RADIOACTIVE WASTE AND POLLUTED SITES

CHAPTER 16

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 no longer wishes to use them or wishes to alter their utilisation.

This chapter looks at how radioactive waste is managed for activities still in operation and how past or confirmed pollution (polluted sites) is managed in order to guarantee protection of the environment and the public.

Some installations intended for the disposal of radioactive waste intentionally concentrate the radioactivity in a single place, but their primary goal must nonetheless be to guarantee the protection of the public and the surrounding environment.

Radioactive waste is radioactive materials for which no subsequent use is planned or envisaged. It may stem from nuclear activities or may be produced by non-nuclear activities in which the radioactivity naturally contained in the materials, not used for their radioactive or fissile properties, may have been concentrated by the processes employed.

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 French National Radioactive Material and Waste Management Plan (PNGMDR). The purpose of the PNGMDR is to produce an inventory of the existing management methods for radioactive materials and waste, to identify the foreseeable needs for storage or disposal facilities, to clarify the necessary capacity of these installations, the length of the storage periods and, for the radioactive waste for which there is as yet no final management solution, the PNGMDR defines the objectives to be met. Decree 2008-357 of 16 April 2008, implementing the 28 June 2006 Act, clarifies the requirements concerning the PNGMDR. In 2010, a new decree will set the requirements relating to the new edition of the PNGMDR to be published at the beginning of 2010.

Clean-out of polluted sites consists in rehabilitating those sites on which a nuclear activity took place and which may potentially have led to contamination of the environment or on which radiological pollution has been observed due either to handling of radioactive materials (possibly some time in the past), or the utilisation of naturally occurring radioactive materials (NORM), albeit with no intention to exploit their radioactive properties.

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.

Certain industrial waste, considered to be hazardous, must be managed in specific routes.

The basic principle laid out in the regulations in force is to optimise the quantity and nature of the waste produced by the installations. 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, processing, 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.

Within the framework of the PNGMDR, the following are considered to be radioactive waste:

– waste from nuclear activities (activities regulated owing to the radioactivity they involve), which have been or are liable to have been contaminated by radioactivity or activated by the nuclear activity;
– waste from activities employing radioactivity, but which are exempted by the regulations, comprising significant concentrations of radioactivity, or which exist in very large quantities and require specific measures (the case of smoke detectors, for example);
– waste containing NORM, possibly enhanced by a human activity (TENORM) although not necessarily using the radioactive properties of the materials, and in which the radioactivity concentration is such that it cannot be ignored in radiation protection terms;
– uranium ore processing residues disposed of in classified installations.

The PNGMDR also defines the status of exploitable materials (uranium, thorium, plutonium) and requires that this status be periodically reviewed.

1 | 1 Radioactive waste management routes

Radioactive waste varies considerably by activity level, half-life, volume or even nature (scrap metal, rubble, oils, etc.) depending on the type. The processing and long-term management solution must be appropriate to the type of waste in order to overcome the risk involved, notably radiological risks.

The latter can be assessed on the basis of two main parameters: the activity level, which contributes to the toxicity of the waste, and the radioactive half-life, which depends on the radioactive decay periods of the 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 activity level is halved in less than a few days). The waste resulting from these diagnostic or care activities is collected and stored for a time allowing the radioactivity to decay sufficiently (generally by about ten half-lives) before it can be eliminated through the conventional hospital waste disposal circuits.

Very low level waste

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. The disposal solution adopted for this waste is burial in the very low level radioactive waste disposal facility (repository). This disposal route was created to deal with the management strategy adopted for this very low level waste and which is specific to France. This consists in rejection of the concept of unconditional clearance of the least radioactive waste.

Table 1: Existing or future disposal routes for the main radioactive solid wastes

<table>
<tr><th>Half-life / Activity</th><th>Very short-lived</th><th>Short-lived</th><th>Long-lived</th></tr>
<tr><td>Very low level</td><td rowspan="4">Management by radioactive decay</td><td colspan="2">Dedicated surface disposal
Recycling routes</td></tr>
<tr><td>Low level</td><td rowspan="2">Surface disposal (Aube repository)
except tritiated waste and certain sealed sources</td><td>Dedicated subsurface disposal under study</td></tr>
<tr><td>Intermediate level</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>

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. 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 organised 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.

Since 2007, it has been possible to dispose of certain sources in the low and intermediate level waste disposal facility (CSFMA). These are short-lived sources with a half-life of 30 years or less, with activity levels below certain thresholds determined on the basis of the radionuclides concerned. For the other sources, ANDRA, the French National Agency for Radioactive Waste Management, released a report at the end of 2008, in compliance with the PNGMDR, concerning the sustainable management of used sealed sources, which defines different management solutions according to the nature of the source (in particular its activity level and the radionuclides it contains). This study enables a solution (existing or planned repository) to be defined for each of the identified sources, provided that a certain number of criteria are met. In 2009, ASN approved the broad outlines of this strategy but issued a number of additional requests. Studies also still need to be carried out to define appropriate packaging processes for the sources (with prior processing as necessary) before disposal.

In addition, some waste contains significant quantities of tritium, a short-lived radionuclide but one that is hard to contain owing to its mobility, unlike the other radionuclides. In the light of the acceptance criteria for ANDRA's repositories, this waste cannot be accepted as-is owing to its tritium content. The management routes chosen consist in storing them for a long enough period to allow radioactive decay (the half-life of tritium being nearly 12 years) before disposal. In accordance with the decree of 16 April 2008, CEA, the French Atomic Energy Commission submitted a report inventorying the tritiated waste produced in France and proposing options for the design and sizing of the future installations required, for each family of waste (total of 6), to allow this storage for several decades. These options meet both the safety and capacity requirements. ASN examined the conclusions of this report and the new edition of the PNGMDR asked the CEA for some additional data, in particular with regard to the capacity of the storage facilities, the impact on installation safety of an operating life of nearly a hundred years and the means to be implemented to limit tritium discharges.

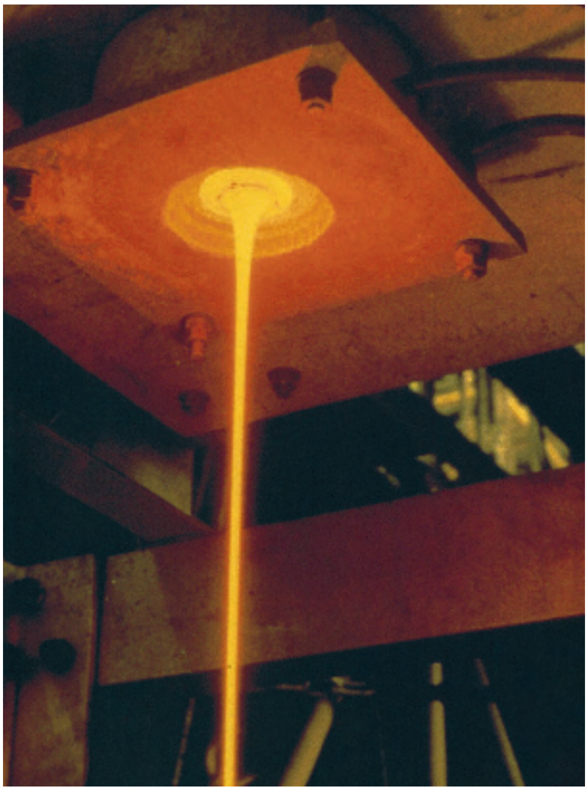
Long-lived low level waste

This waste usually comes from industrial activities leading to concentration of naturally occurring radioactive materials (the former radium industry for example), or from the nuclear industry (such as the irradiated graphite contained in the structures of the former 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 level 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 monitoring. However, its low level of intrinsic hazardousness could lead to subsurface disposal being envisaged at a depth of at least fifteen metres. The disposal concepts for this waste are currently under examination at ANDRA.

Intermediate level long-lived waste and high 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



Vitrification of a solution of fission and activation products at La Hague (Manche *département*)

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 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.

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 3|4).

1 | 2 The legal and regulatory requirements 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 up until disposal, 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 sets the legal requirements 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. It reaffirms 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).

As part of the overhaul of the regulatory system applicable to BNIs, a number of technical measures concerning the production of waste in the installations, its packaging and the storage and disposal of radioactive waste will be clarified by ASN regulatory decisions.

Production of radioactive waste in basic nuclear installations

Management of radioactive waste from BNIs 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 mitigate the detrimental effects and external hazards resulting from the operation of BNIs. This order reaffirms the need for the licensee to take all necessary steps in the design and operation of its installations to ensure optimum management of the waste produced, taking account of the subsequent management solutions. This order requires drafting of a study specifying how the waste produced in BNIs is to be managed. One part of this study is submitted to ASN for approval.

As part of the renovation of the BNI regulations following on from the Act on transparency and security in the nuclear field, known as the "TSN" Act of 13 June 2006, this order will soon be revised and the requirements concerning waste management in BNIs will be grouped within a new order. An ASN decision will supplement the requirements concerning the management of waste produced in BNIs.

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 radiations 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 related to medicine, human biology, or biomedical research and entailing a risk of exposure to ionising radiations must be examined and approved by the public authorities. The ASN decision of 29 January 2008, approved by the ministers responsible for the Environment and Health, implementing the provisions of Article R. 1333-12 of the Public Health Code, sets the technical rules applicable to the disposal of effluents and waste contaminated by radionuclides, or liable to have been contaminated owing to a nuclear activity.

Waste management route regulation

Regulation of the waste management routes requires on the one hand traceability of radioactive waste processing and disposal operations, and on the other detection of the presence of radioactive waste upstream of any processing 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 processing 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 Very low level radioactive waste management principles

Some European countries have adopted a policy of authorising discharge of VLL waste on the basis of an activity threshold, an option that is allowed by Council Directive 96/29/Euratom of 13 May 1996 on radiation protection. French doctrine does not provide for unconditional clearance of VLL waste simply on the basis of universal thresholds. This leads to specific management of this waste and disposal of it in a dedicated repository.

