INDUSTRIAL AND RESEARCH ACTIVITIES

CHAPTER 10

For many years, industry and research have been using sources of ionising radiation in a wide variety of applications and locations. The issue for the radiation protection regulations currently in force is to check that, despite this great diversity, the safety of workers, the public and the environment is guaranteed. It is thus important to be able to supervise the conditions of possession, use and disposal of the sources, from fabrication up to end of life. The investigations carried out by ASN confirmed that the means devoted to radiation protection in the industrial and research worlds vary widely. This situation led ASN to identify action priorities. Particular efforts were therefore focused on the manufacturers and suppliers of radionuclide sources, as they have considerable responsibility for the entire life of the radioactive sources, from production up to final disposal. It is therefore important for their situation with respect to radiation protection rules to be satisfactory.

1 PRESENTATION OF INDUSTRIAL AND RESEARCH ACTIVITIES USING IONISING RADIATION

Industry and research employ radiation produced either by radionuclides - primarily artificial - in sealed or unsealed sources, or by electrical generators. The main applications in these sectors are presented below.

1 | 1 Sealed radioactive sources

Sealed sources are those whose structure or packaging prevents any dispersal of radioactive materials in normal conditions of use. Their main applications are industrial irradiation, non-destructive testing, parameter checking and other routine applications presented below.

1 | 1 | 1 Industrial irradiation

This is used for sterilising medical equipment, pharmaceutical or cosmetic products and for conservation of foodstuffs.

Preparation for gammagraphy operation

At low doses, irradiation inhibits germination (potatoes, onions, garlic, ginger), kills insects and parasites in cereals, leguminous plants, fresh and dried fruits, fish and meat, and slows down the physiological process of decomposition of fresh fruits and vegetables.

At medium doses, ionisation by irradiation prolongs the shelf-life of fresh fish and strawberries, eliminates deterioration agents and pathogenic micro-organisms in shellfish and meat (fresh or frozen), and technically improves foodstuffs, for example by increasing juice production from grapes or reducing the cooking time of dehydrated vegetables.

At high doses, ionisation offers industrial sterilisation of meat and seafood, of ready-to-eat foods, of hospital meals and decontamination of certain food additives and ingredients such as spices, gums, and enzyme preparations. These consumer product irradiation techniques may be authorised because once the products are treated, they show no signs of added artificial radioactivity. Industrial irradiators use cobalt 60 sources, the total activity of which can exceed 250,000 TBq. Some of these installations are classified as basic nuclear installations (BNIs).

1 | 1 | 2

Non-destructive testing

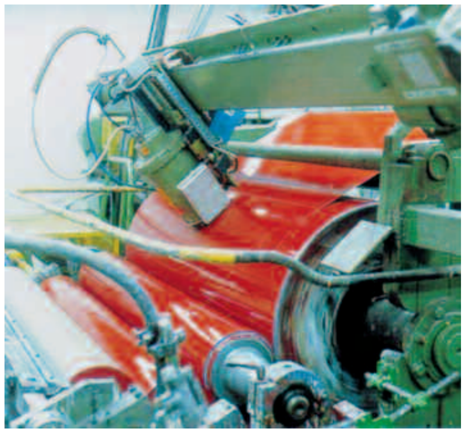
Of the non-destructive testing techniques, gamma radiography in particular uses radioactive sources. It is used to inspect homogeneity defects in metal, particularly in weld beads. This technique in particular uses iridium 192 and cobalt 60 sources, with activity not exceeding about twenty terabecquerels. A gammagraph is usually 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 applicator and the object to be radiographed, while protecting the operator who must remain at a safe distance from the source; and
- a radioactive source inserted into a source-holder.

Gammagraph example – the Gam80

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.



Basis weight measurement by backscatter

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 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;
- smoke detection (see box);
- calibration of 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 on next page).

Tables 1 and 2 specify the number of facilities authorised to use radioactive sources in the applications identified. They illustrate the diversity of these applications.
It should be noted that a given facility may carry out several activities and will therefore appear in the above-mentioned tables 1 and 2 for each of its activities.

