Emergency Management Administration (China)
NNR	National Nuclear Regulator (South African regulatory body since 1999)
NNSA	National Nuclear Safety Administration (Chinese regulatory body)
NORM	Naturally Occurring Radioactive Materials
NOx	nitrogen oxides
NPH	spent fuel element unloading and interim storage facility (plant UP2 800 -AREVA NC – La Hague)
NRC	Nuclear Regulatory Commission (American regulatory body)
NRPB	National Radiological Protection Board (United Kingdom – replaced by the "Health Protection Agency" in April 2005)
NRR	Office of Nuclear Reactor Regulation (NRC office in charge of reactor safety)
NSC	Nuclear Safety Commission (Japanese regulatory body)
NSCI	Nuclear Safety Co-operation Instrument (replaces TACIS as of 2007)
NSD	Nuclear Safety Directorate (United Kingdom regulatory body
NSSG	Nuclear Safety and Security Group (G8)
nSv	nanosievert (thousandth millionth of a sievert)
NSWG	Nuclear Safety Working Group (G7)
NUPEC	Nuclear Power Engineering Corporation (Technical organisation of the NISA – METI – Japan
NuPEER	Nuclear Pressure Equipment Expertise and Regulation (nuclear pressure vessel symposium
NUSSC	Nuclear Safety Standards Committee (IAEA)
OA	approved organisation for supervision
OASIS	name of the ASN intranet
OCNS	Office for Civil Nuclear Security – branch of the British nuclear regulator in charge of nuclear security issues
OECD	Organisation for Economic Co-operation and Development
OHF	organisational and human factors
OMF	reliability centred maintenance
OPECST	French Office for the Evaluation of Scientific and Technological Choices)
OPRI	French Office for Protection Against Ionising Radiation – until 2002
OPS	see JAR-OPS

ORCADE	Project set up by AREVA NC for decommissioning of the La Hague installations
ORPHEE	research reactor (CEA – Saclay)
ORSEC	general plan organising the emergency services at departmental, defence 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)
P4	first series of 1300 MWe nuclear reactors (EDF)
P'4	second series of 1300 MWe nuclear reactors (EDF)
PAHO	Pan American Health Organization
PAI	fire-fighting action plan
PAP	annual performance plan (within the framework of the LOLF – document appended to the budget billand 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)
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)
PELECI	irradiated materials examination laboratory equipment project
PET	Positron Emission Tomography
PET Scan	PETcamera coupled with a scanner
PGAC	General worksite assistance services (EDF)
PHARE	Programme of Community 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	French National Radioactive Waste and Reusable Materials Management Plan (replaced by the PNGMDR in the Act of 28 June 2006)
PNGMDR	French National Radioactive Materials and Waste Management Plan (instituted by the 28 June 2006 Programme Act on the sustainable management of radioactive materials and waste)
PNSE	French National Health Environment Plan (to reduce the effects of environmental damage on the health of the population)
PPH	"Human Performance" project (EDF)
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)
PRA	Probabilistic Risk Assessment
PRECIS	Programme for recovery of spent fuel elements stored in a fuel assembly block
PRER	Radiation Protection, Environment and Risks Centre
PRI	integrated radiological protection
PROCEDE	name of BNI project No. 165 (CEA – Fontenay-aux-Roses)
PROSPER	Peer Review of Operational Safety Performance Experience (organised by IAEA)
PSI	Irradiation Monitoring Programme (PWR)
PSR	preliminary safety report (BNI procedure)
PSRPM	medical medical radiation physicist
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 (PWR)
PUI	on-site emergency plan (established by a BNI licensee to manage a possible emergency situation)
PuO2	plutonium oxide
PWR	Pressurised Water Reactor

RADWASS	Radioactive Waste Safety Standards (AIEA)
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 Efficiency
RCC	design and construction rules
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)
RESERVOIR	aqueous radiaoctive effluent storage installation (CEA – Saclay)
REX	operating experience feedback
RFS	basic safety rule
RGE	general operating rules
RGSE	general surveillance and maintenance rules
RHF	high flux reactor (Institut Laue-Langevin – Grenoble)
RIA	radioimmunoassay
RIC	– in-core instrumentation system (PWR) – Regulatory Information Conference (annual public conference by the United States regulatory body)
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