Waste management in the BNIs is mainly regulated by the order of 31 December 1999, as amended. Pursuant to said order, each licensee of a BNI must therefore send ASN a “waste study” which 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, sent to conventional waste routes (non-specific or special industrial waste). A guide for drafting of the BNI waste studies is available on the ASN website. Waste from nuclear waste zones may only be reused in a nuclear installation.

1 | 4 European regulations harmonisation work within WENRA

The Western European Nuclear Regulators' Association (WENRA) was created in 1999.

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 (see chapter 7).

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. As of 2010, it wishes to extend its work to include definition of the reference levels applicable to the disposal of radioactive waste.

Draft versions of 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 members at the beginning of 2006, in order to collect the opinions of the stakeholders before they are enshrined in national regulations. 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 nuclear regulator 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. The new regulatory texts currently being prepared (order and ASN decisions) already include the WENRA reference levels whenever possible.

2008 and 2009 were devoted to reviewing the incorporation of these reference levels into the regulations of WENRA members, with a view to ensuring the applicability of the recommended requirements and a common reading of these reference levels by WENRA members. With regard to the safety requirements of radioactive waste and spent fuel storage facilities, this exercise was supplemented by a check on the applicability of these requirements to the storage facilities of each WENRA member. This work should enable the storage facility safety requirements to be finalised in 2010.

1 | 5 Stakeholders and responsibilities

Waste producers must also constantly endeavour to minimise the volume and activity level of their waste, at the front-end through design and operating provisions and at the back-end through appropriate waste management. Each producer is responsible for the waste until disposal in a duly authorised installation. However, various stakeholders are also involved in the waste processing, transport, storage or disposal process. Each party along the waste management chain is responsible for the safety of its installations and activities. This concerns:

– companies responsible for transporting waste between production and processing or storage sites (AREVA NC Logistics, BNFL SA, etc.);
– waste processing contractors (SOCODEI, AREVA NC) who sort and package the waste (for example by compacting and then vitrification) in order to make disposal or storage conditions safer. They can also use a variety of methods for recycling certain radioactive materials or eliminating certain waste (in particular by incineration);
– managers of the storage or disposal centres (CEA, EDF, AREVA NC, ANDRA). The Act gave ANDRA a duty of long-term management of the disposal centres. 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);
– research and development organisations such as CEA or ANDRA, which also take part in technical optimisation of radioactive waste management, with regard to both waste production and the development of packaged waste processing, packaging and characterisation. 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 BNIs 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 issues opinions on the waste policy and management practices of the radioactive waste producers.

ASN has three main concerns:

– safety at each stage in radioactive waste management (production, processing, 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.

In the performance of its duties, ASN calls in particular on the services of IRSN.

Other parties are involved in evaluating the implementation of the radioactive waste management policy, particularly the National Review Board (CNE) which was created by the Act of 30 December 1991. This group of scientific personalities was initially tasked with reviewing the findings of research into the management of high level, long-lived radioactive waste. The Act of 28 June 2006 carried over to the second National Review Board (CNE2) all the duties of the first Board. It also extended its duties to include review of the sustainable management of radioactive materials and waste, as related to the guidelines set in the National Radioactive Material and Waste Management Plan (PNGMDR). In addition, the COSRAC (Committee for the Monitoring of Research on the Cycle Back-End) comprising the various research and industrial parties involved (CEA, ANDRA, CNRS, AREVA, EDF) and the ministries concerned, is coordinating the research being done on radioactive waste.

1 | 6 ANDRA national inventory of radioactive waste and exploitable materials

Article L542-12 of the Environment Code, as amended by the Act of 28 June 2006, tasks ANDRA with "establishing, updating every three years and publishing the Inventory of radioactive materials and waste present in France, along with their location on the national territory".

The 2009 national inventory was published in June 2009 and presents the stocks of waste and materials as at the end of 2007, plus the forecasts for the end of 2020, the end of 2030 and at the end of the lifetime of the existing or authorised facilities. This inventory also lists the storage capacity for HLW, LILW-LL, radium and tritiated waste, as well as the storage capacity needs for HLW and LILW-LL waste in deep disposal. Finally, the inventory presents the stocks of radioactive materials, information about sites polluted by radioactivity and mining residue disposal sites. ASN takes part in the steering committee of the national inventory of radioactive waste and exploitable materials.

The volumes of radioactive waste at the end of 2007, the end of 2020 and the end of 2030 and the identified "committed[1]"

Table 2: volumes of radioactive waste stored or disposed of as at end of 2007, in equivalent packaged m³

Waste categories	Volumes (m³)
Very low level	231,688 (including 89,331 disposed of)
Low and intermediate level - short-lived	792,695 (including 735,278 disposed of)
Low level - long-lived	82,536
Intermediate level - long-lived	41,757
High level	2,293 (including 74 of spent fuel)
Management route to be defined	1,564
Total	1,152,533 (including 824,609 m³ disposed of)

Table 3: anticipated quantities of radioactive waste stocks as at end of 2020 and 2030, all sectors

(in equivalent packaged m³)	Existing volumes as at end of 2007	Existing volumes as at end of 2020	Existing volumes as at end of 2030	"Committed" waste
HLW	2,293	3,679	5,060	7,910
ILW-LL	41,757	46,979	51,009	65,300
LLW-LL	82,536	114,592	151,876	164,700
LILW-SL	792,695	1,009,675	1,174,193	1,530,200
VLLW	231,688	629,217	869,311	1,560,200
TOTAL	1,150,969	1,804,142	2,251,449	3,328,310

Tables 2 and 3 are taken from the National Inventory of radioactive materials and waste published by ANDRA, 2009 edition.

1. "Committed waste" is the waste that will be produced by all the current installations up to the end of their lives, assuming the continued production of nuclear generated electricity.

waste are presented in tables 2 and 3 for each management route. The quantities of radioactive waste are given in equivalent packaged m^3 (waste volume once packaged).

The largest volumes concern very low level or low and intermediate level short-lived waste, but which only represent a few teraBecquerels, a minute fraction of the total activity. Conversely, although the high level long-lived waste only accounts for 0.2% of the total volume, it nonetheless represents 95% of the radioactivity.

The radiological inventory of waste covered by the ANDRA disposal routes amounted to 95 million TBq at the end of 2007.

1 | 7 The National Radioactive Material and Waste Management Plan (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 stakeholders. 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 French Parliamentary Office for the Evaluation of Scientific and Technological Choices (OPECST) in 2000, ASN has since 2003 been overseeing the preparation of a national radioactive waste and exploitable 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 her intention to draw up such a plan.

The waste producers (all sectors), the waste disposal organisations, especially ANDRA, the departments of the ministries concerned, environmental protection associations and representatives of elected officials are invited to take part in these working group meetings. An initial draft of the national radioactive waste and exploitable materials management plan was published on ASN's website for consultation purposes on 13 July 2005, and was 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 bill required by the Bataille Act in 1991, and formulated a 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 OPECST for its opinion. The Office published its evaluation report on the National Plan in April 2007, and made a number of recommendations, some of which were implemented in 2008. In particular, a summary of the PNGMDR was produced and sent out to the Local Information Committees, to the High Committee for Transparency and Information on Nuclear Security, to the administrations concerned, to the licensees and to all members of the working group responsible for monitoring implementation of the PNGMDR.

Decree 2008-357 of 16 April 2008 was also published and set out requirements concerning the Plan. The decree specifies the precise management arrangements for the various waste categories: from very low level and very short-lived waste (less than 100 days) to intermediate or high level, long-lived waste (more than 31 years). The management solutions developed for the various waste categories, in particular listing the waste processing, storage or disposal installations, are described in it. ASN submitted its opinion to the Minister for Ecology on 25 August 2009 concerning all the studies initiated pursuant to the decree of 16 April 2008. The results of these studies constituted input data for the revision of the PNGMDR covering the 2010-2012period. ASN also inventoried the management solutions used for enhanced waste and in July 2009 sent the Ministers for Health and the Environment proposals for improvements to the radiation protection aspects of management of this waste category.

In 2009, the pluralistic working group tasked with drafting the PNGMDR, chaired by ASN and the General Directorate for Energy and Climate (DGEC), met 5 times and examined the following subjects in particular: the planned repository for low level long-lived waste, used sealed sources, mining residue repositories, waste storage facilities for small scale nuclear activities and management of exploitable materials. The presentations made within the working group were a source of information for drafting of the 2010-2012 PNGMDR, an initial version of which was presented to the members of the working group in September 2009 and finalised during the November 2009 meeting. This new edition of the PNGMDR is in particular based on the national inventory of radioactive waste and exploitable materials, published in mid-2009 by ANDRA. A notable addition to this edition was the issue of exploitable materials and the overall consistency of the nuclear fuel cycle. The next edition of the PNGMDR will be published at the end of 2012.

2 MANAGEMENT OF RADIOACTIVE WASTE BY THE PRODUCERS

2|1 Waste management in basic nuclear installations

Once produced and before final disposal, certain categories of radioactive waste undergo treatments to reduce the volume or harmfulness of the waste 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 asks that in the design of new installations, the licensees meet a reduction target for the quantity of waste produced.

The following sections examine the situation of BNIs.

2|1|1 CEA waste management

CEA's waste management strategy

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 14). 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 level, 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).

The two main issues for CEA with regard to radioactive waste management are:
– bringing new processing installations on-line within a time frame compatible with its commitments to shutdown of old installations, in which safety no longer complies with modern requirements;
– running projects for removal of certain legacy waste from storage.

As in previous years, ASN observes that CEA is experiencing persistent difficulties with managing these two issues.

