RADIOACTIVE WASTE AND CONTAMINATED SITES AND SOIL

CHAPTER 16

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This chapter presents the role and actions of ASN concerning the management of waste generated by activities using radioactive substances and the management of sites polluted by radioactive contamination. It in particular describes the steps taken to define and determine the main radioactive waste management orientations and the controls carried out by ASN with respect to nuclear safety and radiation protection in facilities involved in the management of radioactive waste. It also presents the steps taken by ASN concerning sites polluted by radioactive contamination and how they are managed.

Radioactive waste means 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.

Clean-out of contaminated sites consists in rehabilitating sites on which a nuclear or non-nuclear activities has created pollution from radioactive substances.

1 RADIOACTIVE WASTE

Like any human activity, nuclear activities produce waste. Pursuant to the provisions of the Environment Code and more specifically of Act 2006-739 of 28th June 2006, the producers of waste are responsible for it until disposed of in a duly authorised facility. 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.

Radioactive waste varies considerably by activity level, half-life, volume or even nature (scrap metal, rubble, oils, etc.). Each type of waste requires treatment and a long-term management solution that is appropriate, in order to overcome the risk involved, notably the radiological risk. 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 (radioactivity halved in less than 100 days), short-lived (radioactivity halved in less than 30 years) and long-lived, containing a large quantity of long half-life radionuclides (radioactivity halved in more than 30 years).

All the operations associated with managing a category of waste, from production, through sorting, packaging, interim storage to final disposal, are what make up the disposal route. Each disposal route must be adapted to the nature of the waste handled. The operations within each route are interlinked and all the routes are interdependent. Each party in the route is responsible for the safety of the facilities it operates and the activities it performs.

1|1 Radioactive waste management regulatory framework

Radioactive waste management falls within the general framework defined in book V, part IV, chapter I of the Environment Code and its implementing decrees. The particular requirements concerning radioactive waste were introduced by Act 91-1381 of 30th December 1991 on research into high-level, long-lived waste, known as the "Bataille Act", and by the 28th June 2006 Act giving a legislative framework to management of all radioactive materials and waste (these Acts are codified in book V, part IV, chapter II of the Environment Code). This latter sets the new calendar for research into high and intermediate level, long-lived waste and a clear legal framework for ring-fencing the funds needed for decommissioning and for the management of radioactive waste. It in particular requires the production of a national radioactive materials and waste management plan, which aims to produce a periodic review of radioactive materials management policy. It also reinforces the duties of the French national radioactive waste management agency (ANDRA). Finally, it bans the final disposal on French soil of foreign waste, by providing for the adoption of rules specifying the conditions for the return of waste resulting from reprocessing in France of spent fuel or waste from abroad.

1|1|1 Production of radioactive waste in basic nuclear installations

In France, radioactive waste management is such that there are no predetermined release thresholds below which a very low level waste from a nuclear facility can be considered as manageable by a conventional waste disposal route. In concrete terms, this doctrine leads to the definition of "waste zoning" which, in basic nuclear installations (BNIs), separates zones producing contaminated, activated or potentially activated waste, from zones producing conventional waste. Waste that is contaminated, activated or potentially activated must be managed in dedicated radioactive waste routes and it can only be reused in a nuclear facility. Waste from conventional waste zones, once confirmed as free of radioactivity, is sent to routes dedicated to conventional waste. Waste zoning and changes to this zoning are subject to approval by ASN. The order of 31st December 1999 on the general regulations applicable to

BNIs stipulates the creation of this zoning. This order also asks the licensees to carry out a study on the management of their waste, specifying their objectives with respect to reducing the production and harmfulness of the waste produced in their facilities and optimising its management, taking account of the reprocessing routes, as disposal is reserved solely for ultimate waste. Summaries of these studies are submitted to ASN for approval.

During the course of 2010, ASN posted a draft decision on its website for consultation, concerning the study of waste management and the review of the waste produced in the BNIs. This text also details the content of the waste studies requested and the general principles for establishing and modifying zoning. In 2011, ASN revised the text so that its publication could coincide with the order defining the general regulations applicable to BNIs.

The 9th August 2011 incident involving the unloading of a lorry load of rubble from the Bugey power plant, which comprised slight traces of radioactivity, into a quarry backfilled with inert materials, was because of incorrect definition of waste zoning. This incident, which had no consequences on the environment, the general public or workers, was rated level 0 on the INES scale. ASN sent the licensee formal notice to comply with the requirements of Article 21 of the above-mentioned order of 31st December 1999 on waste zoning.