ROI	industrial tool renewal
Rostekhnadzor	Russian Federation regulatory body
ROTONDE (la)	solid waste management installation project (CEA – Cadarache)
RPII	Radiological Protection Institute of Ireland
RRA	residual heat removal system
RRI	component cooling system (PWR)
RSE-M	rules for in-service monitoring of mechanical equipment
RSN	regulation concerning the safety of ships
RTE	French Transmission System Operator
RTSG	Radioactive Transport Study Group (IAEA working group)
RTGV	steam generator tube rupture
RTRs	Research and Test Reactors (research reactors using fuel assemblies known as “aluminides”)
RTV	main steam rupture
RUS	Louis Pasteur University reactor (Strasbourg)
RVM	maintenance volume reduction policy (EDF project)
RWMC	Radioactive Waste Management Committee (NEA)
R & D	Research and Development
SAFARI	South African nuclear reactor
SAMU	French Emergency Medical Service
SARnet	European Severe Accident Research network
SATURNE	former particle accelerator (CEA – Saclay)
SCHAPI	Central Hydrometeorology and Flood Prediction Support Department – Ministry for Ecology, Sustainable Development and Spatial Planning/Water Directorate)
SCR	Radiation Protection Department
SCSIN	Central Nuclear Installations Safety Department – replaced by the DSIN in 1991
SDIS	Departmental Fire and Emergency Response Department
SEC	essential service water system (PWR)
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)
SET	*Société d'enrichissement du Tricastin*
SEVESO	– "Seveso II" directive: name given to Council Directive 96/82/EC of 9 December 1996 on the control of major-accident hazards involving dangerous substances (with reference to the site of a 1976 accident in a chemical plant) – "Seveso" installation: installation subject to the "Seveso II" directive
SFBMN	French Society for Biophysics and Nuclear Medicine
SFEN	French Nuclear Energy Society
SFMN	French Nuclear Medicine and Molecular Imaging Society
SFPM	French Medical Physics Society
SFR	French Radiological Society
SFRO	French Oncology Radiotherapy Society
SFRP	French Radiation Protection Society
SGCISN	French General Secretariat of the Interministerial Committee for Nuclear Security – until 2003
SGDN	French General Secretariat for National Defence
SHFJ	*Service hospitalier Frédéric Joliot* (CEA hospital service located in Orsay hospital – Essonne)
SI-ASN	ASN Information System
SICN	*Société industrielle de combustible nucléaire* (Industrial Nuclear Fuel Company)
SIEVERT	Computerized System For Assessing the Exposure to Cosmic Radiation during Air Transportation
SIGIS	Source Inventory Management Information System
SILOE	CEA research reactor (Grenoble)
SILOETTE	CEA research reactor (Grenoble)
SIRCOM	Communication Department (Ministry of the Economy, Finance and Industry)
SISE-Eaux	Environment-Water Health Information System
SISE-Habitat	Environment Habitat Health Information System
SISERI	Ionizing Radiation Exposure Monitoring Information System
SITA FD	"ultimate" waste and polluted earth processing and disposal company (SITA Group)
SITOP	Site Optimisation (SITOP project about organisation change at AREVA NC La Hague)

SKI Swedish Nuclear Power Inspectorate (Swedish regulatory body)

SNCS *Société Normande de Conserve et de Stérilisation* (Osmanville – Calvados)

SNM military nuclear system

SNR *Société Nouvelle du Radium* (former radium mining company which left polluted sites after it closed)

SNRCU State Nuclear Regulatory Committee of Ukraine (Ukrainian regulatory body)

SOC Organised disposal of hulls

SOCATRI *Société auxiliaire du Tricastin* (company operating a clean-up and uranium recovery installation at Bollène – Vaucluse)

SOCODEI *Société pour le Conditionnement des Déchets et Effluents Industriels* (Company for industrial effluent and waste treatment)

SOMANU *Société de Maintenance Nucléaire* (Nuclear Maintenance Company (Maubeuge))

SOx sulphur oxides

SPIN in-pile separation and incineration (Actinides Incineration Research Programme – CEA)

SPIRAL radioactive accelerated ion beam production source (GANIL – Caen)

SPRA French Army Radiological Protection Service

SPN *Section permanente nucléaire de la CCAP* (standing section of the CCAP for nuclear matters)

SPF fission products disposal (SPF facilities – AREVA NC – La Hague)

SPS Super Proton Synchrotron (CERN – Geneva)

SSE Safe Shutdown Earthquake

SSI Swedish Radiation Protection Authority (Swedish regulatory body)

STAR treatment, cleanup and reconditioning station (CEA – Cadarache)

STC Scientific and Technical Committee (EURATOM)

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	Radiation and Nuclear Safety Authority (Finnish regulatory body)
SÚJB	State Office for Nuclear Safety (Czech regulatory body)
SUPERPHENIX	Fast Breeder Reactor under decommissioning (Creys-Malville – Isère)
SUPPORT	Name of BNI No. 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)
TDG	Transport of Dangerous Goods
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)
TEPCO	Tokyo Electric Power Company (Japanese electric utility)
TER	liquid waste discharge system (PWR)
TID	total indicative dose
TMR	radioactive material transport
TN International	subsidiary of AREVA NC specialising in the packaging, transport and interim storage of nuclear materials
TRanSAS	Transport Safety Appraisal Service (IAEA)
TRANSSC	Transport Safety Standards Committee (IAEA)
TRM	Transport of radioactive materials
TSN	TSN act: act of 13 June 2006 concerning transparency and security in the nuclear field
TSO	Technical Support Organisation
TU5	fuel cycle installation (COGEMA – Pierrelatte)
TVO	*Teollisuuden Voima Oyj* (Finnish electricity utility)
U_3O_8	uranium oxide (yellowcake)
UALx	mixture of uranium and aluminium
UF_4	uranium tetrafluoride

UF_6	uranium hexafluoride
UJD	Nuclear Regulatory Authority of the Slovak Republic (Slovak regulatory body)
UKEA	United Kingdom Environment Agency (England and Wales)
UKSO	United Kingdom Safeguards Office (branch of the British nuclear regulator in charge of non-proliferation issues)
ULYSSE	"Teaching" reactor (CEA – Saclay)
UN	United Nations
UNGG	former French gas-cooled reactor technology
UNIE	Operational engineering department (EDF – since 2007)
UNIPE	National NPP operational engineering department (EDF)
UNSCEAR	United Nations Scientific Committee on the Effects of Atomic Radiation
UO_2	uranium oxide
$UO_2(NO_3)_2$	uranyl nitrate
UOX	uranium oxide
UP2-400	1st spent fuel reprocessing plant (AREVA NC – La Hague)
UP2-800	spent fuel reprocessing plant (AREVA NC – La Hague)
UP3	spent fuel reprocessing plant (AREVA NC- La Hague)
URE	enriched reprocessing uranium (fuel assemblies)
USNRC	see NRC
USSR	Union of Soviet Socialist Republics (until 1991)
UTE	Technical Union of Electricity
UTO	operational technical unit (EDF)
VATESI	State Nuclear Power Safety Inspectorate (Lithuanian regulatory body)
VD	ten-yearly outage
VD1	1st ten-yearly outage
VD2	2nd ten-yearly outage
VD3	3rd ten-yearly outage
VDS	surveillance inspection visit
VIV	main steam isolation valves (PWR)