ASN observed that in 2009, some projects had progressed regularly, in line with the commitments made, some of which are among CEA's major undertakings with regard to safety and radiation protection (see chapter 14). CEA is however continuing to experience difficulties with the recovery of waste from the trench in BNI 56 in Cadarache. ASN also noted delays in commissioning of STELLA, primarily linked to the definition of the waste package to be

Metal drums containing low level waste stored at CEA in Saclay (Essonne *département*) produced in this installation. CEA also informed ASN that there would probably be a delay in removal from storage of the drums containing plutonium in the PEGASE facility, owing to problems with manufacturing of the repackaging containers for this waste. ASN is also concerned by the change in strategy announced by CEA with regard to the future of the Cadarache effluent and waste treatment station press (BNI 37).

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 changes, both in terms of organisation (decommissioning of the UP1 plant in Marcoule and relinquishment of certain projects), ASN wishes to review all CEA activities linked to its BNI and secret BNI waste, to spent fuels and to used sealed sources. Jointly with the Delegate for Nuclear Safety and Radiation Protection for National Defence Installations and Activities (DSND), ASN thus asked CEA to send it a file by the beginning of 2010, explaining its management strategy for these wastes, fuels and sealed sources. 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 concerned, by the year 2011.

Storage of CEA waste

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 has initiated a waste recovery program as part of the delicensing of the Grenoble and Fontenay-aux-Roses sites. In BNI 72, fuel is stored in concreted fuel blocks. Recovery of this fuel is currently being reviewed, for subsequent reconditioning in the STAR 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 Aube waste repository. The waste is stored there in pits, in warehouses and, for the VLL waste, in a dedicated area. The start of operations at CEDRA (radioactive waste packaging and interim storage unit) 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 (FOSSEA project).

BNIs 37 and 56 will eventually be replaced by the CEDRA installation, for which creation on the Cadarache site was authorised by decree 2004-1043 of 2004 October 2004. On 20 April 2006, the Ministers for Industry and the Environment authorised start-up of CEDRA unit 1. CEA is aiming for commissioning of units 2 and 3 by 2012 and 2014 respectively.

At Cadarache, CEA also operates the PEGASE and CASCAD installations, 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 occur in 2010.

Removal from storage began in January 2006 with OSIRIS type fuel being sent to the CARES store (INBS). Removal of the OSIRIS silicide elements from storage for transfer to La Hague then began. All the OSIRIS fuels have now been evacuated. The remaining fuels are currently the subject of requests to ASN for repackaging and then evacuation, particularly to CASCAD.

2006 also saw the creation of a project for recovery of the drums of plutonium-bearing materials for storage in CEDRA. On 28 January 2008, CEA notified ASN of installation of the recovery equipment. This project, which began in 2009 and which is proceeding as scheduled, should have enabled CEA to finalise removal of the plutonium-containing drums from the PEGASE installation no later than the end of 2010 (considered by ASN to be a priority action), although CEA has announced that it cannot guarantee that this date will be met.

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. In 2008, CEA launched a periodic safety review of the CASCAD installation. This file was reviewed by IRSN. Further to this technical review, ASN adopted a stance in 2009 on the continued operation of the installation.

In November 2007, CEA sent a safety options report to ASN concerning a new irradiating waste storage project for Marcoule, called DIADEM (a French acronym for decommissioning irradiating or alpha waste). ASN issued its position on this report on 1 July 2008, stating that it had no objection to continuation of the process leading to creation of the installation, subject to the provision of a certain amount of additional information.

Recovery of CEA legacy waste

The Cadarache interim storage facility partly consists of 5 trenches which, between 1969 and 1974, were filled

Operators working on the recovery of waste from the trenches of BNI 56 in Cadarache (Bouches-du-Rhône *département*)

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.

Recovery of the waste from the trenches, which started in 2005 as part of the installation clean-out process, was 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. ASN issued a favourable opinion on the new scenario for recovery from pit F3 in July 2008, although with a number of reservations. In April 2009, ASN also approved the recovery operations from pits F5 and F6 provided that the above-mentioned reservations were taken into account.

2 | 1 | 2 AREVA NC waste management

Description of waste produced by AREVA

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 from 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.

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 burnt 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 shipped to AREVA's foreign 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 stored on the site or shipped to AREVA's foreign customers.

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 are treated there by chemical co-precipitation. The sludges produced in STE3 are evaporated and encapsulated in bitumen, with the final

Fuel assembly hulls, ACC facility – AREVA NC at La Hague (Manche *département*)

encapsulated product then being poured into stainless steel drums in this facility. The drums are then stored on the site. Following the meeting of the Advisory Committee to deal with the BNI 118 safety review, ASN issued a ban on bituminisation of the STE2 sludges and asked AREVA to continue to look for an alternative process for sludge recovery. These sludges, representing 3,400 tons of salts, were produced between 1966 and the late 1990s in the UP2 400 plant and the CEA research centres. After technical studies, AREVA selected the C5 standard package as an alternative to the bituminisation process. This package should be able to meet the requirements of the Act and enable recovery of the IL-LL legacy waste by 2030. It should also enable the final volume of the waste to be reduced by comparison with the bituminisation protection. This package consists of compacted pellets, encapsulated in a cement binder. The tests carried out by AREVA in the summer of 2008 were unable to validate this solution on an industrial scale. At the end of 2008, AREVA validated a process involving replacement of the cement by an inert material made of sand. Manufacture of this package will require ASN approval. ASN will first of all rule on whether or not any aspects disqualify the C5 package in terms of safe storage and disposal. This opinion will be required before detailed design studies can start on preparation of the facilities for the alternative process 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. During the course of a non-destructive test as part of the approval review process, ANDRA detected a nonconformity linked to the inadequate mechanical strength of the encapsulation. In 2007, production was suspended while a search for the causes was conducted. The appraisal carried out by AREVA showed a modification to the process was the reason for the anomalies detected. Changes were made to enable production to resume at the end of 2009. The nonconforming packages will be recovered. ASN reminded the licensee of the need to carry out impact assessments on the effect of the modifications on the quality of the waste packages.

– 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 in the ACC (hulls and end-pieces)

On 27 November 2001, ASN authorised the production of CSD-C packages. This authorisation carried a restriction banning the introduction of organic technological waste and dissolver bottom debris into the primary drum. At the end of 2007, AREVA forwarded a safety analysis file to obtain lifting of the restriction on the introduction of organic technological waste. Analysis of the data transmitted did not permit this restriction to be lifted. In 2008, AREVA sent ASN a further authorisation application with its justification file. This file is currently being reviewed and an ASN decision is expected at the beginning of 2010.

– Other technological waste

The technological waste is sorted, compacted and encapsulated or blocked in cement in the AD2 facility. The packages complying with ANDRA technical specifications for surface disposal are sent to the Aube repository. Those that do not are temporarily stored on the site. With regard to the waste 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 disposal 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 is examining 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 the 9th meeting of the working group, held in September 2008, ASN asked AREVA to consider an industrial strategy for controlling the hydrogen release rate if the assessments, albeit conservative, were to confirm that the release rate did not allow disposal without prior storage for several decades. At the beginning of 2009, AREVA forwarded a draft specification for the S5 package. ASN will decide in early 2010 on whether to continue with production of this package.

Cold crucible technology

In partnership with CEA, AREVA has completed the development of cold crucible direct induction furnace technology. This technique offers advantages over the existing hot crucible method for producing glass. First of all, the cooling of the melting furnace allows the formation of a fine layer of solid glass, which protects the crucible and prevents it from being corroded by the molten glass. Then, direct induction heating allows far higher production temperatures and therefore the design of new matrices.

AREVA therefore sent new specifications to ASN for the production launch authorisation. AREVA in particular sent ASN the results of its research into packaging of UMo (uranium-molybdenum alloy) solutions. Similarly, borosilicate type glass formulations which can be produced at very high temperature and be used to contain a higher waste mass content, are being studied.

Specification 300 AQ 59 rev. 0A applies to vitrified packages known as CSD-U. These are packages used to contain fission product solutions resulting from reprocessing on the La Hague site, between 1966 and 1985, of UMo and MoSnAl (molybdenum, tin and aluminium alloy) type GCR fuels. In order to minimise the number of packages that need to be produced, the composition of the CSD-U must maximise the level of incorporation of molybdenum (Mo) and phosphorus, which are two limiting factors for the glass formulation. The cold crucible technology enables this optimisation process to take place. Given that the radiological activity levels of these solutions are low when compared to the fission product solutions packaged in glasses produced in accordance with specifications 300 AQ 16 or 300 AQ 60, they should not constitute a limiting design factor for the CSD-U. The constraints linked to the packages are more chemical in nature. Specification 300 AQ 59 rev. 0A was sent to ASN for its opinion at the end of 2009.

Specification 300 AQ 60 Rev. 00 only concerns the CSD-V packages with a high actinides content, produced using the hot crucible technology. AREVA obtained temporary approval from ASN pending the results of the characterisation studies into the behaviour of the glass. In July 2008, AREVA sent ASN additional information in order to obtain authorisation to continue with this production beyond 31 December 2008, pending implementation of the cold crucible technology. ASN issued the authorisation in a decision of 16 December 2008. A new specification for production of CSD-V packages using the cold crucible process will be sent to ASN for approval.

Specification 300 AQ 061 Rev. 0A applies to the CSD-B packages produced by vitrification of intermediate level effluents originating primarily in the rinsing operations carried out for final shutdown of the UP2-400 plant. The solutions to be vitrified are characterised by their high sodium content. Therefore, in order to optimise the number of packages to be produced, the composition of the CSD-B must maximise the incorporation of sodium into the glass. For the same reason as for the CSD-U package, the main constraint is chemical in nature. AREVA sent ASN a production authorisation application for this package so that it could begin active production testing. ASN authorised production of this package at the end of 2009.

The COMURHEX waste installation in Malvési

The waste produced by the installation is stored in ponds on the Malvési site. This waste primarily contains natural radionuclides. Nonetheless, some traces of artificial radionuclides, resulting from the spent fuel reprocessing which took place in the installation until 1983, were detected. Owing to the presence of artificial radionuclides in the waste, the storage areas cannot be excluded from the BNI system (Article 2 of the BNI list decree of 11 May 2007). The ponds concerned are ponds B1 and B2.