1|1|2 Production of radioactive waste in nuclear facilities using radioactive substances

The provisions mentioned in decree 2002-460 of 4th April 2002 concerning the general protection of persons against ionising radiation have been incorporated into the Public Health Code. Article R. 1333-12 of this Code states that the management of effluents and waste contaminated by radioactive substances originating from all nuclear activities related to medicine, human biology, or biomedical research and entailing a risk of exposure to ionising radiation must be examined and approved by the public authorities. ASN decision 2008-DC-0095 of 29th January 2008, approved by the Ministers responsible for the Environment and Health, lays out the technical rules to be met for the disposal of effluents and waste contaminated or potentially contaminated by radionuclides owing to a nuclear activity.

1|1|3 The national inventory of radioactive materials and waste

Article L.542-12 of the Environment Code 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 national inventory was published in June 2009 and presents information concerning the quantities and locations of radioactive materials and waste as at the end of 2007, plus the forecasts for the end of 2020, the end of 2030 and following the operating lifetime of the existing facilities or those for which construction has been authorised. ASN takes part in the steering committee of the national inventory of radioactive waste and recoverable materials. This inventory constitutes input data for the national radioactive materials and waste management plan.

1|1|4 The national radioactive materials and waste management plan

Article L.542-1-2 of the Environment Code requires the production of the national radioactive materials and waste management plan (PNGMDR), revised every three years, the purpose of which is to review the existing management procedures for radioactive materials and waste, to identify the foreseeable needs for storage and disposal facilities, to clarify the necessary capacity of these facilities and the storage durations and, for radioactive waste for which there is as yet no final management solution, to determine the objectives to be met. The main provisions of the plan and the studies required by the PNGMDR are set by a decree implementing Article L.542-1-2 of the Environment Code.

This plan is drafted by a pluralistic working group co-chaired by the General Directorate for Energy and Climate (DGEC) and ASN, for example including environmental protection associations, representatives of elected officials, the regulatory authorities, alongside the radioactive waste producers and managers.

The Parliamentary Office for the evaluation of scientific and technological choices (OPECST) published a report in early 2011 on the evaluation of the PNGMDR 2010-2012. This report praises the creation and the actions of the PNGMDR working group and the dialogue initiated with the associations. It presents a number of recommendations concerning the organisation of the PNGMDR working group as well as the content and format of the plan that the DGEC and ASN have already adopted or which will be adopted in the drafting of the next plan.

The studies stipulated by the PNGMDR 2010-2012 for example concern the management of legacy situations (disposal and storage of legacy waste, mines), long-term management of radioactive substances (depleted uranium, reprocessed uranium, thorium) and radioactive waste. These studies in particular concern sealed sources, tritiated waste, the optimisation of disposal facilities for existing routes and continued research into planned routes.

In addition to the studies requested and to ensure overall management consistency, two working groups, under the supervision of the DGEC, were set up. These working groups, in which ASN is a participant, aim to define the management methods for waste currently with no disposal route and to optimise the breakdown of the flow of radioactive waste between the existing or planned routes.

1|2 The role of ASN in the radioactive waste management system

The public authorities, ASN in particular, are keen to ensure that this management of radioactive waste takes place in safe

Meeting of the PNGMDR working group at the French National Assembly – June 2011

conditions at each step (from production in the BNIs up to disposal) and that there is a management route for all the waste. ASN thus considers that the development of management routes appropriate to each waste category is of vital importance and that any delay in the search for waste disposal solutions will only increase the volume and size of the storage areas in the facilities, with all the attendant risks. Within the context of the PNGMDR, ASN is particularly vigilant in ensuring that the system consisting of all these routes is optimised as part of an overall, consistent approach to the management of radioactive waste. This approach must take account of safety, radiation protection, traceability and waste volume minimisation issues. Finally, ASN considers that this management must be transparent to the public. The PNGMDR is thus produced by a pluralistic working group. Furthermore, the publication of the PNGMDR and its summary on the ASN website, as well as the publication in early 2011 of number 190 of *Contrôle* magazine devoted to radioactive waste, help inform the public about the main issues associated with radioactive waste management.

In order to fulfil its duties, ASN can call on the services of the Institute for Radiation Protection and Nuclear Safety (IRSN).