VLLW	Very Low Level Waste
VP	partial inspection visit
VVP	main steam system (PWR)
W	fuel cycle plant (AREVA NC – Pierrelatte)
WANO	World Association of Nuclear Operators
WASSC	Waste Safety Standards Committee (IAEA)
WATRP	Waste Management Assessment and Technical Review Program (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)
WGPC	Working Group on Public Communication of Nuclear Regulatory Organisations (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)
www.asn.fr	address of the Nuclear Safety Authority website
ZGEL	liquid effluent management zone
ZS	products and foodstuffs surveillance zone (following a nuclear accident)

APPENDIX B
ACRONYMS AND ABBREVIATIONS

This list comprises all the decisions and opinions published by ASN during the course of 2007 in its Official Bulletin.

The ASN Official Bulletin can be consulted on the ASN website at www.asn.fr under the "ASN Official Bulletin" heading.

ASN decisions

Act n° 2006-686 of 13 June 2006 lists the various categories of regulatory or individual decisions taken by ASN, for example:
• technical regulatory decisions for implementation of decrees or orders concerning nuclear safety and radiation protection;
• BNI commissioning licenses;
• authorisation or approval of the transport of radioactive materials or of medical installations and equipment using ionising radiation.

In 2007, 84 decisions(1), as listed below, were published in the ASN Official Bulletin.

Reference	Date of the decision	Title
n° 2007-DC-0087	18 December 2007	Constituting approval of organisations responsible for individual monitoring of external exposure of workers exposed to ionising radiation.
n° 2007-DC-0086	18 December 2007	Constituting approval of medical biological analysis laboratories (LABM) responsible for individual monitoring of the internal exposure of workers exposed to ionising radiation.
n° 2007-DC-0085	20 November 2007	Constituting refusal to approve a notified organisation for control of nuclear pressure vessels.
n° 2007-DC-0084	20 November 2007	Constituting approval of a notified organisation for control of nuclear pressure vessels.
n° 2007-DC-0083	20 November 2007	Constituting approval of an organisation for control of new nuclear pressure vessels subject to the decrees of 2 April 1926 and 18 January 1943.
n° 2007-DC-0082	20 November 2007	Constituting approval of an organisation for control of new nuclear pressure vessels subject to the decrees of 2 April 1926 and 18 January 1943.
n° 2007-DC-0081	20 November 2007	Constituting approval of a notified organisation for control of nuclear pressure vessels.
n° 2007-DC-0080	4 December 2007	Constituting requirements for the transfer and environmental discharge of radioactive effluents containing liquid and gaseous tritium and carbon 14, from basic nuclear installation n° 105, operated by the *société pour la conversion de l'uranium en métal et l'hexafluorure* (COMURHEX) in the *communes** of Pierrelatte and de Saint Paul-Trois-Châteaux (Drôme).
n° 2007-DC-0079	4 December 2007	Setting the limits for the environmental discharge of gaseous and liquid effluent containing tritium and carbon 14 from basic nuclear installation n° 105, operated by the COMURHEX company in the *communes* of Pierrelatte and Saint Paul-Trois-Châteaux (Drôme).

*Smallest administrative subdivision administered by a mayor and a municipal council.
(1) The missing decisions will be published on the date of publication of the orders confirming the Ministers responsible for nuclear safety.

ASN decisions *(continuation)*

Reference	Date of the decision	Title
n° 2007-DC-0078	4 December 2007	Constituting requirements for environmental discharge of liquid and gaseous effluent from basic nuclear installation n° 138, operated by the *Société auxiliaire du Tricastin* (SOCATRI) in the *commune* of Bollène (Vaucluse).
n° 2007-DC-0077	4 December 2007	Setting the limits for environmental discharge of gaseous radioactive effluent from basic nuclear installation n° 138, operated by the *Société auxiliaire du Tricastin* (SOCATRI) in the *commune* of Bollène (Vaucluse).
n° 2007-DC-0076	4 December 2007	Constituting requirements for the intake and consumption of water, the transfer of liquid effluent and the environmental discharge of liquid and gaseous effluent from basic nuclear installation n° 155, known as TU5, operated by AREVA NC in the *commune* of Pierrelatte (Drôme).
n° 2007-DC-0075	4 December 2007	Setting environmental discharge limits for liquid and gaseous effluents from basic nuclear installation n° 155, known as TU5, operated by AREVA NC in the *commune* of Pierrelatte (Drôme).
n° 2007-DC-0074	29 November 2007	Setting the list of equipment or equipment categories for which a handling aptitude certificate is required as mentioned in the first paragraph of article R. 231-91 of the Labour Code
n° 2007-DC-0073	6 November 2007	Setting the limits for environmental discharge by the *Société d'Enrichissement du Tricastin* for operation of the installation for the isotopic separation of uranium by centrifuging, located on the Tricastin site.
n° 2007-DC-0072	6 November 2007	Setting the requirements concerning water intake and consumption, transfer and discharge of liquid effluent, discharge of gaseous effluent, and environmental supervision, for operation by the *Société d'Enrichissement du Tricastin* of the installation for the isotopic separation of uranium by centrifuging, located on the Tricastin site.
n° 2007-DC-0071	6 November 2007	Constituting renewal of the approval of an organisation responsible for radiation protection checks as mentioned in articles R. 1333-43 and R. 1333-44 of the Public Health Code and R. 231-84 and R. 231-86 of the Labour Code.
n° 2007-DC-0070	6 November 2007	With regard to the reception and interim storage in the UP2-800 plant of fuel assemblies from the ULYSSE teaching reactor.
n° 2007-DC-0069	6 November 2007	With regard to the reception and treatment, in the UP3-A plant, of fuel assemblies from the ULYSSE teaching reactor.
n° 2007-DC-0068	30 October 2007	Constituting delegation to the Chairman of certain decision-making powers.
n° 2007-DC-0067	2 October 2007	Constituting technical requirements for basic nuclear installation n° 162, known as EL 4 D, operated by *Électricité de France* in the *commune* of Loqueffret (Finistère).