The ASN Commission therefore issued decision 2009-DC-0170 on 22 December 09 which stated that the COMURHEX company had until 31 December 2010 to submit a BNI authorisation decree application. The scope of this new BNI is currently being defined. However, without waiting for submission of this application, ponds B1 and B2 are already subject to ASN regulation.

2 | 1 | 3 EDF waste management

Description of waste produced by EDF

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.

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.

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. The draft authorisation decree for the ICEDA storage installation was given a favourable opinion by the ASN Commission at the end of September 2009. The function of this installation will be to process and store activated waste from the BNIs currently being operated by EDF, from the decommissioning of the first generation reactors and from decommissioning of the Creys-Malville plant.

Operating and maintenance waste

This consists of ion exchanger resins (water treatment), filters, concentrates, evaporators, sludges, cleaning and upkeep waste (rags, vinyl sheets and bags, gloves, etc.). Some waste comes from replacement and maintenance operations and can be of large size (vessel heads, steam generators, fuel 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 incinerable materials), in order to reduce the volume of ultimate waste.

For the other types of operating and maintenance waste, various packaging methods exist, in particular:
- solid waste compacting in the Aube 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.

Legacy waste

This is structural waste (graphite sleeves) from fuel used in the former gas cooled reactors (GCRs). This is low level, long-lived waste which is eventually to be disposed of in the corresponding ANDRA repository currently being planned. This waste is primarily stored in semi-buried silos at Saint-Laurent-des-Eaux.

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 strategy

EDF fuel use policy (see chapter 12) has consequences for the fuel 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 "cycle consistency" file be updated. The revised file was sent by EDF to ASN at the end of 2008. It will be presented to the Advisory Committees during the course of 2010.

The 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, as well as 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 2019. 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 in a file transmitted to ASN in July 2007. In July 2008, ASN approved the principle of the geotechnical containment proposed by EDF, provided that EDF submitted additional data, which it did in 2009. The geotechnical containment installation work should begin in 2010.

2 | 1 | 4 Management of waste by other licensees

The waste management strategy of other BNI licensees is reviewed by ASN on the basis of their waste surveys (see point 1|2).

2 | 2 Radioactive waste management in medical, industrial and research activities

2 | 2 | 1 Origin of radioactive waste and 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. 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 the production of solid waste: small laboratory equipment items used to prepare sources (tubes, multiwell plates, 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 preparations (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.

2 | 2 | 2 Management and disposal of radioactive waste and effluents

Faced with this problem of health care waste contaminated by radionuclides, which appeared with the growth of nuclear medicine, the public authorities began regulating activities and information of both patients and practitioners concerning good practices to be observed in managing this waste. A circular from the Minister for Health (DGS/DHOS 2001/323 of 9 July 2001) clarified the provisions of the 30 November 1981 order on the conditions for the use of artificial radionuclides used in unsealed sources for medical purposes.

On 2 August 2008 the order of 23 July 2008 was published, concerning approval by the ministers for Health and the Environment of ASN decision 2008-DC-0095 of 29 January 2008 setting out the technical rules to be followed for the disposal of effluents and waste contaminated or likely to have been contaminated by radionuclides as the result of a nuclear activity. This decision was taken pursuant to Article R-1333-12 of the Public Health Code. It includes the broad outlines of circular DGS/DHOS 2001/323 of 9 July 2001 and contains measures with regard to:
– the drafting and approval of effluent and waste management plans;
– the creation of contaminated waste zones;
– waste storage conditions;
– the conditions for decay management of waste and effluents contaminated by radionuclides with a half-life of less than 100 days and their discharges;
– the conditions for management and disposal of waste and effluents contaminated by radionuclides with a half-life of more than 100 days;
– installation discharge outlet monitoring conditions;
– conditions requiring use of a radioactivity detection portal at site exits.

ASN is now finalising a guide for implementation of this decision, which will specify good practices for the management of waste and effluents resulting from nuclear activities outside BNIs.

2 | 3 Management of waste containing natural radioactivity

In the environment, there is measurable natural radioactivity 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.

2 | 3 | 1 Uranium mining waste

Uranium mines were worked in France between 1948 and 2001, producing 76,000 tons of uranium. Exploration, mining and processing work was carried out on about 210 sites in France spread over 25 *départements*[2]. Ore processing however was only carried out in 8 plants. The management strategy currently being used is in-situ management given the very large quantities of waste produced, and provided that steps are taken to mitigate the long-term risk.

The uranium mine workings produced two categories of products:
– static or dynamic processing residues, which are the products remaining after extraction of the uranium from the ore. Such residues correspond to process waste (as defined by the Environment Code);
– mining waste rock, comprising the soil and rock excavated to access the minerals of interest. The waste rock with an average uranium content corresponding to the characteristic natural background level is differentiated from the barren rock consisting of the mineralised rock excavated when working a field, but which has insufficiently high content to allow processing at an economically acceptable cost.

The processing residues can be divided into two categories, with different specific activity levels:
– 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, produced by static leaching (about 20 Mt), are placed either in stockpiles, or in open-cast mines, or used as the first covering layer in dynamic processing residue disposal sites;

2. Administrative region headed by a *Préfet*

– 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, produced by dynamic leaching (about 30 Mt) are either placed in former open-cast mines, sometimes with an additional dyke, or in pools with a surrounding dyke, or behind a dyke damming a thalweg.

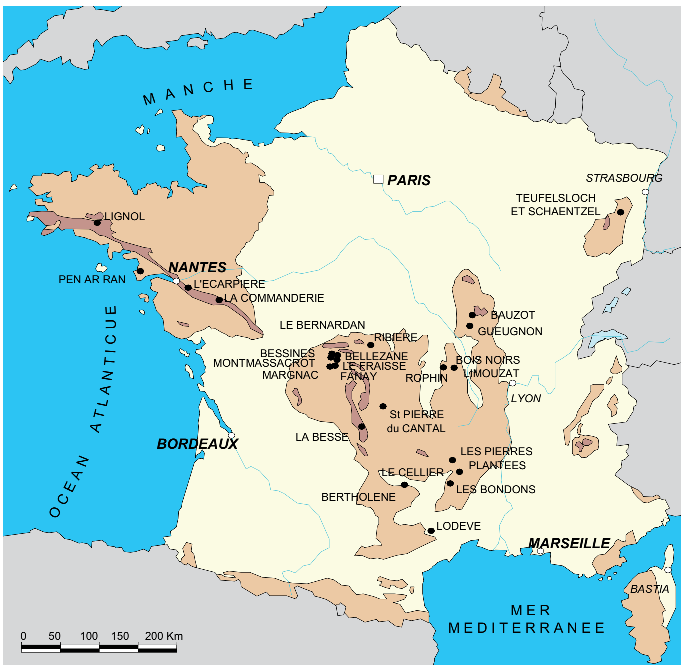
In France, the processing residues account for 50 million tons spread over 17 disposal sites, regulated as installations classified on environmental protection grounds.

The national inventory of uranium mining sites is a part of the MIMAUSA (History and impact of uranium mines: summary and archives) programme, under the supervision of the Ministry for Ecology, Energy, Sustainable Development and the Sea. ASN is part of the steering committee for this programme.

The inventory is available on the website www.irsn.fr and an e-mail contact address (mimausa@irsn.fr) was created at the end of 2007. An updated version of the MIMAUSA inventory (version 2, September 2007) was published on 4 December 2007.

The next step is to set up a MIMAUSA IT application for the Government's departments and for the public.

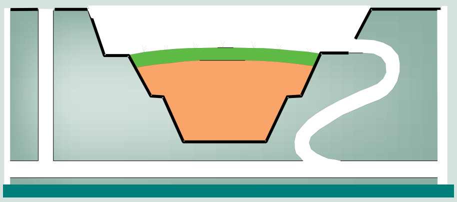
Article 4 of Act 2006-739 of 28 June 2006 required that by the end of 2008, an inventory be produced of the long-term impact of uranium mining residue disposal sites, with the implementation if necessary of an enhanced radiological monitoring plan for these sites. ASN in 2008 validated the modelling methodology chosen by AREVA for assessing the long-term impact of the residue disposal facilities, with a normal evolution scenario and four altered evolution scenarios dealing with loss of the covering, construction of homes above the disposal site, construction of a road, presence of a child playing on the backfill. This modelling concerns 9 former mining sites in the final report submitted by AREVA at the beginning of 2009. In 2009, ASN examined the files forwarded by AREVA and sent the Minister its opinion on 25 August 2009 (see ASN opinion 2009-AV-0075). ASN considers that the study submitted by AREVA concerning the long-term health and environmental impact of the disposal sites for the mining residues resulting from the former uranium ore extraction and processing installations is a crucial milestone in checking the safety of the uranium ore residue disposal sites, even if additional analyses are required to ensure a more robust long-term safety case for these disposal sites. The work done represents the first real application by a licensee of the approach officially set out in the circular from the Minister for the Environment on 7 May 1999 concerning the rehabilitation of uranium ore processing residue disposal sites. The study of the nine sites selected gives an initial detailed assessment of the long-term impact of mining residues around the country and informs the public of these results. According to the results of this study, the dosimetric impact liable to be received by the population in a normal evolution scenario remains lower than 1 mSv/year in the active surveillance phase and the conceivable impact for scenarios involving significant deterioration of the disposal sites remains below



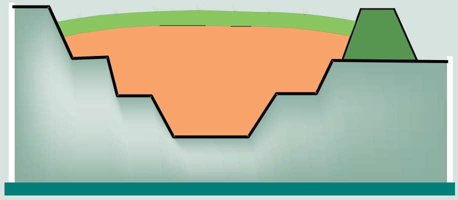
Map of former mining sites

Mining residue disposal sites

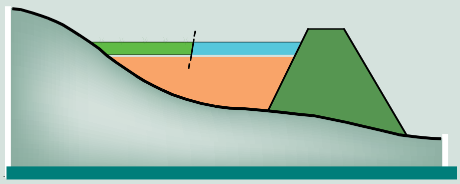
The mining residue disposal sites were installed near the uranium ore processing installations in former open-cast mines or in pools with a surrounding dyke or behind a dyke damming a thalweg. These disposal centres, covering from one to several tens of hectares, contain several thousand to several million tons of residues.