MAIN USES OF UNSEALED RADIOACTIVE SOURCES	2006
Research	995
Use of tracers	10
Calibration	64
Teaching	18

Table 1: use of unsealed radioactive sources

NUMBER OF FACILITIES AUTHORISED IN	2006
Gamma radiography	130
Density measurement and weighing	243
Thickness measurement	143
Dust measurement	62
Thin layer thickness measurement	20
Basis weight measurement	179
Level measurement	240
Humidity and density measurement	265
Logging	13
Elimination of static electricity	22
Smoke detectors	2
Use of neutron sources	21
Analysis	63
Calibration	777
Teaching	122
Research	18
Chromatography	431
Electron capture detectors	52
X-ray fluorescence analysis	2237

Table 2: use of sealed radioactive sources

Lead detection in paint

Saturnism is a disease caused by lead poisoning. This poisoning usually results from ingestion or inhalation of dust from paint containing lead salts. This type of paint is usually encountered in older housing (until 1948), as lead is now prohibited as a paint additive.

A legislative framework aimed at combating social exclusion sets an obligation for action to prevent child saturnism by requiring that the concentration of lead in paint be controlled. Article 3 of the order of 12 July 1999 concerning diagnosis of the risk of intoxication from the lead contained in paint, implementing article R. 32-2 of the Public Health Code (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 line characteristic of lead can be recognised and quantified. The measurement principle is as follows: the gamma photon emitted by a radionuclide interacts photoelectrically to eject an electron from an atom of the target. De-excitation of the atom to return it to its equilibrium state, leads to emission of an X-ray photon (X-ray fluorescence), the energy of which is characteristic of the element to be analysed (lead). The X-ray photons emitted are counted by a detector and their number is proportional to the number of atoms per unit surface area of the element looked for. Measurement precision is currently 0.058 mg of lead per cm2 of surface.

The appliances, which are portable, use sources of cadmium 109 (half-life 464 days) or cobalt 57 (half-life: 270 days). The activity of these sources is about 400 MBq.

In 2004, a new type of device came onto the market, containing no radioactive source and using an electrical generator working on the same principle as the emission of X-ray fluorescence photons. However, this new type of device is not currently able to meet the criteria defined in the order of 25 April 2006 concerning detection of the risk of exposure to lead and can therefore no longer be authorised.

These various devices are used by a wide variety of organisations, mainly consulting firms, architects, surveyors, solicitors, real estate agents and building managers. ASN therefore ensures that the appliances offer radiation protection guarantees appropriate to the conditions of use and sets obligations on the users for handling and storage of these appliances, in order to prevent unauthorised loans and theft.

1 | 2

Unsealed radioactive sources

The main radioelements used in unsealed sources are phosphorus 32 or 33, carbon 14, sulphur 35, chromium 51, iodine 125 and tritium. They are used as tracers for calibration and teaching. Radioactive tracers incorporated into molecules is common practice in biological research. They are thus a powerful investigative tool in cellular and molecular biology. Unsealed sources are also used as tracers for measuring wear, searching for leaks, for friction research, for building hydrodynamic models and in hydrology.

The number of facilities authorised to use unsealed sources stands at 1,061.

1 | 3

Electrical generators of ionising radiation

Electrical generators of ionising radiation (generally X-rays) are mainly intended for use in non-destructive structural analyses (tomography, diffractometry, etc.), checks on weld bead quality, or material fatigue inspections (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.

Veterinarians also use these appliances for bone radiography and other common diagnosis procedures.

Baggage controller

Unlike equipment used in the medical field, there is no CE marking obligation allowing free circulation of these appliances throughout the European Union.

The following table specifies the number of facilities authorised to use electrical generators of ionising radiation in the listed applications. It illustrates the diversity of these applications.

MAIN USES OF ELECTRICAL GENERATORS OF IONISING RADIATION	2006
Non-destructive testing (radiography/radioscopy)	103
Crystallography	32
X-ray fluorescence analysis	88
Industrial gauging (level measurement, etc.)	27
Research	9
Calibration	1
Teaching	2

Table 3: use of electrical generators of ionising radiation

1 | 4

Particle accelerators

Finally, certain applications require the use of particle accelerators which produce photon or electron beams.

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

Table 4: scope of use of particle accelerators

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 4.

Accelerator

1 | 5

Activities being phased out, unjustified activities, prohibited activities

Some activities are in the process of being phased out, mainly because of technical developments: this is the case with smoke detection (see box). It is also the case with determining the dew point, level measurements and density measurements, for which techniques based on X-rays or ultra-sounds are tending to replace those based on radionuclides. This is also the case with measuring snow height or the position of cable cars using a radionuclide source incorporated into the splices of the support cable.