ASN decisions *(continuation)*

Reference	Date of the decision	Title
n° 2007-DC-0066	19 July 2007	Concerning implementation of "ALCADE" fuel management in the reactors of the Chooz B and Civaux power plants.
n° 2007-DC-0065	10 and 19 July 2007	With regard to the organisation of an in-depth review of priority topics.
n° 2007-DC- 0064	10 July 2007	Constituting approval of laboratories for the measurement of radioactivity in the environment.
n° 2007-DC-0063	10 July 2007	Constituting delicensing of basic nuclear installation n° 21, known as the Siloette research reactor, in the *commune* of Grenoble (Isère).
n° 2007-DC-0062	4 July 2007	Constituting delegation to the Chairman of powers to take decisions concerning the approval of organisations qualified to measure the radon activity concentration in premises open to the public.
n° 2007-DC-0061	3 July 2007	Constituting refusal to approve an organisation for the control of nuclear pressure vessels in service and subject to the decrees of 2 April 1926 and 18 January 1943.
n° 2007-DC-0060	3 July 2007	Constituting approval of an organisation for the control of nuclear pressure vessels in service and subject to the decrees of 2 April 1926 and 18 January 1943.
n° 2007-DC-0059	3 July 2007	Constituting approval of an organisation for the control of nuclear pressure vessels in service and subject to the decrees of 2 April 1926 and 18 January 1943.
n° 2007-DC-0058	8 June 2007	Constituting approval of organisations for the control of nuclear pressure vessels.
n° 2007-DC-0057	26 June 2007	Constituting refused renewal of approval of an organisation responsible for radiation protection checks as mentioned in articles R. 1333-43 and R. 1333- 44 of the Public Health Code and R. 231-84 and R. 231-86 of the labour code.
n° 2007-DC-0055 and 2007-DC-0056	26 June 2007	Constituting approval of an organisation responsible for radiation protection checks as mentioned in articles R. 1333-43 and R. 1333-44 of the of the Public Health Code and R. 231-84 and R. 231-86 of the Labour Code.
n° 2007-DC-0054	8 June 2007	Constituting refusal of acceptance of a notified and qualified organisation.
n° 2007-DC-0053	8 June 2007	Constituting acceptance of a notified and qualified organisation.
n° 2007-DC-0052	8 June 2007	Constituting acceptance of a service for the inspection of designated users.
n° 2007-DC-0051	26 June 2007	With regard to the incident that occurred on Monday 9 April 2007 on the electrical systems of basic nuclear installation n° 85, operated by *Électricité de France* (EDF) at the Dampierre-en-Burly nuclear power plant (Loiret).

ASN decisions *(continuation)*

Reference	Date of the decision	Title
n° 2007-DC-0050	22 June 2007	Commissioning authorisation for basic nuclear installation n° 148, known as Atalante, in the *commune* of Chusclan (Gard).
n° 2007-DC-0041 to 0049	17 April 2007	Radiation protection checks as mentioned in articles R. 1333-43 and R. 1333-44 of the Public Health Code and R. 231-84 and R. 231-86 of the Labour Code.
n° 2007-DC-0040	20 April 2007	Constituting technical requirements for the reconditioning and removal of oils contaminated by uranium in basic nuclear installation n° 65, known as the nuclear fuel fabrication plant, operated by the *Société industrielle de combustible nucléaire* (SICN) on the Veurey-Voroize site (Isère).
n° 2007-DC-0039	20 April 2007	Constituting delicensing of basic nuclear installation n° 134, called the uranium store, on the *commune* of Istres (Bouches-du-Rhône).
n° 2007-DC-0037 and 0038	26 March 2007	Constituting renewal of approval of an organisation responsible of an organisation responsible for radiation protection checks as mentioned in articles R. 1333-43 and R. 1333-44 of the Public Health Code and R. 231-84 and R. 231-86 of the Labour Code.
n° 2007-DC-0036	21 March 2007	With regard to the processing of scrap from former industrial manufacturing facilities in basic nuclear installations n° 32 and n° 54 known as the Plutonium Technology Facility (ATPu) and the Chemical Purification Laboratory (LPC) respectively, operated by the French Atomic Energy Commission on the Cadarache site, in the *commune* of Saint-Paul-lez-Durance (Bouches du Rhône).
n° 2007-DC-0035	27 February 2007	Constituting approval of an organisation responsible for radiation protection checks as mentioned in articles R. 1333-43 and R. 1333-44 of the Public Health Code and R. 231-84 and R. 231-86 of the Labour Code.
n° 2007-DC-0031 to 0034	27 February 2007	Constituting renewal of approval of an organisation responsible for radiation protection checks as mentioned in articles R. 1333-43 and R. 1333-44 of the Public Health Code and R. 231-84 and R. 231-86 of the Labour Code.
n° 2007-DC-0030	26 January 2007	Constituting acceptance of a body for inspection of designated users.
n° 2007-DC-0029	26 January 2007	Constituting acceptance of a recognised and qualified third party.
n° 2007-DC-0028	26 January 2007	Constituting acceptance of a notified and qualified organisation.
n° 2007-DC-0027	29 January 2007	Constituting approval of an organisation responsible for radiation protection checks as mentioned in articles R. 1333-43 and R. 1333-44 of the Public Health Code and R. 231-84 and R. 231-86 of the Labour Code.
n° 2007-DC-0024 to 0026	29 January 2007	Constituting renewal of approval of an organisation responsible for radiation protection checks as mentioned in articles R. 1333-