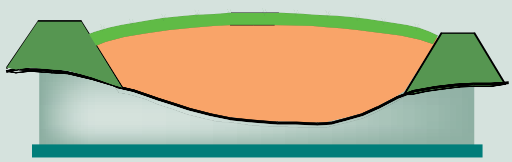
Former open-cast mines (± Mining works)
Complete or partial filling
(Ex.: Bellezane - Cellier)



Former open-cast mines + DYKE
Complete filling
(Ex.: Brugeaud - Montmasscrot - Lodève)



THALWEG DAMMED BY A DYKE
Complete filling
(Ex.: Forez - Bertholène)



PIT + BUND WALL OR SURROUNDING DYKE
Complete filling
(Ex.: Ecarpière - Jouac - Lavaugrasse)

Different types of mining residue disposal centres

With the gradual closure of the mine works, these sites were rehabilitated by placing a solid covering over the residues to provide a geomechanical and radiological protective barrier designed to minimise the risks of intrusion, erosion, dispersion of the products contained and the risks linked to external and internal exposure (radon) of the surrounding populations. The results of the measurements taken in the disposal centres are approximately the same as those of the measurements taken in the site environment.

The former mining site at Bellezane (Haute-Vienne *département*) before its redevelopment)

The former mining site at Bellezane after its redevelopment

The GEP Limousin Pluralistic Expert group

On 24 December 2004, the Regional Directorate for Industry, Research and the Environment (DRIRE) received AREVA NC's operating results, which although they met all the requirements nonetheless needed some additional work. The DRIRE therefore asked AREVA NC to have a third-party assessment carried out. In order to intensify the dialogue and debate concerning the Limousin region uranium mining sites, the ministries for Ecology, for Industry and for Health decided to set up a pluralistic expert group (GEP) for regular supervision and oversight of the third-party assessment. ASN contributes to funding the working of the GEP. Three working sub-groups have been set up to cover source term and discharges, environmental and health impacts, and long-term legal and regulatory requirements. 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. This work has since then continued on the other sites and catchment basins. A second interim report was issued at the end of 2007 and the third in January 2009. These reports are available on IRSN's website. The GEP's final report was issued at the end of 2009.

a few tens of mSv/year. This method is felt to be consistent with the principles contained in the strategy, in particular with regard to the definition of the baseline scenarios, the altered evolution scenarios, the reference groups or the performance of sensitivity studies. It is important to point out that it is also consistent with the approach adopted for ANDRA's surface repositories, particularly with regard to the altered evolution scenarios involving the construction of roads or homes over the disposal site. The new edition of the PNGMDR scheduled for early 2010 will specify the additional analyses that AREVA will have to carry out.

A generic modelling study of the potential impact in order to assess exposure linked to the use of mining waste rock in the public domain was also transmitted by AREVA at the end of 2008 and reviewed by ASN. The study submitted by AREVA includes four scenarios involving the reuse of mining waste or barren rocks in the public domain, that is pathways, a farm courtyard, a school yard, a company platform. These scenarios correspond to the most frequently observed cases of reuse of waste rock and in principle do not exceed 1 mSv/year. It should be remembered that for "nuclear activities", the value set by the Public Health Code is 1 mSv/year.

Following these studies and in accordance with the undertakings made by AREVA in the letter sent to the Minister for Ecology on 12 June 2009, AREVA has begun to look at replacement of the water covering of the Bois Noirs Limouzat site by a solid covering and presented its action plan for surveillance of the former uranium mines.

Following these studies, ASN proposed a number of recommendations with respect to continuation of:

– the mining residue characterisation studies;

– the geomechanical assessment of the strength of the embankments surrounding the mining residue disposal sites, specifying the requirements for checking the long-term safety of these sites;

– the analysis of the results of the dosimetric impact assessment performed in 2008, in particular to study the feasibility and relevance of increasing the quality of the covering on all mining residue disposal sites;

– the assessment of the long-term dosimetric and environmental impact of the mining waste rock.

The results of the review by the pluralistic expert group of the Limousin mining sites (GEP Limousin) are also expected for the end of 2009. The final report on the work of the group should in particular propose recommendations for long-term management.

Sign indicating a former uranium mine in Auvergne

Site of the former Bois Noirs treatment plant (Loire *département*)

In a circular dated 22 July 2009, the Ministry responsible for sustainable development and ASN jointly defined an action plan comprising the following three areas of work:
– controlling the former mining sites;
– improving understanding of the environmental and health impact of the former uranium mines and their surveillance;
– waste rock management: achieving a better understanding of its uses and reducing its impacts if necessary;
– improving information and dialogue.

At the end of 2009, AREVA began steps to consolidate the inventory of places where waste rock is reused, in order to detect any incompatibilities that might need to be remedied.

2 | 3 | 2 Waste resulting from other activities

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. This is known as enhanced natural radioactivity. Most of these activities are (or were) regulated by Part 1 of book V of the Environment Code.

Waste containing enhanced natural radioactivity can be accepted in various types of facilities, depending on its specific activity:
– in a waste disposal centre authorised by order of the préfet, if it can be proven that the waste activity level is negligible from a radiation protection viewpoint. The circular from the Directorate for the Prevention of Pollution and Risks (DPPR) dated 25 July 2006 clarifies the conditions for acceptance of this waste. This circular comes with a methodological guide drafted by IRSN under the supervision of a steering committee made up of representatives of industry, disposal centre licensees, environmental protection associations, experts and Government departments. This circular states that enhanced natural waste must not constitute a majority of the waste received by the disposal centre;
– in ANDRA's very low level waste disposal facility,
– in a 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. ANDRA is currently looking for a site for this disposal facility, which should enter service by 2020.

In June 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 sites polluted as a result 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 radiations and was transmitted to the local, regional and national administrations. In 2008, ASN continued to work with the Robin de Bois association, asking it to carry out a new study on the stores of legacy waste containing enhanced natural radioactivity and more particularly the stores of phosphogypsum and coal ash.

In compliance with the PNGMDR, ASN in July 2009 sent the ministers for the Environment and Health a report on the enhanced waste management solutions and its recommendations for improving management routes. The conclusions of this report do not call into question the existing management solutions. ASN however made 13 recommendations designed to improve management of this type of waste. Most of these recommendations are focused on ICPEs. On these matters, ASN is working together with relevant departments of the ICPE inspectorate.

2 | 4 Management of incidental contamination

The obligation of systematic installation of radioactivity detection systems in the "conventional" waste disposal or recycling centres authorised by order of the *préfet* has on several occasions in recent years revealed traces of radioactivity in the waste to be processed, leading to management of incidental radioactive contamination. Initial operating experience 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. ASN has also extended to the small-scale nuclear activities the principles of notification of the public authorities concerning significant events involving safety, radiation protection or the environment, which already apply to BNIs and radioactive material transport. ASN thus defined a number of criteria which should lead to the notification of significant events in the field of radiation protection, along with the corresponding notification form.

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

3 LONG-TERM MANAGEMENT OF RADIOACTIVE WASTE

3 | 1 Long-term management of very low level waste

The VLL waste management streamlining process initiated by ASN in 1994 showed that it was necessary to create a repository for this type of waste. At the request of the nuclear licensees, technical studies were 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 chosen. This ICPE, licensed by order of the *préfet* dated 26 June 2003, offers a disposal capacity of 650,000 m³ and has been in service since August 2003.

After two years of operation, ANDRA applied to the Aube *préfet* for modification of the operating conditions. This concerned modifications to the architecture of the disposal cells (increasing the surface of the two face-to-face cells with a unit area of 10,000 m² each, to a single cell of 24,000 m²), the slope of the covering and the leachates pumping rule. This application, which was approved by a supplementary order of the *préfet* on 21 July 2006, enables ANDRA to take account of experience feedback from the actual conditions of operation of the disposal centre.

At the end of 2008, the total volume contained was about 115,700 m³, in other words 17,8% of the capacity authorised by regulations.

3 | 2 Long-term management of low level and intermediate level short-lived waste

Most intermediate and low level waste with a short half-life (less than 30 years) is sent for final disposal to 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, set 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.

3 | 2 | 1 The Manche repository

The Manche radioactive waste repository (CSM) currently occupies an area of about 15 hectares at the end of the La Hague peninsular. It was commissioned in 1969 and was the first radioactive waste repository to be operated in France. The CSM was initially managed by CEA but was transferred to ANDRA responsibility on 24 March 1995. CSM operations ceased in July 1994. The repository entered the surveillance phase in January 2003 (decree 2003-30 of 10 January 2003).

Isolated problems with the repository covering were identified a few years ago and required limited consolidation work. In January 2009, ANDRA transmitted a file on the benefits of fitting a new covering to ensure the

Operations to close cells and move the mobile roof on the Morvilliers site (Aube *département*)

View of the Manche repository

Disposal structures in the Aube repository

long-term passive safety of the repository. ANDRA has also submitted the final safety report as well as the monitoring plan for the facility.

In accordance with the recommendations of the "Turpin" commission, ANDRA in March 2008 produced an interim version of the "Concise history", the purpose of which is to preserve essential information about the CSM for future generations.

These documents were presented to the Advisory Committee for waste in December 2009. At the beginning of 2010, ASN will adopt a stance on the additional measures to be taken by ANDRA for gradual fitting of the new covering, but also for enhancing the environmental monitoring of this centre and consolidating the work being done on conserving records about the repository.

3 | 2 | 2 The low and intermediate level short-lived waste (LIL-SL) repository

In 1992, the low and intermediate level waste repository (CSFMA) took over from the Manche repository, taking full advantage of operating experience 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 m³ of waste located in 400 structures. 112 structures have been built so far. The service includes packaging of the waste sent by the producers, either by injecting mortar into the 5 or 10 m³ metal containers, or by compacting the 200-litre drums.