Detectors awaiting removal of their Americium source

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 this respect, the manufacture, import and trade in irradiated precious stones, which contain residual activity following activation designed to improve their aesthetic quality and sale value, are not authorised.

The same applies to accessories such as key-rings, hunting equipment (sighting devices), navigation equipment (compasses), or equipment for river fishing (floats) fitted with sealed tritium sources.

Smoke detection

The aim is to signal an outbreak of fire as early as possible, by detecting the smoke produced. The devices used comprise two ionisation chambers, including one reference chamber being tight to the ambient gas, while the other lets combustion gases enter. The intensity of the current passing through the reference chamber is compared with that of the current passing through the measurement chamber. When the difference in intensity is higher than a preset threshold, an alarm is triggered. The gases contained in the reference chamber are ionised by emission of radiation from a sealed source. Although several types of radioelements were used in the past (americium 241, plutonium 238, nickel 63, krypton 85), at present only americium is used, with an activity not in excess of 37 kBq. In recent years, progress in the design of these devices has led to a reduction in the level of activity they need to operate, with some of them using a 10 kBq source.

Domestic use of smoke detectors employing radioactive sources is prohibited in France. This ban does not apply to the common areas of residential buildings. The licences are issued under a procedure tailored to the constraints arising from use of these appliances.

New detection techniques, particularly optical, have appeared in the meantime. They are as effective as those that use a radioactive source. There is thus no further justification for using detection devices containing radioactive sources. ASN has therefore entered into discussions with the profession concerning the eventual withdrawal of smoke detectors containing radioactive sources. It is planned to put an end in 2007 to the sale of new devices, except to replace devices for maintenance of detection systems (maintenance means the replacement of existing devices and/or the addition of detectors to an existing line), followed in 2009 by a total halt in the sale of new devices. From this date, only the reconditioning of old devices would be authorised for two maintenance cycles of a maximum of four years each.

2 REGULATORY PROVISIONS CONCERNING INDUSTRIAL AND RESEARCH APPLICATIONS

The provisions concerning the industrial and research applications given in the Public Health Code (articles R. 1333-26 to R. 1333-28) are recalled below.

2 | 1 Licensing frameworks for ionising radiation sources used for industrial and research purposes

Table 5 presents the procedures governing the various industrial and research applications, including for veterinary purposes.

Unlike medical applications, industrial and research applications always require licensing, although some of them in certain conditions may be exempted from this licence requirement. The Public Health Code also introduced a licence waiver issued by the Minister for Health for nuclear activities which have already been licensed under the Mining Code, the basic nuclear installations system or that covering installations classified on environmental protection grounds.

The maximum validity of the licences is 5 years renewable. The licence which is issued to the head of an installation is personal and non-transferable. Any modification to the licence concerning either its beneficiary, or the installation, or its operating conditions, must be re-examined under article R. 1333-36 of the Public Health Code. The licensee must make arrangements to protect, inform and pro-

<table>
<tr><th>Nature of the nuclear activity</th><th>Procedure and competent authority</th><th>Observations</th></tr>
<tr><td>Manufacture of radioactive or devices containing them</td><td rowspan="4">ASN licence[1], except if nuclear activity in licensed ICPE: authorisation by préfet</td><td></td></tr>
<tr><td>Manufacture of products or devices containing radioactive sources</td><td rowspan="2">Exemption possible if criteria set in article R.1333-27 of the CSP are met[2]</td></tr>
<tr><td>Use of radioactive sources</td></tr>
<tr><td>Irradiation of products, including food products</td><td></td></tr>
<tr><td>Use of electrical generators, including particle accelerators</td><td rowspan="3">ASN licence</td><td>Exemption possible if criteria set in article R.1333-27 of the CSP are met[2]</td></tr>
<tr><td>Import or export of radioactive sources or devices containing them</td><td></td></tr>
<tr><td>Distribution of radioactive sources or devices containing them</td><td>Exemption possible if criteria set in article R.1333-27 are met[2]</td></tr>
</table>

Table 5: procedures applicable to industrial or research nuclear activities

(1) The licences issued for nuclear activities subject to the Mining Code or the basic nuclear installations system are equivalent to a licence issued under the Public Health Code.