1|2|1 Checks and inspections

With regard to radioactive waste management, the checks and inspections which lie at the heart of ASN's duties consist, on the one hand, in checking correct application of the regulations regarding waste management on the production sites and the safety of facilities dedicated to radioactive waste management (waste reprocessing, storage and disposal facilities). On the other hand, the checks carried out by ASN must ensure correct implementation of the defined conditions for manufacture of the waste packages intended for the waste disposal facilities. These measures are described in this chapter as well as in chapters 8 and 13.

1|2|2 Drafting of recommendations and prescriptions for sustainable waste management

Together with the DGEC, ASN is responsible for drafting the PNGMDR, with the assistance of a specifically created pluralistic working group. This PNGMDR drafting work is followed by an examination of the dossiers submitted pursuant to the decree stipulating the PNGMDR requirements with regard to improvements to the radioactive waste management arrangements. On 25th August 2009, ASN presented the Minister for the Environment with its opinion on the studies requested under the decree of 16th April 2008 setting out the requirements concerning the PNGMDR (opinion 2009-AV-0075 of 25th August 2009). The ASN opinion served as the basis for the preparation of the second edition of the PNGMDR (2010-2012 version) which was transmitted to the Government in early 2010.

ASN also gave the Government its recommendations concerning the disposal projects for long-lived radioactive waste. ASN is also focusing on verifying that the conditions in which these projects are developed will guarantee the operational and long-term safety of the future facilities.

1|2|3 Production of the legislative and regulatory framework

ASN was a key player in the drafting of the 28th June 2006 Act on the sustainable management of radioactive materials and waste. Following the passage of the "TSN" Act on transparency and security in the nuclear field, ASN also engaged in a process to overhaul the regulations applicable to BNIs. ASN thus pays particularly close attention to reinforcing the oversight of radioactive waste management. The order defining the general regulations applicable to BNIs thus makes provision for special measures to be implemented in the ASN decisions on the topics of waste management in BNIs, storage of radioactive waste, waste packaging and radioactive waste disposal facilities.

1|2|4 Evaluation of the nuclear financial costs

The regulatory framework designed to secure the financing of nuclear facility decommissioning costs or, for radioactive waste disposal facilities, the final shutdown, maintenance and surveillance costs, in addition to the cost of managing spent fuel and radioactive waste, is described in chapter 15 point 1|3|2. In 2011, ASN sent the DGEC its opinion on the three-yearly reports submitted by the nuclear operators to describe the evaluation of the nuclear costs and ways and means chosen to create the assets needed to cover these costs (see chapter 15 point 1|3|2).

ASN also sent the DGEC its opinion on decree 2010-1673 of 29th December 2010 amending decree 2007-243 of 23rd February 2007 concerning the ring-fencing of the financial costs of decommissioning (see chapter 15 point 1|3|2).

1|2|5 ASN's contribution to international works

One of the WENRA[1] missions is to develop a joint approach to nuclear safety and regulation. WENRA implemented a procedure designed to draft reference safety levels for harmonising nuclear safety practices in Europe. 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 safety of interim storage of radioactive waste and spent fuel and of nuclear installation decommissioning operations. In 2010, this group extended its work to include definition of the reference levels applicable to radioactive waste disposal facilities. The coordination of the work involved in drafting this report was entrusted to the ASN representative within the WGWD. In 2010, the WGWD finalised the reference levels for the storage of radioactive waste and spent fuels. The report was published in 2011. In 2010, the WGWD continued its work to draft reference levels concerning the safety of decommissioning operations.

The transposition of the reference levels by the WENRA members will require updating of the national regulations. The work to update the French regulations currently in progress, already partly incorporates these reference levels. An additional ASN decision on interim storage will be drafted as part of this transposition process. The WENRA member countries are required to produce national action plans for the implementation of this transposition. ASN will thus draft an action plan to meet the WENRA requirements.

On the strength of its experience with drafting the PNGMDR, but also the creation of a regulatory authority and the preparation of a dedicated legislative framework, France was a driving force behind the project to draft a European directive on radioactive waste management, in particular through its

TO BE NOTED IN 2011

Council directive 2011/70/EURATOM establishing a community framework for the responsible and safe management of spent fuel and radioactive waste

On 19th July 2011, the Council of the European Union adopted directive 70/2011/Euratom establishing a community framework for the responsible and safe management of spent fuel and radioactive waste.