Waste containment is built around a system of three consecutive barriers: the package, the covering structure and the geological formation. The repository's activities therefore generate a very small quantity of radioactive effluents. These discharges are regulated by the order of 21 August 2006, leading to a modification of the authorisation decree dated 10 August 2003.

In June 2006, the Advisory Committee 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. In August 2008, ANDRA sent ASN the answers to the recommendations made by the Advisory Committee and to the subsequent requests from ASN. The general operating rules were revised in 2009 to take account of the modifications made following the revision of the safety analysis report. They are currently being analysed by ASN.

After ASN's approval of the design modifications, ANDRA in 2009 began the construction of a new tranche (tranche 8) consisting of seven lines of structures. The extension of the disposal area required adaptation of the radiological, physico-chemical and piezometric monitoring of the groundwater in the Aptian sands.

3 | 2 | 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 defines 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.

As part of this, ANDRA draws up general and specific specifications for each 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 assessment, followed by periodic assessment by the producer, ANDRA and ASN, which may lead to approval suspension or revocation.

In 2008, ANDRA redefined the waste package specifications to take account of operating experience feedback acquired since the surface repository was opened.

ASN is particularly attentive to the strategy implemented by ANDRA for checking the quality of the packages accepted in its repositories: at the request of ASN, ANDRA in 2008 drew up a document presenting its strategy on this subject. ASN considers that this document is on the whole satisfactory, but asked ANDRA to supplement it with a file to define its strategy, presenting the more operational aspects of its approach and giving a clearer justification of the link between the safety analysis report, waste acceptance specifications and the checks carried out. The document supplemented in this way should be available in 2010. ANDRA sent ASN a complete summary of the approvals and acceptances issued in 2008 concerning the waste packages intended for the CSFMA. In addition to traditional quality control, ASN also reaffirmed the need for ANDRA to continue to conduct "super-inspections" (package destruction to verify its content), which means that it needs appropriate installations for this type of inspection.

3 | 3 Long-term management of long-lived low level waste

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.

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, also produce waste containing graphite and significant quantities of long-lived radionuclides. This waste consists mainly of graphite stacks and sleeves, activated by neutron irradiation.

In June 2008, ANDRA issued an information file about its search for a site to host a low level long-lived radioactive waste repository, to those communes[4] which in principle offer potentially favourable geology. This type of sub-surface disposal centre (several tens of metres deep) could be located in a hillside, or excavated. A number of repository design options could be contemplated and their technical feasibility is currently being examined. Studies and research are also under way to gain a clearer understanding of the nature of this waste (inventory and behaviour of very long half-life radionuclides, understanding of radionuclide release mechanisms, etc.) and to determine its compatibility with the characteristics of the repository. The candidate *communes* had until the end of October 2008 to make themselves known. Before continuing with the site selection process, the Government consulted ASN and the National Review Board about the analysis methodology adopted by ANDRA. ASN had analysed this methodology in the light of the general safety guidance memorandum for the LL-LL waste disposal site search which it published in June 2008, and it sent the Minister its opinion on 15 January 2009. ASN stated that there was nothing, from a geological standpoint, to rule out continued investigation into the siting of a LL-LL waste repository on one of the sites classified by ANDRA as geologically "very interesting" and that the capacity of the sites to host a disposal facility should be confirmed on the basis of the results of detailed investigations.

In June 2009, ANDRA announced the Government's decision to conduct detailed investigations on two *communes* in the Aube *département* Auxon and Pars-lès-Chavanges, and thus check the feasibility of siting a shallow depth disposal centre for LL-LL waste. The municipal councils of the two above-mentioned communes decided to withdraw from the project in the summer of 2009. ANDRA will therefore have to find new potential sites. A public debate will be held before the final site is chosen, following the detailed investigations phase. The pre-selected *communes* will be asked to debate the matter again, before the site is chosen, in order to confirm whether or not they are candidates.

4. Smallest administrative subdivision administered by a mayor and a municipal council.


Operators constructing a graphite assembly in a reactor

The waste to be accepted in this repository will mainly be graphite and radium-containing waste but, as requested by decree 2008-357 of 16 April 2008, ANDRA is also examining the possibility of taking other types of low level long-lived waste, such as objects containing radium, uranium and thorium, and used low level long-lived sealed sources, as well as other waste from the processing of liquid effluents incorporated into bitumen by an encapsulation process and then packaged in metal drums.

3|4 Long-term management of long-lived high and intermediate level waste

3|4|1 Separation/transmutation

Separation/transmutation processes are aimed at isolating and transforming long-lived radionuclides in nuclear waste into short-lived radionuclides or stable elements.

Separation covers a number of processes, the purpose of which is to separately recover certain long-lived radionuclides, minor actinides and fission products. Once repackaged, these species are intended to be transmuted either by fission, for the minor actinides, or by neutron capture, for the fission products, resulting in short-lived nuclides or stable atoms. The studies conducted on this subject complement those carried out by ANDRA into a deep disposal concept. The footprint of the HL-LL waste repository in fact depends on the thermal properties of the glass packages and, generally speaking, any increase in the interim storage time helps to reduce the footprint of the facility. The heat released is primarily due to the minor actinides after 300 years, in particular in the presence of americium 241. In the absence of these minor actinides, the package cooling time (a few decades in interim storage) and the footprint of the HL-LL waste disposal installations would be reduced by about 30%. The length of the thermal phase would then be shortened to about a hundred years and would be the result of the fission products alone.

The relationship between the minor actinides content, the length of the interim storage period and the underground footprint of the repository means that combinations are then possible in order to optimise the storage/disposal arrangement, in the light of other, essentially economic, criteria.

Furthermore, the radiotoxicity inventory of the glass packages is correlated with the presence of minor actinides after several hundred years. For the impact assessment of an altered evolution scenario such as intrusion into the repository, the radiological impact would be reduced.

The 28 June 2006 Act and the PNGMDR direct studies and research towards the industrial possibilities of transmutation of minor actinides in fast neutron reactors, whether critical (FNR) or sub-critical (Accelerator Driven System - ADS) in conjunction with the studies and research being conducted into the new generations of nuclear reactors.

The first deadline is 2012 when, according to the Act, CEA is required to “submit a report assessing the prospects of the various industrial separation-transmutation technologies”, in particular comprising a part dealing with the benefits of separation-transmutation for geological disposal.

After the TSN Act was passed, the following strategic decisions were taken by CEA on 20 December 2006. Studies and research into critical reactors will concern sodium-cooled (FNR-Na) and gas-cooled (FNR-He) fast neutron reactors. For the first technology, priority is given to designing and producing a prototype by 2020. The technologies and operating principles of a gas-cooled fast neutron reactor will be examined at a European level, leading to a study and technological development (REDT) demonstrator for the gas-cooled fast neutron reactor technology for which a construction decision could be reached in about 2012. ADS studies will be carried out under an international programme.

Given the scale of the research still to be carried out, ASN believes that no industrial application of these processes will be possible before about 2040.

3 | 4 | 2 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.

The function of interim storage is to allow the safe management of waste packages between their production and their final disposal. In the case of thermal packages, it also allows cooling under surveillance. Throughout the storage phase, it must be possible to recover the packages.

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 findings.

The Act of 28 June 2006 now gives ANDRA responsibility for continuing interim storage studies.

The Act no longer considers storage to be a final management solution but stipulates that studies must be carried out into storage so that "no later than 2015, new interim storage installations can be created, or existing installations modified, in order to meet the requirements, particularly in terms of capacity and duration".

The storage programme comprises three parts, covering the following respectively:
– identification of the storage needs, according to various disposal scenarios. An initial inventory was supplied at the end of 2009;
– production of storage concepts, giving details on their feasibility, durability and performance. Options were proposed in 2009;
– preparation of new storage capacities, for implementation in 2015 and for which the projects must be described in 2011.

3 | 4 | 3 Deep geological disposal

The Programme Act of 28 June 2006 on the sustainable management of radioactive materials and waste sets a schedule prior to the 2025 commissioning, subject to authorisation, of a reversible deep geological repository. ANDRA has drawn up a development plan (PDD) for the HL-LL waste project, which presents the project research and studies strategy for the period 2007-2015 to meet the objectives of the 28 June 2006 Act. The development plan is divided into 8 thematic programmes (experimentation, reconnaissance, phenomenology, simulation, engineering, information, surveillance, transport) and 5 cross-disciplinary activities (safety, reversibility, cost, occupational health and safety, impact assessment). The cross-disciplinary activities consolidate the data obtained by the programmes at the different stages of the project and give an overall, complete picture of the performance of the project. Each cross- disciplinary activity is described in a document giving the input data, the deliverables, the interfaces with the programmes and the other cross-disciplinary activities.

The PDD was presented to the Advisory Committee for waste in December 2007.

The project milestones are as follows:
– in 2009, presentation of the reversibility and safety options, proposal of a restricted zone of interest of about 30 km^2, within the transposition zone;
– in 2012, public debate file;
– in 2014, authorisation decree application file;
– in 2025, commissioning.

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.

Study of the rock enables its physical-chemical properties to be determined in terms of repository safety. Scientific experiments are also designed to enhance the available knowledge concerning:
– understanding the geology of the region and its history, with the possibility of predicting its future behaviour;
– the regularity of the clay layer in the transposition zone (on which the repository could potentially be sited);
– water circulation in the limestone and marl terrain above and below the clay layer;
– the impact of excavation of the underground structures and the possibility of mitigating or cancelling out the effects;
– the performance of argillites in containing the radioactive elements and delaying their migration.

In 2009, study and research continued on the choice of a site and the repository design. Among the experiments carried out by ANDRA, the surface reconnaissance campaign allowed examination of the lateral continuity and spatial variability of the properties of the formations studied, in order to obtain exhaustive information about the transposition zone. A zone of interest of 30 square kilometres for detailed reconnaissance with a view to siting of the underground facilities of the future disposal centre (ZIRA) and one or more potential zones for siting the surface facilities (ZIIS) were proposed to the ministers responsible for Energy, Research and the Environment at the end of 2009. On 5 January 2010, ASN communicated its favourable opinion on the choice of the ZIRA to the Government.