(2) The criteria for exemption from the licensing procedures apply:

– to radionuclides, if the total quantities involved or their concentration per unit of mass are below the thresholds set in the appendix to the Public Health Code (provided that the masses of materials involved do not exceed one ton);

– to electrical generators of ionising radiation, if of a certified type compliant with the standards and if, in normal operation and at any point 0.1 m from their accessible surface, they do not generate an equivalent dose of more than 1 µSv/h, or if an appliance operating with a potential difference of 30 kV or less in the same dose equivalent rate limit conditions.

vide radiation protection training for all those likely to be exposed to ionising radiation, specified in articles L. 1333-8 and L. 1333-11 of the Public Health Code.

Finally, any incident or accident likely to be the cause of over-exposure of an individual must be immediately declared to the *préfet*[1] of the *département* and to ASN. It should be recalled that in 2003, ASN set up a 24-hour telephone hotline for emergency situations (toll-free number: 0 800 804 135), but which can also be used for any radiological incident occurring in an industrial or research facility using sources of ionising radiation.

Section 2|3 provides details on how to prepare the licence application dossiers provided for in articles R. 1333-26 and R. 1333-27. A regulation currently under preparation and based on article R. 1333-44, will detail the corresponding procedures.

Particular conditions for 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 radioelements beyond the ten-year period stipulated in the CPAs;
- use of natural krypton gas;
- use of gaseous phase leak detectors on underground piping;
- use in hydrology;
- use for measuring air renewal rates;
- use of portable devices*;
- use of adsorbed tritium sources;
- use for ionisation of electron tubes and discharges;
- use for combustion smoke or gas detectors*;
- use of sealed sources for reference, calibration and testing*;
- distribution of laboratory reagents, calibration sources and measuring or analysis instruments;
- use of sources which, in nuclear power reactors are employed as start-up sources, or in fixed radiation protection channels for unit control systems, or in boron meters and power range measurement channel control systems as well as in irradiation specimen capsules.

Table 6: scope of the main CPEs for radiation sources

Particular conditions for use

The CIREA (Interministerial Commission on Artificial Radioelements), which until 2002 was responsible for giving its opinion on issues relating to artificial radioelements had, for activities requiring licensing, set particular conditions of use (CPEs) designed to inform the future licensee of the conditions for applying the regulations in its field of activity. Until such time as a text of at least equivalent scope is published, the CPEs are still in force in accordance with decree 2002-460. Table 6 presents the scope of the main CPEs.

The more commonly used of these CPEs will then be transcribed into regulations, while the others will remain particular technical specifications recalled in the individual licences. This is why, given the scale of the risks involved in the practice of gamma radiography, an order was published in March 2004 to update the conditions for use of gamma radiography appliances and cancel the corresponding CPE.

2 | 2

Radionuclide source management rules

These rules, already presented in chapter 3, point 1|2|4, are of course also applicable to the fields of industry and research. It should be remembered that these rules concern:
- the obligation to obtain a licence prior to any transfer or acquisition of sources;
- preliminary registration of all source movements with IRSN;
- the obligation on the licensee to keep detailed accounts of the sources in its possession and their movements;
- immediate notification to the *préfet* and ASN of any loss or theft of radioactive sources;

- return by the user, at its own expense, to its suppliers - who are then obliged to take them - of sealed sources that have expired, are damaged or are no longer needed.

2 | 3

Licensing procedures

For each nuclear activity mentioned in table 2 and requiring licensing by the Minister for Health, the corresponding application is reviewed by ASN. It must be submitted by the person in charge of the nuclear activity jointly with the head of the establishment or his representative. This dossier should be drawn up on the basis of a form to be collected from ASN and returned to it, accompanied by all elements requested.

The dossier should establish that radiation protection guarantees are in place and effective and that they were defined taking account of the principles of justification, optimisation and limitation specified in article L. 1333-1 of the Public Health Code. This dossier should therefore comprise elements concerning:
- the justification for the application;
- the conditions of possession and use of the sources;
- the presence of a person with competence in radiation protection;
- the characteristics and performance of appliances containing the sources held and used;
- radiation protection provisions;
- drafting of safety instructions; and
- the precautions taken against the risks of theft or fire.

When reviewing the licensing applications, ASN may, as it sees fit, call on the expertise of the Institute for Radiation Protection and Nuclear Safety (IRSN) and, if necessary, that of organisations whose competence it recognises in the fields of radionuclide source safety and the safety of electrical generators of radiation.