This directive defines a binding legislative framework and in particular requires that each member State set up a regulatory authority with competence for the safe management of waste and spent fuel, given the financial and human resources necessary for the performance of its duties. It sets safety requirements and requires the creation of a system of authorisations for waste and spent fuel management facilities. It also requires those holding these authorisations to devote adequate financial and human resources to waste management.

Moreover, this directive requires the definition of a national programme to implement the waste and spent fuel management policy. This programme, which is based on a national inventory, must concern all waste, from production up to disposal. It must be periodically revised and the Commission notified.

The directive also defines the requirements concerning transparency with regard to the public and requires periodic self-evaluation of the regulatory arrangements, supplemented by a peer review. It also requires that there be a system of sanctions.

Finally, it formally stipulates the ultimate responsibility of each member State for the management of its radioactive waste and specifies the possibilities regarding the export of this waste for disposal.

ASN considers the adoption of this directive to be a key event and one that helps strengthen nuclear safety within the European Union, while making the member States more accountable for the management of their radioactive waste and spent fuels.

Each member State must now transpose this directive within a period of two years. With regard to France, most of the provisions of this directive are already an integral part of national legislation, for example through the requirements of the 28th June 2006 Act on the sustainable management of radioactive materials and waste, and those of the 13th June 2006 Act on transparency and security in the nuclear field, recently integrated into the Environment Code.

Implementation schedule:
– Publication in the Official Gazette of the European Union: 2nd August 2011;
– Transposition in the 27 member States: no later than 23rd August 2013;
– First notification by the member States to the European Commission of their national radioactive waste and spent fuel management programme: no later than 23rd August 2015.

1. WENRA: Western European Nuclear Regulators' Association. that brings together the heads of nuclear safety authorities in countries of Western Europe

TO BE NOTED IN 2011

ASN publication

Issue no.190 of Contrôle *magazine, published in February 2011, is devoted to "Radioactive waste management: progress and outlook". It was presented to the press on 10th February 2011. This issue gives the viewpoint of the various stakeholders, licensees, administrations, environmental protection associations, consultative committees and foreign experts on the subject of radioactive waste management. It explains the issues and the complexity of radioactive waste management and looks at the various aspects of the waste problem: scientific, technical, but also as related to society.*

***Contrôle* magazine 190 is also available in English**

involvement in the preparatory work done by ENSREG[2] (European Nuclear Safety Regulators' Group). After the July 2011 adoption of the European directive on radioactive waste management, new provisions will need to be transposed into French law.

Finally, at an international level, ASN is a participant in the International Atomic Energy Agency's (IAEA) Waste Safety Standards Committee (WASSC), whose role is to draft and then approve the international standards defined by IAEA, for example concerning the management of radioactive waste.

1|2|6 Public information

ASN has a general public information duty. In 2011, the main form of communication about radioactive waste management was the publication of an issue of *Contrôle* magazine on "Radioactive waste management: progress and outlook" (see box). ASN and ANDRA also co-organised the radioactive waste workshop at the *Assises des déchets* conference on 15th September 2011. ASN recalled the fundamental principles contained in the PNGMDR and the management doctrine for very low level (VLL) waste based on BNI zoning.

1|3 Management of waste from nuclear licensees

Before final disposal, certain categories of radioactive waste undergo processing to reduce their volume or harmfulness and, whenever possible, to recover reusable materials. This processing 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 disposal facility. ASN asks the licensees to define a management strategy for all the radioactive waste produced in their facilities. The following sections clarify the waste management procedures adopted by the main producers of waste.

1|3|1 CEA waste management

a) CEA's waste management strategy

CEA has processing, packaging and storage facilities for the waste it produces. Each CEA nuclear site has processing and packaging installations for the waste and radioactive effluents it produces. 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, ANDRA repositories, etc.). Long-lived intermediate and high level waste is stored by CEA in dedicated storage facilities 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 before being taken away to the Morvilliers VLL waste repository. Liquid waste is treated, solidified and packaged. 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 is also in possession of legacy solid and liquid waste for which there could be certain processing problems, owing to its physical-chemical nature or the fact that there is currently no disposal route. Nuclear fuel without further use from the CEA civil facilities is placed in interim storage, either dry (pit) such as in the CASCAD facility, or in a pool, pending definition of a final management route (reprocessing or storage).