After Government approval of the ZIRA and associated ZIIS, ANDRA will carry out detailed reconnaissance (3D seismic survey in particular) in the ZIRA along with surface planning studies for the ZIIS, so that no later than the end of 2012 it will be able to transmit the dossier required for organisation of the public debate, including a proposed site for the future disposal centre (surface and underground).

At the end of 2009, ANDRA submitted a dossier presenting the updated safety and reversibility options for the repository. These dossiers will be presented to the Advisory Committee for waste in the second half of 2010. The ASN recommendations and requests subsequent to this review will enable ANDRA to continue with its design studies prior to submitting the application for the authorisation to create a repository.

By means of inspections at ANDRA's head office and on the Bure site, ASN ensures that all quality assurance steps are taken so that the experiments performed provide the expected results.

In 2009, in Saudron near Bure, ANDRA inaugurated a technology demonstration and information centre for the disposal and reversibility concepts. This centre hosts prototypes and technology demonstrators built to test and validate the industrial concepts contemplated for the nuclear installations in the repository.

In February 2007, ASN published the safety guide for final disposal of radioactive waste in deep geological formations, in place of Basic Safety Rule III.2.f., following the favourable opinion given by the Advisory Committee for waste. However, during the course of the debates, members of the GPD raised questions concerning the radiation protection criteria values and the problem of providing a safety case for such very long time-scales. The Advisory Committee thus considered that further work was needed to examine the criteria, the time-scales for which they apply and how they can be interpreted. Against this backdrop, ASN decided in 2008 to convene a working group comprising experts on these subjects. The conclusions of the working group will be presented in mid-2010 to the Advisory Committee for waste.

3 | 4 | 4 Specifications and approval certificates for waste packages unsuitable for surface disposal

ANDRA, together with the waste producers, has chosen a gradual approach 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.

The implementation of this approach is being 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 Programme Act 2006-739 of 28 June 2006 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 an opinion concerning the waste packaging specifications;
– the guide published by ASN "on final disposal of radioactive waste in deep geological formations", which presents the safety functions relating to the packages, along with guidelines in its appendix 1.

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 two-fold 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;
– harmonisation of all practices; in the current situation, the packaging conditions for the packages produced at La Hague are subject to ASN approval. The packages produced on the other sites are not explicitly bound by such a requirement.

At the end of 2008, ASN started work on drafting a decision on waste packaging approval procedures. This draft was discussed within a working group comprising ANDRA, IRSN, DSND and ASN. It will be transmitted to the waste producers for their opinion. This decision will be published after implementation of the future order concerning the BNI regime.

4 ABANDONED RADIOACTIVE OBJECTS AND SITES POLLUTED BY RADIOACTIVE MATERIALS

4 | 1 The organisation and regulation of action by the public authorities

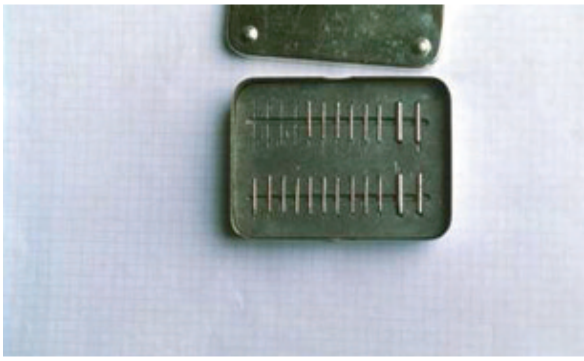
Article 14 of Act 2006-739 of 28 June 2006 Act on the sustainable management of radioactive materials and waste (Article L 542-12 of the Environment Code) states that ANDRA is in particular responsible for the collection, transport and handling of radioactive waste and the rehabilitation of sites polluted by radioactive materials, on request, and at the expense of the parties 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. This arrangement replaces the two financial systems that previously existed: the radium fund and the agreement between producers in the nuclear power generating sector and ANDRA.

The Government circular of 17 November 2008, co-signed by the General Directorate for Risk Prevention (DGPR), the General Directorate for Health (DGS), the General Directorate for Energy and Climate (DGEC) and ASN, explains ANDRA's public service duties, the responsibility it assumes for certain types of radioactive waste and the management of sites polluted 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 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 recovered by the State.

4 | 2 Abandoned radioactive objects

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.



Radium needles

In 2007, the CNAR validated the policy of helping with recovery of radioactive objects as required by the Act of 28 June 2006. In order to inform those in possession of these objects, who can range from private individuals (sometimes as the result of an inheritance), to teaching establishments, municipal authorities, fire brigades, etc., an information brochure entitled "Identification and collection of radioactive objects found in the home" was produced by ANDRA in September 2008, as part of the CNAR and then updated in February 2009. This brochure presents the various objects (natural radioactive salts, ore samples, radium-containing objects for medical uses, alarm clocks, compasses, radioactive lightning conductors, radium fountains, etc.) and the risks associated with them. It also specifies the usual precautions and the conditions for free collection by ANDRA, reaffirming ANDRA's public service role and the role of the CNAR.

4 | 3 Sites polluted by radioactive materials

4 | 3 | 1 General remarks

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. The circular of 17 November 2008, intended for the *préfets*, describes the applicable administrative procedure for managing sites polluted by radioactive materials covered by the ICPE regime or the Public Health Code, whether the party responsible is solvent or defaulting. This circular is thus able to deal with legacy radioactive contamination of sites caused by past craft or industrial activities involving radioactivity (see 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. 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 assistance with handling of 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 (DGEC, DGPR, DGS), ASN, IRSN, the Association of Mayors of France, environmental defence associations and qualified personalities.

CNAR secretarial services are provided by ANDRA. The commission met quarterly in 2009 to discuss operational subjects, i.e. the drafting of a guide for assistance with handling of waste, the management of polluted sites considered to be priorities, such as Gif-sur-Yvette, Bandol, Isotopchim, etc.

This commission is the equivalent of ADEME's national funding Commission dealing with management of sites polluted by non-radioactive materials.

Members of the CNAR visiting the Coudraies district in Gif-sur-Yvette (Essonne *département*) on 9 September 2008

radium clock making industry, radium extraction workings of the 1920s to 1930s, the laboratories of the early 20th century which discovered radioactivity, and so on). These sites are not generally ICPEs.

The methodology guide for management of industrial sites potentially contaminated by radioactive materials, which was published in October 2000 (version 0), describes the applicable approach for dealing with the various situations likely to be encountered in the rehabilitation of sites (potentially) contaminated by radioactive materials. This guide was revised to take account of the new public service duty created by the Act of 28 June 2006. This update should also allow an approach that is consistent with the management of sites and soils polluted by chemicals, and encourage dialogue for the duration of the rehabilitation projects. DGPR and ASN asked IRSN to produce this new guide.

In connection with this revision of the management guide for industrial sites potentially contaminated by radioactive materials, DGPR and ASN set up a pluralistic working group on the approach to be adopted to determine the clean-out objectives for sites contaminated by radioactive materials. This group comprises the regulatory authorities (ASN, DGPR, DGS, the Regional Directorate for the Environment, Planning and Housing, the French Health Monitoring Institute), licensees (CEA, AREVA, ANDRA), associations (CRIIRAD, Robin des Bois), representatives of the public (local elected officials, OPECST) and French and foreign experts (IRSN, FANC). The outcome of the work done by this group will be taken into account in the drafting of the guide.

Following the work of this group, ASN will officially state its policy with regard to sites potentially contaminated by radioactive materials. ASN already believes that the solution involving the contamination being maintained in-situ should not be considered the reference solution for management of sites polluted by radioactive materials and that this option can only be an interim solution or reserved for specific cases in which complete clean-out cannot be contemplated owing to the volume of waste to be excavated.

4 | 3 | 2 The polluted sites inventories

Several complementary inventories are available to the public.

- The ANDRA national inventory
  Since 1993, ANDRA has been publishing 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 June 2009 edition is available on the ANDRA website, www.andra.fr.

- The databases of the Ministry for Ecology, Energy, Sustainable Development and the Sea (MEEDDM).
  The MEEDDM has created a web portal specifically for sites and soils that are polluted or contaminated by radioactive materials (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.
  – "BASIAS" which is a record based on regional historical inventories of former industrial sites, a trace of which must be kept. Its purpose is to maintain inventoried site records in order to provide information of use for town planning, land transactions and environmental protection.

4 | 3 | 3 Some of the files in progress

a) Coudraies area in Gif-sur-Yvette (Essonne)

Review of the files on the properties in the Coudraies district in Gif-sur-Yvette, which began in 2002, enabled the Essonne *préfet* to propose allocation of technical and financial aid for clean-out of contaminated sites, for the simpler cases. A property was purchased at the end of 2005, with the site being made safe by ANDRA in 2006 and 2007. Surveillance was put into place in 2008 and the house should eventually be demolished at the beginning of 2010. Two properties were cleaned-out in 2008 and early 2009. Nonetheless, radon measurements are still being taken and the possible purchase of another property is being examined.

Interior of a home in the Coudraies district of Gif-sur-Yvette after clean-out

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 planning scheme (PLU), which specifies the health requirements concerning the Coudraie district. This document was submitted to ASN for its opinion. The Mayor of Gif incorporated these provisions into the update of the town's PLU approved by the municipal council on 9 May 2007. The CNAR confirmed financial coverage of the radiological checks defined in the PLU on behalf of the former owners (before May 2007).