In 2006, ASN continued with its actions to promote handling of licensing applications by its regional divisions. ASN is therefore gradually entrusting the Regional Departments for Nuclear Safety and Radiation Protection (DSNRs) with the review of certain licences, for example those concerning the possession and use of gammagraphs, gammadensimeters or appliances for detecting lead in paint.

Several gammadensimeter models

3 PRIORITIES IMPLEMENTED DURING THE YEAR

3 | 1

General actions

In 2006, 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 the INSERM (National Institute for Health and Medical Research) to rationalise the number of licence holders;
- 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; and
- several meetings held in universities.

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. With respect to rationalisation of the scope of licensing, we would also mention:
- the continued process to combine the licences of the Pasteur Institute in Paris, with a view to improved internal supervision of the Institute; and
- combination of the licences (in particular for gamma radiography) of several companies with a number of facilities in France and operating with internal rules common to the various sites.

When the company organisation so allows, this approach is designed to reduce the number of licences covering all the company's activities and thus shift overall responsibility to the head of the facility.

Finally, concerning the encouragement given to professionals to define guides of good practice for radiation protection in their daily activities, ASN in July 2005 suggested to the COFREND that consideration be given to justification of gamma radiography work and production of a document detailing the best practices to be observed, both by the client and by the gamma radiography contractors. Gamma radiography is an area in which the radiation protection stakes are high, as incorrect use of the appliances or loss of a gammagraph source are likely to have serious health consequences. This hazard is indeed illustrated by the accident which occurred on 15 December 2005 in Chile, in which a Chilean worker was seriously irradiated and was treated at the Percy hospital in France. In a letter dated 8 September 2005, the COFREND agreed in principle to such actions.

3 | 2

Suppliers

In 2006, 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. 1333-27 of the Public Health Code.

During the course of 2006, 46 licences were issued to suppliers and 5 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.

3 | 3

Users

Review by ASN of about 1500 application dossiers for possession and use of radionuclides led to 440 new licences being notified and 153 licences being revoked. About 900 dossiers dealing with an industrial or research activity are currently being reviewed by ASN. Table 7 presents the licences issued or revoked in 2006.

"User" licence trends	2006
New licences	440
Renewals – Updates	955
Revocations	153

Table 7: Radioactive source "user" licences

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 investigates applications for licences to possess and use electrical generators, it being recalled that in the previous regulations, these installations simply required notification.

A number of problems were raised during these investigations. X-ray generators are in particular defined as working equipment by the Labour Code and therefore have to comply with a number of standards dating back to the early 1990s. These requirements were not abrogated with the changing regulations, which modified the annual exposure limits for workers and members of the public and which have switched these appliances from the notification category to that requiring licensing.

ASN has begun discussions with the Ministry for Labour with a view to changing these regulations and encouraged the UTE (technical electricity union) to begin to update the above-mentioned standards. The UTE therefore initiated a revision of the NF-C 15-160 standards and the associated specific standards.

Electric X-ray generator in a radiography chamber

However, in 2006, ASN granted 128 licences for the use of electrical X-ray generators.

Sources of ionising radiation used in BNIs

Article R. 1333-26 of the Public Health Code states that the licence (authorisation decree) issued for a basic nuclear installation (BNI) is equivalent to a licence to possess and use ionising radiation sources. This simplification applies to the sources needed for BNI operation, with the other sources being subject to licensing under the terms of the Public Health Code.

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.

The 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 is continuing with respect to electrical generators of ionising radiation and the registration of the sources in its possession.

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. In this respect, ASN sent out a circular letter to the firms concerned on 26 April 2004, urging them to abide by the main regulatory requirements in force, following the discovery of numerous inadequacies in application of good radiation protection practices, and even some serious breaches of the regulatory requirements stipulated in the Public Health, Labour and Environment Codes. A reminder was sent out in a circular letter dated 29 December 2005, following the loss of a gamma radiography source in Chile, with 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. The main inadequacies concern prior evaluation and optimisation of doses, as well as the conditions for carrying out gamma radiography operations on the worksites.

The incidents declared primarily concern loss or theft of radioactive sources or portable devices containing them (lead detection, etc.), inappropriate use or total or partial accidental destruction of a radionuclide source.

For the year 2006, there were about twenty, including:
- 14 losses or thefts of sealed sources from their place of use;
- 4 potential over-exposure incidents.