2. ENSREG, set up in March 2007, is a grouping of the heads of the European Union's safety regulators and the European Commission. Based on guidelines defined by the Council of Ministers, it applied itself to a review of safety, waste and spent fuel management and transparency in the nuclear sector, at a European level. This work in particular led to the adoption of a nuclear safety directive on 25th June 2009.

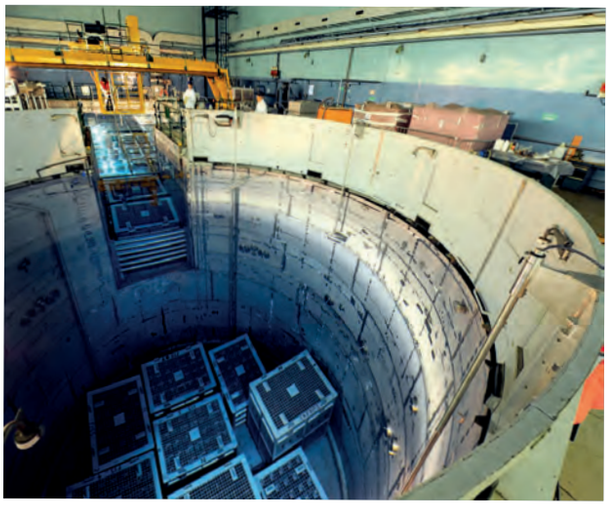
In the light of changes to the CEA's waste management strategy, both in terms of organisation and plans for new facilities or upgrades to existing facilities, ASN asked CEA in late 2008 to present its management strategy for solid waste, liquid effluents, sources and spent fuel from CEA civil uses in the coming decades, as well as the means necessary to implement this strategy (facilities, transport containers, etc.). In March 2010, CEA submitted the corresponding file. Jointly with the ASND, ASN stated that this file should be examined by the Advisory Committee. This latter will for example analyse the pertinence and consistency of CEA's management strategy for existing and future waste, effluents and spent fuel, in the light of safety and radiation protection issues, as well as its calendar for recovery of legacy waste and effluents, given the available and planned resources. ASN will issue a position statement on this subject in the first half of 2012, together with the ASND.

In April 2011, ASN carried out an inspection at CEA head offices in order to examine the processes CEA had defined in order to produce its management strategy for waste, spent fuels and sources and to ensure implementation and coordination by the nuclear sites. The inspectors for example noted that a process dedicated to clean-out, decommissioning, management and transport of radioactive materials and waste was in the process of being implemented by the CEA's services. They did however observe that the waste management strategy control and monitoring tools were not all available. With regards to nationwide coordination, they appreciated the fact that the division in charge of clean-out projects and waste management held periodic follow-up meetings with the heads of the facilities whose projects it is monitoring.

b) Issues associated with CEA waste management

The two main issues for CEA with regard to radioactive waste management are:

– bringing new waste reprocessing and storage facilities online within a time frame compatible with its commitments to shut down old installations in which safety no longer complies with modern requirements;
– running projects for removal of certain legacy waste from storage.



Spent fuels from the CEA research reactors have been stored in this pool since 1980. They are currently being removed and reprocessed.

As in previous years, ASN observes that CEA is experiencing persistent difficulties with managing these two issues. For 2011, ASN noted, however, that there had been occasional progress with some projects, in line with the licensee's commitments and especially concerning the licensee's "major commitments" on nuclear safety and radiation protection. ASN for example noted that the project for removal from storage of the drums containing plutonium in the PEGASE facility (BNI 22) is currently being run satisfactorily by the Cadarache centre, with a scheduled completion date of late 2013. ASN also observes that in recent years, CEA has strengthened the organisation of the project to recover waste from BNI 56 in Cadarache but nonetheless notes significant delays in the performance of the operations, owing to the many unexpected technical uncertainties the licensee has to deal with.

ASN also points outs the technical difficulties and project management problems encountered by CEA in running the new facility projects and the delays in upgrading of the existing facilities dedicated to radioactive waste management.