Following a request by a local resident and after analysis of the history of the district, ASN also initiated a process to clear up any ambiguity concerning a few plots of land in the Clos Rose district of Gif-sur-Yvette. A public meeting was held on this subject on 22 September 2009.

b) Making safe the Isotopchim site in Ganagobie (Alpes-de Haute-Provence département)

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. This priority waste was packaged and removed to CEA's Marcoule centre from March to June 2008. The rest of the site clean-out and rehabilitation work will be managed by the CNAR. Greater security (installation of an operational fire detection system and replacement of the fence) was put into place in July 2009. Additional analysis of the remaining liquid waste was initiated in order to define the disposal routes. All the results should be known by the end of 2010. Removal of the remaining VLL solid waste was validated by the CNAR and has started. ANDRA is also looking for an interim storage solution for the liquid waste pending availability of a disposal route for all of this waste.

c) Danne property in Bandol (Var département)

Clean-out work was carried out on this property in the past. 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. Isolated doubtful areas were clarified in 2008 and

Site of the Danne property in Bandol (Var *département*)

a few contamination spots were identified but with no health risk. A new map of the Danne property was also produced in April 2008 and shows that on 2/3 of the land, the values are comparable to the background levels of the region. In 2010, ANDRA plans to carry out site rehabilitation studies.

The CNAR will then examine them and specify which aspects are covered by public service financing.

d) Établissements Charvet on the Île Saint-Denis (Seine-Saint-Denis département)

From 1910 to 1928, this site housed a plant extracting radium from uranium ore and a laboratory for Marie Curie. Until August 2006, buildings still existed on the site. Since 1966 they had been partly 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 closed. The Charvet site has been identified as being eligible for financing under France's recovery plan, and is part of the project to rehabilitate an eco-zone on the Île-Saint-Denis island. On 29 September 2009, the CNAR accepted the rehabilitation project based on a scenario involving partial excavation of the contaminated earth, allowing the creation of a park or comparable activity, taking account of possible subsequent intervention for that part of the site on which the contaminated soil and rubble would be stored.

e) Former Curie laboratory in Arcueil (Val de Marne département)

By order of the *préfet* on 20 August 2004, University Paris VI, the owner of the Curie Foundation's former radioactive materials handling site (Institut du radium) in Arcueil was asked to carry out safeguard, surveillance and decontamination work. Since 2006, this has been the responsibility of the State. In September 2008, ASN validated the objectives for sorting conventional waste from contaminated waste, in line with the waste evacuation routes. It would appear that all the waste and furniture present on this site will need to be removed before radiological characterisation of the site prior to its rehabilitation. A public meeting was held on 22 June 2009.

An ASN inspection was carried out on 16 October 2009.

f) Orflam-Plast in Pargny-sur-Saulx

In 1934, the UTM Company (UTM standing for monazite treatment unit) started to produce lighter flints by extracting the cerium contained in imported monazite ore, and then began to make lighters under the brand name ORFLAM PLAST. Using the same ore, the company also produced pure thorium nitrate for export until 1959. Direct processing of the raw material ceased in 1967, when this activity was replaced by materials that were pre-treated prior to import and free of either thorium or uranium. The OrflamPlast company was wound up by a decision of the court of commerce in May 2006. The consequence of this judgement was to relieve the liquidator of all responsibility for the site.

In an administrative decision, the Orflam site was transferred to the State property department on 24 November 2008.

Since the beginning of 2008, rehabilitation of the site has been managed by the National Funding Commission for Radioactive Matters (CNAR). Since the end of October 2008, stores of contaminated legacy waste from the Orflam-Plast plant have been discovered and work has been done to make them safe. ASN asked IRSN to analyse the sediment, water, and aquatic fauna and the measurements obtained enabled the pond to be opened for fishing at the end of August 2009. Spectrometry mapping was carried out by a helicopter on 29 and 30 June 2009 over a 60 km2 area. The active zones previously identified were confirmed and no other zone showing thorium activity significantly higher than the local natural background level was brought to light. At the end of 2009, the CNAR ruled on the rehabilitation scenarios for the contaminated areas both off and on the site, so that work could begin in mid-2010. A local information committee should also be created by the end of 2009.

4 | 4 Public service storage facilities

ANDRA has a public service storage duty. So far, however, it has not operated any storage facilities, simply signing agreements with other nuclear licensees for access to their storage capacity. For example, the SOCATRI company was authorised by decree in 2003 to provide interim storage on behalf of ANDRA for low level long-lived waste, CEA at Cadarache for interim storage of radium lightning conductors and depleted uranium radioactive objects, and CEA at Saclay for interim storage of used radioactive sources for which there are currently no disposal routes.

In September 2009, ANDRA approved the creation of a storage facility for diffuse nuclear waste, in particular low level, long-lived waste. This facility will not however be able to accept tritiated waste.

Site of former Curie laboratories in Arcueil (Val-de-Marne *département*)

5 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 French National Radioactive Material and Waste Management Plan (PNGMDR). The first edition of the PNGMDR, produced by a pluralistic working group co-chaired by ASN, was issued at the end of 2006. A new edition of the PNGMDR for the period 2010-2012 was finalised at the end of 2009. This new edition identifies new possibilities for continuing to improve the management of radioactive waste, in particular with regard to the former radioactive waste storage sites, the fate of the waste stored by AREVA on its Malvési site, packaging of waste, particularly that containing organic substances, the management of mining waste rock liable to have a radiological impact, reuse in the nuclear sector of waste resulting from decommissioning, and optimisation of the waste management solutions.

ASN considers that the 28 June 2006 Act and the PNGMDR provide a clear, coherent and complete framework for the management of radioactive waste in France. It also considers that the discussion and debating arrangements put into place to deal with the subject of radioactive waste, particularly within the framework of the PNGMDR, are satisfactory. ASN attaches importance to informing its foreign counterparts of the framework created for radioactive waste management in France. This was in particular the case with the 2009 presentation of the French report, pursuant to the Joint Convention on the safety of spent fuel management and on the safety of radioactive waste management (www.asn.fr). This Convention requires that each Contracting Party present a report every three years, describing how it implements the obligations of the Convention. For France, drafting of this report was coordinated by ASN, with contributions from other nuclear regulators and nuclear licensees. This report was presented in Vienna in May 2009.

In 2009, 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 installations and periodically assesses the management strategies put in place by the licensees. Therefore in 2006, ASN took a stance on the possibility of recovering legacy waste in the AREVA NC plant at La Hague. It would appear that although AREVA NC has adequate resources for implementing its recovery strategy, the safety of some of the storage facilities, such as the HAO silos, is unsatisfactory. ASN will remain vigilant in ensuring that the strategy changes announced by the licensee in 2009 do not compromise the announced time-frame for removal from storage.

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 the time aspect, and it has to periodically review its strategy and regularly postpone deadlines for removal of legacy waste from storage. A new summary file concerning the CEA waste strategy will be transmitted in mid-2010 so that ASN can adopt a stance following a joint review by the Advisory Committee for waste and the waste management safety committee for defence installations. ASN will pay close attention to ensuring that CEA presents a coherent and well-structured strategy for management of all the existing and future waste, identifying the needs with respect to treatment and packaging facilities, transport and storage of the waste, along with the anticipated resources (both human and material) required. It will also ensure that the storage removal schedules comply with the CEA commitments and the schedules defined during its discussions with ASN. ASN will also closely monitor the storage removal operations for waste with the highest safety stakes.

With regard to EDF, ASN will in 2010 be reviewing the document transmitted by EDF at the end of 2008 concerning the consistency of the nuclear fuel cycle.

With regard to the long-term management of radioactive waste, ASN is encouraged by the way ANDRA operates its waste centres currently in service.

In January 2009, ASN submitted its opinion to the Minister for Ecology concerning the search for a site started by ANDRA in June 2008 for the LL-LL waste repository project, pursuant to the 28 June 2006 Programme Act and the decree of 16 April 2008. The repository is designed to take graphite and radium-containing waste and could also accept other low level long-lived waste. ASN believes that it is essential for France to have a repository of this type. ASN will therefore continue to closely monitor the selected sites investigation process and, together with ANDRA, will prepare the forthcoming review milestones with a view to obtaining the authorisation decree for the future repository.

After it adopts a stance on the choice of a reversible repository in deep geological formations in January 2010, ASN will in 2010 review the dossiers submitted at the end of 2009 by ANDRA. These dossiers concern a small area of interest suitable for siting of a repository, a presentation of the design options, the operational and long-term safety and reversibility options, a presentation of the waste inventory model to be used and a definition of the storage options that will be needed in addition to the repository. ASN will also be referring to the Advisory Committee for waste with regard to the application for renewal of the license to operate the Bure laboratory after 2011, to be presented by ANDRA in early 2010.

Since 2002, ASN has been involved in regulating management of sites polluted by radioactive materials. The circular that was published in 2008, specifying the roles and responsibilities of the various stakeholders with regard to handling of polluted sites and soils, consolidates ASN's role of providing support for the préfets. ASN also takes part in the National Funding Commission for Radioactive Matters set up within ANDRA as part of its public service role, the aim of which is to review rehabilitation projects for contaminated sites for which the party responsible has defaulted. This renovated regulatory framework gave ASN greater powers to act on polluted sites in 2009 and this will continue in 2010, in collaboration with the administrations concerned and the other stakeholders (ANDRA, IRSN, local authorities, associations, etc.). ASN restates its position that the solution involving maintaining the contamination in-situ must not be the reference solution for management of sites polluted by radioactive materials and that this option can only be an interim solution or reserved for situations in which the complete clean-out option cannot be contemplated owing to the volume of waste to be excavated.

In 2010, ASN will also continue to work on revising the regulations, following the publication of the TSN Act, in particular by issuing decisions to clarify the measures applicable to BNIs concerning the production of nuclear waste, the storage of this waste, its packaging and its disposal in the appropriate installations.

Finally, ASN will remain closely involved in international work, by maintaining its active participation in the working groups of WENRA and NEA and by completing the work it revived in 2009 within the European Pilot Group (comprising a number of European regulatory authorities and international bodies) on what is required in the safety case for a deep geological repository and the acceptance criteria for radioactive waste. ASN will also make an active contribution to the work done within the European Nuclear Safety Regulators Group (ENSREG) in order to ensure that a European directive on radioactive waste and spent fuel is adopted.