ASN decisions *(continuation)*

Reference	Date of the decision	Title
		43 and R. 1333-44 of the Public Health Code and R. 231-84 and R. 231-86 of the Labour Code.
n° 2007-DC-0023	29 January 2007	Constituting approval of laboratories for environmental radioactivity measurements.
n° 2007-DC-0004	3 January 2007	Establishing the list of basic nuclear installations as at 31 December 2006.
n° 2006-DC-0005 to 0022	27 December 2006	Constituting extension of approval of organisations responsible for radiation protection checks as mentioned in articles R. 1333-43 and R. 1333-44 of the Public Health Code and R. 231-84 and R. 231-86 of the Labour Code.

ASN opinions

It is essential to consult ASN with regard to the following:
– draft decrees or ministerial orders of a regulatory nature concerning nuclear safety;
– draft authorisation, final shutdown and decommissioning decrees concerning a BNI.

It may be consulted at the request of the Government or Parliament with regard to draft texts or particular issues.

In 2007, 35 opinions(2), as listed below, were published in the ASN Official Bulletin.

Reference	Date of the opinion	Title
n° 2007-AV- 0042	18 December 2007	With regard to the draft order modifying the order of 6 December 2003 concerning the conditions for issue of the certificate and approval for organisations responsible for individual monitoring of workers exposed to ionising radiation.
n° 2007-AV- 0041	18 December 2007	With regard to the draft order modifying the order of 26 October 2005 concerning the procedures for training the person with competence for radiation protection and for certification of the trainer.
n° 2007-AV-0039	29 November 2007	With regard to the draft order defining the procedures for training and for issue of the certificate of aptitude for handling industrial radiology equipment (CAMARI).

(2) Certain opinions issued by ASN in 2007 concerning draft regulatory texts issued by the Ministers responsible for nuclear safety, will be published in the Official Bulletin on the date of publication of said texts.

ASN opinions *(continuation)*

Reference	Date of the decision	Title
n° 2007-AV-0038	13 November 2007	With regard to the draft order authorising the French Atomic Energy Commission (CEA) to continue with liquid and gaseous effluent discharge and water intake for operation of the secret basic nuclear installation at Marcoule (Gard).
n° 2007-AV-0037	20 November 2007	Concerning the reports submitted by the licensees of basic nuclear installations pursuant to article 20 of Act 2006-739 of 28 June 2006.
n° 2007-AV-0035	19 November 2007	Concerning the request from Mr Gabriel VASILE for authorisation to exercise the duties of a medical radiological physics specialist.
n° 2007-AV-0034	19 November 2007	Concerning the request from Mrs Isabelle GOBERT for authorisation to exercise the duties of a medical radiological physics specialist.
n° 2007-AV-0033	13 November 2007	Concerning the share of the 2008 budget of the Institute for Radiation Protection and Nuclear Safety devoted to ASN technical support work.
n° 2007-AV-0029	10 July 2007	With regard to the draft order authorising *Électricité de France* to continue with water intake and liquid and gaseous effluent discharges for operation of the Tricastin nuclear site (Drôme).
n° 2007-AV-0028	du 11 May 2007	With regard to the draft order authorising the Max von Laue - Paul Langevin Institute (ILL) to continue with water intake and liquid and gaseous effluent discharges for operation of the Grenoble nuclear site (Isère).
n° 2007-AV-0027	11 May 2007	With regard to the draft order authorising *Électricité de France* to continue with water intake and liquid and gaseous effluent discharges for operation of the Creys-Malville nuclear site.
n° 2007-AV-0026	15 May 2007	With regard to the draft decree concerning the protection and regulation of nuclear materials, transports and installations.
n° 2007-AV-0025	4 April 2007	With regard to the draft order modifying the order of 14 April 2006 concerning the conditions for approval of organisations qualified to conduct radon activity concentration measurements in premises open to the public.
n° 2007-AV-0024	4 April 2007	With regard to the draft decree implementing article L. 542-1-2 of the Environment Code and setting requirements for the management of radioactive materials and wastes.
n° 2007-AV-0023	4 April 2007	With regard to the draft decree authorising the CIS bio international company to operate basic nuclear installation n° 29, known as UPRA, in the *commune* of Saclay, previously operated by CEA.
n° 2007-AV-0022	26 March 2007	With regard to the draft order modifying the order of 26 February 1974 concerning the construction of the main primary system for nuclear steam supply systems.