Dose rate measurement before a gammagraphy operation

Irradiation accident in Senegal and Ivory Coast

On 29 August 2006, ASN was informed of an irradiation accident that had occurred in Dakar and Abidjan between 3 June 2006 and 4 August 2006, during which several people had accidentally come into contact with a high-level source of iridium 192.

The incident in particular concerns the Senegal and Ivory Coast subsidiaries of the French Bureau Veritas group.

On 3 June, during a weld radiography operation in Dakar, the iridium source being used (activity of 3.7 TBq) apparently remained jammed in the ejector tube after the operation and was not returned to its storage container. The operators did not notice this malfunction and the source remained in the accessory, which contains no biological protection.

The problem was only detected on 3 August 2006 in Abidjan once the remote-control and tube had been sent for use on another worksite.

The unprotected source had thus been stored, handled and transported with no particular precautions and with no biological protection for two months, entailing exposure of a certain number of individuals, four of whom were seriously affected.

The appliance used was apparently a TIF type gammagraph distributed by the MDS Nordion company in Belgium.

TIF type devices have been banned in France since 1989 as they are not in conformity with the requirements of decree 85-968 defining the health and safety conditions to be met by radiography devices using gamma radiation. They do not therefore have technical certification.

4 | 2

Sealed source recovery and replacement requirement

According to the Public Health Code (articles L. 1333-7 and R. 1333-52), all users are required to have the suppliers recover the sealed sources they supplied, as soon as the user no longer needs them, and in any case no later than ten years following the date the first approval was marked on the source supply request.

The supplier is required to recover the source whenever requested by the user. It must also set up a security deposit to cover the consequences should it default and should another party or the ANDRA be required to step in to take its place. Finally, in accordance with article R. 1333-52, the supplier is required to declare any source not returned to it within the specified time.

The 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 an "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 disposal of the sealed sources.

In order to further strengthen the guaranteed recovery of radionuclide sources and make the system easier to use, the suppliers set up a non-profit association in 1996, called Ressources, the purpose of which is to create a guarantee fund from which to reimburse ANDRA or any other approved organisation for the cost involved in recovering sources from the user, either because the supplier normally responsible for their recovery has defaulted, or because no supplier can be identified in the case of stray sources.

The Ressources association, which comprises about sixty members, has become the profession's main interface, in that it covers nearly 95% of the market for this activity.

As part of the national plan for management of radioactive materials and waste (see chapter 16), used source disposal solutions are being reviewed, as there are no disposal channels for these sources at present. A draft regulation stipulating the disposal (delicensing) method for sources is being prepared accordingly. ASN also gave its agreement in principle for disposal in the Aube repository of sources with a half-life equal to or less than that of caesium isotope 137 (or about 30 years).

5 OUTLOOK

With regard to the regulation of ionising radiation applications in industry and research, the main issues for ASN primarily concern the extent to which the licensees take 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 which occurred abroad, such as that in Senegal and Ivory Coast, again underline the need for scrupulous application of the regulations and stringent operational practices. ASN has therefore continued with definition of its priority actions, while optimising use of its resources:
- headquarters has continued its work targeted at the suppliers, concerning both review of the licensing dossiers and the regulation of these organisations;
- the regional levels have gradually taken charge of investigating a certain number of licence applications (gammagraphs, gammadensimeters, paint lead detectors, unsealed sources), creating close links between the users and their authority, and have continued to carry out checks and inspections on the users.

At the same time, the gradual increase in ASN's resources has continued, with the recent appointment of radiation protection inspectors, so that the safety authority is able to carry out its duties in full, with about 500 inspections scheduled for 2007.

During the course of its regulatory activities, ASN must remain vigilant and determined in dealing with any incidents that could have serious consequences for workers or for the public. Following the gammagraph 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 update the licences issued to the manufacturers and suppliers of radioactive sources and the actions undertaken concerning the research sector;
- application of the licensing system to electrical generators of ionising radiation used in industry and research;
- visits carried out in particular to the users and those in possession of gammagraphs and gammadensity meters; and
- rationalisation of licences within the establishments whenever possible, with continuation of this particular objective, which will be made easier by the planned changes to the Public Health Code.

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.

A draft decree was prepared. It was made available on ASN's website in September 2005, thus enabling the various stakeholders concerned, but also the general public to submit comments. It updates the provisions of the Public Health Code, 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 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 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 make ASN's regulatory work more efficient and effective.

Finally, during the course of its regulation, ASN will remain vigilant with regard to the use of ionising radiation sources in the industrial and research fields.