New facility projects

STELLA project

Basic nuclear installation (BNI) 35, notified by CEA in a letter of 27th May 1964, is located on the CEA Saclay site. Its purpose is the reprocessing of radioactive liquid effluents. Decree 2004-25 of 8th January 2004 authorises CEA to create an extension in BNI 35, called STELLA, for reprocessing low-level aqueous effluents from the Saclay centre, using an evaporation concentration process with the concentrates then blocked in a cement matrix, to produce packages that can be placed in an ANDRA surface repository. STELLA commissioning is seriously behind schedule owing to technical problems with qualification of the waste packages. Given the problems with producing satisfactory packages without cracks, CEA decided in 2010 to opt for commissioning of the STELLA facility in stages. In its decision 2010-DC-0198 of 9th November 2010, ASN authorised this staged commissioning to enable CEA to run tests on the evaporation process and concentrate the effluents present in the facility. In its decision 2011-DC-041 of 22nd September 2011, ASN authorised commissioning of the cementation and chemical pretreatment processes. ASN did however ask CEA to provide the necessary justifications concerning management of the effluents containing complexing substances and to continue its work to qualify the reference packages known as "12H".

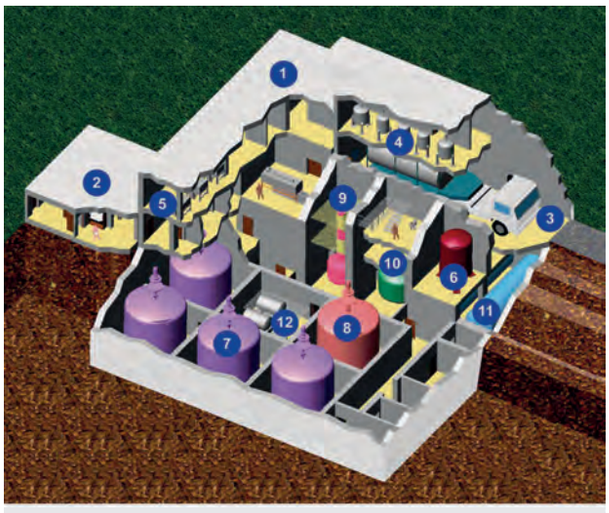
DIADEM project

In November 2007, CEA sent ASN a file of safety options concerning a new project, DIADEM, to be located in Marcoule for storage of irradiating waste, plus decommissioning of the PHÉNIX facility. This storage would be for a period of 50 years, pending the arrival of an appropriate disposal route. ASN issued its position on this report on 1st July 2008, indicating 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. In 2009, CEA informed ASN that the files applying for the DIADEM creation authorisation would be late. CEA should be submitting the creation authorisation application file in 2012. Commissioning of the installation will now take place by mid-2016 at the earliest.

AGATE project

ASN also observes delays in commissioning of the AGATE facility, the creation of which was authorised by decree 2009-332 of 25th March 2009. The AGATE installation will provide evaporation treatment of radioactive liquid effluents mainly from the CEA/Cadarache nuclear installations, comprising primarily beta and gamma radionuclides. The file on commissioning of the AGATE installation was examined by the Advisory Committee in the spring of 2010. After this examination, ASN observed that the safety measures adopted by CEA were satisfactory. It nonetheless asked CEA to present and justify the strategy adopted for processing of the concentrates produced by the AGATE facility, taking account of any problems with handling of these concentrates by the Marcoule effluents treatment station. At its session of 16th November 2011, the CSLUD[3] noted the technical feasibility of bituminisation of the AGATE concentrates in the Marcoule STEL. However, it reminded CEA of the need to continue research on development of packaging of these same concentrates by cementation in the STEL, once it has been renovated and the waste treatment processes modified. Commissioning of the AGATE facility was repeatedly postponed and is now planned for the second half of 2012.

In the light of the important issues linked to the commissioning of these facilities, ASN regularly reminds CEA of its undertakings to provide operational waste management routes.



1. Process Building
2. Cloakrooms building
3. Truck hall
4. Reagents area
5. Radiological and chemical analyses laboratory
6. Transfer tank
7. Upstream liquid storage tanks
8. Assembly tank
9. Evaporator
10. Concentrates tanks
11. Distillates tanks
12. Industrial effluents tanks

Cross-section of the AGATE project in Cadarache

CEDRA facility

Decree 2004-1043 of 4th October 2004 authorised CEA to create the CEDRA (packaging and storage of radioactive waste) basic nuclear installation 164 on the Cadarache site. The purpose of the facility is to treat low and intermediate level, long-lived waste and store packages of low and intermediate level waste. This storage would be for a period of 50 years, pending the arrival of an appropriate disposal route.

In April 2006, ASN authorised start-up of the storage facility for low-level waste (two storage buildings) and intermediate level waste (one storage building).