ASN opinions *(continuation)*

Reference	Date of the decision	Title
n° 2007-AV-0021	26 March 2007	With regard to the draft decree concerning technical inquiries into accidents or incidents involving a nuclear activity.
n° 2007-AV-0020	21 March 2007	With regard to the draft decree authorising EDF to introduce and use MOX fuel in reactors 5 and 6 of the Gravelines nuclear power plant (BNI n° 122) in the Nord *département**, modifying the decree of 18 December 1981 authorising EDF to create two units at the Gravelines nuclear power plant, modified by decree 85-1331 of 10 December 1985.
n° 2007-AV-0019	7 March 2007	With regard to the draft decree concerning the local information committees set up for the basic nuclear installations.
n° 2007-AV-0018	27 February 2007	With regard to the draft decree concerning the part-time assignment to ASN of certain state civil servants.
n° 2007-AV-0017	16 February 2007	With regard to the draft decree authorising *Électricité de France* to proceed with the final shutdown and complete decommissioning of basic nuclear installation n° 163, known as the Ardennes nuclear power plant, located in the *commune* of Chooz.
n° 2007-AV-0016	16 February 2007	With regard to the draft decree authorising the creation of the basic nuclear installation known as Flamanville 3, comprising an EPR type nuclear reactor, on the Flamanville site (Manche).
n° 2007-AV-0015	1st February 2007	With regard to the draft decree implementing article L. 542-2 and L. 542-2-1 of the Environment Code.
n° 2007-AV-0014	1st February 2007	With regard to the draft order concerning the secure financing of nuclear costs.
n° 2007-AV-0013	1st February 2007	With regard to the draft decree concerning the secure financing of nuclear costs, implementing article 20 of planning Act 2006-739 of 28 June 2006 covering the sustainable management of radioactive materials and wastes.
n° 2007-AV-0012	1st February 2007	With regard to the draft decree modifying the decree of 8 September 1977 as amended, authorising the creation by the Eurodif-Production company of a plant separating uranium isotopes by gaseous diffusion on the Tricastin site (Drôme and Vaucluse *départements*).
n° 2007-AV-0011	26 January 2007	With regard to the draft decree setting the maximum annual capacity of the Melox production plant at the equivalent of 195 tons of heavy metal.
n° 2007-AV-0010	1st February 2007	With regard to the draft authorisation decree for the basic nuclear installation known as the Georges Besse II plant.
n° 2007-AV-0009	24 January 2007	With regard to the draft order concerning the creation of authorisation application files as mentioned in articles R. 1321-6, R. 1321-7, R. 1321-8, R. 1321-9, R. 1321-11, R. 1321-12 and R. 1321-42 of the Public Health Code.

ASN opinions *(continuation)*

Reference	Date of the decision	Title
n° 2007-AV-0008	1st February 2007	With regard to the draft decree concerning certain obligations to inform and train workers liable to be exposed to ionising radiation and consideration of the competence devolved to ASN, modifying part III of book II of the Labour Code.
n° 2007-AV-0007	1st February 2007	With regard to the draft decree concerning the authorisation and notification of nuclear activities and their regulation and constituting various modifications to the Public Health Code.
n° 2007-AV-0006	24 January 2007	With regard to the draft decree concerning basic nuclear installations and the regulation of the nuclear safety of radioactive material transports.
n° 2007-AV-0004	24 January 2007	With regard to the draft decree concerning the list of basic nuclear installations.
n° 2007-AV-0003	12 January 2007	With regard to the draft decree setting the procedures for designating, qualifying and swearing-in the nuclear safety inspectors and the procedures for designating the agents responsible for inspecting nuclear pressure vessels.
n° 2007-AV-0002	8 January 2007	With regard to the decree creating the Nuclear Safety Authority (ASN) joint technical committee.

APPENDIX C

ASN DECISIONS AND OPINIONS PUBLISHED IN 2007 IN ITS OFFICIAL BULLETIN

ASN-SFRO EXPERIMENTAL SCALE FOR DEALING WITH RADIATION PROTECTION EVENTS AFFECTING PATIENTS UNDERGOING A MEDICAL RADIOTHERAPY PROCEDURE

1 - PURPOSE OF THE ASN-SFRO EXPERIMENTAL SCALE

The purpose of the ASN-SFRO experimental scale is to inform the public about radiation protection events affecting patients undergoing a medical procedure.
It was published in July 2007 and will be tested for a 12-month trial period, with the results jointly evaluated by ASN and SFRO.

2 - PRESENTATION OF THE ASN-SFRO EXPERIMENTAL SCALE

The events are rated on eight levels on the ASN/SFRO scale:

- **level 0** is used to rate events with no dosimetric consequences;
- **levels 1 to 3** correspond to events categorised as "incidents";
- **levels 4 to 7** correspond to events categorised as "accidents".

The severity of the effects is assessed with reference to the international clinical classification (CTCAE grades) already used by practitioners.
The effects considered in the declaration submitted to ASN are the unexpected or unforeseeable effects due to inappropriate doses or irradiated volumes. Not included however, are any side-effects, whatever their grade, that may for example result from a strategy agreed by the practitioner and patient, with no error in the irradiated volume or delivered dose (accepted risk).
For patients affected by a radiotherapy event, the effects or complications may not be immediate. A provisional rating followed by a final rating several months later may therefore be necessary.
For confirmed effects, over-rating will be used to take account of the number of patients concerned.
Unlike the INES scale, the defence in depth criterion (assessment of the level of safety of the installation) is not incorporated into this rating system, in order to prevent any confusion between the seriousness of a medical condition and a failure of the installation or breakdown in the organisation of a department.

ASN-SFRO EXPERIMENTAL SCALE

	EVENT (UNFORESEEN, UNEXPECTED)	CAUSE	CONSEQUENCES (CTCAE V3.0 GRADE)
5 to 7[1]	Death	Dose (or irradiated volume) far higher than normal leading to fatal complications or sequelae	Death
4[2]	Serious life-threatening event, disabling complication or sequelae	Dose or irradiated volume far higher than tolerable doses or volumes	Acute or late serious effect, either unexpected or unforeseeable, grade 4
3[2]	Event leading to a severe impairment of one or more organs or functions	Dose or irradiated volume higher than tolerable doses or volumes	Acute or late severe effect, either unexpected or unforeseeable, grade 5
2[2]	Event leading to or liable to lead to a moderate impairment of an organ or function	Dose higher than recommended doses, or irradiation of a volume liable to lead to unexpected but moderate complications	Acute or late moderate, unexpected or unforeseeable effect, grade 2 or no disablement
1	Event with no expected consequences or liable to lead to mild consequences	Dose or volume error with no expected consequences (for example, non-compensable target error during a session)	
0	Event with no dosimetric consequences for the patient	Error in identification of a patient treated for the same pathology (compensable). Anomaly detected in time before treatment started	

(1) In the event of death of several patients:
- the minimum level 5 is raised to 6 if the number of patients is higher than 1 but no more than 10,
- the minimum level 5 is raised to 7 if the number of patients is higher than 10.

(2) If the number of patients is higher than 1, a + sign is added to the chosen level (for example: 3 becomes 3+).

[1] *Cancer Therapy Evaluation Program*, August 2006, http:/ctep.cancer.gov

3 - RATING CRITERIA

In the same way as the INES scale, the ASN-SFRO scale was designed so that the rating criteria for an event concern not only its confirmed consequences, but also its potential effects.

The number of patients exposed is also taken into account.

Criteria concerning confirmed consequences

When the effects are confirmed, the rating refers to the various clinical classification grades, as follows:

- **level 1,** corresponding to grade 1, concerns mild effects but also events for which no effect is expected;
- **level 2,** corresponding to grade 2, concerns the acute or late moderate effects such as moderate post-radiation stenosis, relatively unproblematic tissue impairment (cutaneous fibrosis), or minimal or no disablement;
- **level 3,** corresponding to grade 3, concerns acute or late severe effects such as non-life-threatening manageable tissue necrosis, with moderate disablement (severe colitis, severe cystitis, etc.);
- **level 4,** corresponding to grade 4 concerns acute or late serious effects such as post-radiation myelitis, life-threatening extensive unmanageable tissue necrosis, with serious or major disablement (serious colitis, serious cystitis, etc.);
- **levels 5, 6 and 7,** corresponding to grade 5 of the clinical classification, refers to one or more deaths.

Dosimetric criteria and potential effects

When the effects are not yet confirmed, dose or irradiated volume criteria are chosen for a provisional rating. The difference between the received dose and the intended dose is evaluated on the basis of accepted or tolerated deviations, in the light of existing practices or available references.

Similarly, the difference between the volume actually irradiated and the volume that should have been treated is analysed, taking account of the presence or otherwise of any organs particularly sensitive to radiation.

For any significant or extremely significant discrepancies, the event will be rated level 2 or 3, or possibly 4.

If there is a high level of uncertainty over whether or not possible effects may have occurred, the event is rated level 1 or 2 (depending on the conditions of the event).

Criteria concerning the number of patients exposed

For confirmed effects of a level of 5 or more, the minimum rating level defined is increased by:

- **+ 1** if the number of patients concerned is greater than 1 and less than 10;
- **+ 2** if the number of patients concerned is 10 or more.

For confirmed effects of level 2, 3 or 4, the rating level is given the + sign when the number of patients concerned is greater than 1.

In order to prevent any confusion concerning the severity of the effects, the over-rating criterion concerning the number of cases is not applied to potential effects, except when the information concerning the delivered dose and/or irradiated volumes already allows a prognosis to be made in terms of death, serious or severe effects.

The event will eventually be re-rated if there are any confirmed effects that may be linked to the over-exposure or exposure error.

4 - SUMMARY OF EVENTS FROM 1 JULY TO 31 DECEMBER 2007

ASN was notified of 10 events during the first 6 months of use of the experimental scale:

- 5 were rated level 0;
- 4 were rated level 1;
- 1 was rated level 2.

AUTORITÉ DE SÛRETÉ NUCLÉAIRE
www.asn.fr
6, place du Colonel Bourgoin
75012 Paris - France
Tel.: +33 1 40 19 86 00
Fax: +33 1 40 19 86 69

Société Française de Radiothérapie Oncologique
Centre Antoine Béclère
45 rue des Saints-Pères • 75006 Paris • France
Tel. / Fax +33 1 40 15 92 05

December 2007. ARTYG.

AUTORITÉ DE SÛRETÉ NUCLÉAIRE

6, place du Colonel Bourgoin
75012 Paris

The public information and documentation
Phone (+33) 1 40 19 87 22
Fax (+33) 1 40 19 86 69

www.asn.fr

The INES scale of nuclear incidents and accidents

Presentation and objectives

In the same way as for natural phenomena such as earthquakes, wind and avalanches, France in 1987 set up a scale of severity for nuclear events, which IAEA used extensively as a basis for the INES scale (International Nuclear Event Scale). This scale, which was implemented internationally in 1991, is based partly on objective and partly on subjective criteria. It is used by about sixty countries and its purpose is **to facilitate media and public perception of the scale of any nuclear incidents. It is not an assessment tool** and cannot in any circumstances be used as a basis for international comparison. 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 rated on the INES scale

The INES scale is designed to cover events occurring in all civil nuclear installations, including those classified as secret, and during nuclear material transports. These events are rated by ASN on 8 levels from 0 to 7, depending on their severity. Application of the INES scale to nuclear installations is based on three rating criteria (columns 2, 3 and 4 of the following table):

• **off-site impact**, assessed in terms of radioactive releases that can affect the public and the environment;

• **on-site impact**, which can affect workers and the conditions of the installations;

• **degradation of the lines of defence** in depth of the installation, consisting of successive barriers (safety systems, procedures, technical or administrative checks, etc.) placed between the radioactive products and the environment. For transport of radioactive materials on the public highway, only the off-site impact and degradation of the defence in depth criteria are used for application of the INES scale.

Examples of events rated on the INES scale

Level 0. In France: several hundred events are rated level 0 every year. They concern deviations from the normal operation of the facilities or the normal transport of radioactive materials, but which have no impact in terms of safety.

Level 1. In France: about a hundred events are rated level 1 every year. These comprise anomalies, deviations from facility normal operating conditions or from normal transportation operations, owing to equipment failure, human error, or inadequate compliance with procedures.

Level 2. In France: **•2006•** Incorrect use of a MOX fuel fabrication scrap crusher in the Plutonium Technology Facility (ATPu) on the Cadarache site, following application of inappropriate and informal procedures and instructions. **•2005•** Anomaly concerning certain safety pumps in EDF's 900 MWe reactors which could, in certain accident situations, lead to loss of the cooling water recirculation function. **•2004•** Generic anomaly affecting certain marshalling boxes in EDF nuclear power plants. This

Criteria or safety attributes

	Offsite impact	Onsite impact	Defence in depth degradation
7 Major accident	Major release: widespread health and environmental effects		
6 Serious accident	Significant release: likely to require full implementation of planned countermeasures		
5 Accident with offsite risk	Limited release: likely to require partial implementation of planned countermeasures	Severe damage to reactor core/radiological barriers	
4 Accident without significant offsite risk	Minor release: public exposure of the order of prescribed limits	Significant damage to reactor core/ radiological barriers/fatal exposure of a worker	
3 Serious incident	Very slight release: public exposure at a fraction of prescribed limits	Severe spread of contamination/acute health effects to a worker	Near accidents – no safety barriers remaining
2 Incident		Significant spread of contamination/ overexposure of a worker	Incidents with significant failures in safety provisions
1 Anomaly			Anomaly beyond the authorized operating conditions
0 Deviation	No safety significance		
Out of scale event	No safety relevance		

could have prevented various items (motors, valves) from operating in accident conditions involving the presence of water or steam in the reactor building.

Level 3. In France: •2002• Incident rated by the Swedish competent authority during transport by Federal Express (FedEx) between Sweden and the United States, via Roissy airport, of a package which at arrival registered a dose rate higher than the acceptable regulatory limit. **•1981•** Fire in a storage silo at La Hague. **Abroad: •2005•** Detection of a radioactive leak from a pipe between the dissolver and a tank in the Thorp fuel reprocessing plant in Sellafield (United Kingdom). **•2002•** On the Davis Besse power plant reactor (United States) discovery of a cavity in the reactor vessel closure head caused by boric acid corrosion of the metal.

Level 4. In France: •1980• Damage to the core of the Saint- Laurent A1 reactor. **Abroad: •1999•** Criticality accident in a fuel fabrication facility in Tokai-Mura, Japan, with acute irradiation of three workers, two of whom subsequently died. **•1973•** Release of radioactive material following an exothermal reaction in a reprocessing tank in the Windscale plant (United Kingdom).

Level 5. In France: none. **Abroad: •1979•** Partial meltdown of the Three Mile Island reactor core in the United States.

Level 6. In France: none. **Abroad: •1957•** Explosion of a tank of radioactive products in the Kyshtym reprocessing plant in the USSR.

Level 7. In France: none. **Abroad: •1986•** Explosion of reactor 4 in the Chernobyl nuclear power plant in Ukraine.

Use of the INES scale in France

All nuclear safety-significant events are reported by the licensees to ASN within 24 hours. This notification comprises a proposed rating on the INES scale, to be approved by ASN, which has full responsibility for the final rating decision.

Using the INES scale enables 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 ASN's asn.fr website. Incidents rated level 2 and above are also the subject of a press release and a notification to IAEA;
- **incidents rated level 0** are not the subject of an incident notification, unless they are of particular interest.

International transport incidents concerning a foreign country are also notified to IAEA as of level 1. In the event of loss of a radioactive source, this notification is made as of level 0.

Experimental classification of a radiation protection event on the INES scale

Following a proposal by ASN in 2003, the IAEA member states are experimenting with a new part of the INES scale applicable to radiation protection incidents, taking account of radioactive sources and radioactive material transport. This new part, which in France concerns only BNIs, includes the principle of the relationship between the radiological risk and the severity of the incident. Its experimental application to medical installations (excluding patients), industrial facilities or research establishments is in process. Publication of a new INES manual by IAEA in 2008 will mark the end of this trial period.

Together with the French Oncology Radiotherapy Society (SFRO), ASN also began a one year trial period in July 2007 for a radiotherapy incident rating scale based on the INES scale.

Event	Number of exposed individuals and final rating		
	Minimum rating	Number of individuals	Final rating*
Death or lethal dose received	4	> 10	6
		> 1	5
		1	4
Deterministic effect or potential deterministic effect according to the dose received	3	> 10	5
		> 1	4
		1	3
Exposure higher than 1 Sv or 1 Gy	4	> 100	6
		> 10	5
		≤ 10	4
Exposure higher than 100 mSv	3	> 100	5
		> 10	4
		≤ 10	3
Worker exposure to a dose higher than the regulation annual limit or exposure of a member of the public to a dose higher than 10 mSV	2	> 100	4
		> 10	3
		≤ 10	2
Worker exposure to a dose higher than one quarter the regulation annual limit or exposure of a member of the public to a dose higher than the annual dose limit	1**	> 100	3
		> 10	2
		≤ 10	1

** Select the higher rating*

*** When a dose limit is exceeded as a result of accumulated exposure over a given period of time, ASN systematically attributes a level 1 rating because of the lack of safety culture*

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