The inspections performed by ASN on the CEDRA facility mainly concern the package acceptance conditions (acceptance file, transfer of responsibility on the site, radioactivity measurement, handling in the storage buildings) and the conditions for this transfer to the ANDRA repositories as applicable.

ASN drew CEA's attention to the need to make plans to build and commission extensions to the CEDRA facility, so that the capacity needed to store the amount of waste to be managed is available on time. CEA stated that the currently available data indicate that the maximum storage capacity for low and intermediate level waste will be reached in 2019 and 2018 respectively.

Retrieval of legacy waste

On the Saclay site

BNI 72

The decree of 14th June 1971 authorises CEA to modify the facilities in the Saclay nuclear research centre by building a zone for management of radioactive solid waste (BNI 72). BNI 72 provides waste storage and packaging as well as waste recovery from small producers (sources, scintillating liquids, ion exchanger resins) and storage of radioactive sources. At the beginning of 2009, at the request of ASN, the competent Advisory Committee examined the periodic safety review file for the solid waste management zone. At that time, CEA made a number of commitments, in particular to shut down the installation's waste treatment units within a period of 10 years and, within the same time-frame, to remove the fuel stored in the pool and the fuel stored in the blocks.

At the request of ASN, CEA transmitted the BNI 72 decommissioning plan in 2011. CEA should be forwarding its authorisation application file for final shutdown in 2017, as requested by ASN following the facility's periodic safety review in 2009. At its request, CEA also sent ASN the calendar of removal from storage of waste, fuels, sources and materials with no further use inside the facility. These projects will require considerable technical and human resources.

By means of periodic meetings, ASN checks the licensee's progress with regard to its undertakings. It notes that there are delays in meeting the deadlines set for some of the undertakings.

BNI 35

The progress of the operations to recover legacy effluent stored in BNI 35, pending initial processing and then clean-out of the facility's old buildings, are among CEA's priorities concerning this facility. The first operations were performed to recover the organic radioactive effluent stored in tank HA4

3. Safety commission for laboratories and plants, reporting to the ASND

and a part of the effluent was removed to the ATALANTE treatment facility. The end of the clear-out operations is scheduled for 2013. The decree of 8th January 2004 states that tank HA4 and the other radioactive effluents contained in the MA 500 tanks of building 393 must be removed from storage before 8th January 2014.

On the Cadarache site

The radioactive waste storage area
The radioactive waste storage area (BNI 56) in Cadarache was the subject of notification SJC 68/036 of 8th January 1968 to the Ministry responsible for scientific research and atomic and space questions, under the title "Final disposal area for solid waste" concerning the solid waste disposal area and the trenches disposal area. The main purpose of this facility is storage of legacy radioactive solid waste (ILW-LL) from operation or decommissioning of CEA facilities and which cannot be sent to the Aube surface repository. The waste is stored there in pits, in trenches, in warehouses and, for the VLL waste, in a dedicated area.

A part of the Cadarache interim storage facility consists of five trenches which, between 1969 and 1974, were filled with a variety of low and intermediate level solid waste, then covered with earth. The facility was at the time an experimental waste disposal facility. An ASN inspection on 17th March 2011 brought to light shortcomings in CEA's surveillance of the contractors responsible for waste recovery. CEA then took the initiative of suspending the work to recover the waste from this trench T2 in order to integrate ASN's observations. The T2 recovery work restarted on 23rd May 2011.

Recovery of waste from the other trenches will require major modifications to the facility. In 2011, ASN informed the CEA that the examination of these modifications should be included in the final shutdown and decommissioning application file (MAD-DEM) expected no later than the second quarter of 2013.

In its old pits, BNI 56 also stores intermediate level waste in conditions which no longer meet current safety standards. In April 2009, ASN also approved the recovery operations from pits F5 and F6, provided that certain reservations are taken into account. In order to address the problems encountered when recovering waste from pits, CEA intends to make major modifications to the facility. ASN informed CEA that these modifications will be reviewed as part of the MAD-DEM file.

BNI 22
The PEGASE reactor in BNI 22 entered service in 1964 and was then operated for about ten years. By decree of 17th September 1980, CEA was authorised to reuse the PEGASE facilities to store spent fuel elements.

Pegase is now an installation mainly storing spent fuel elements under water or dry and radioactive substances and equipment. Removal of the fuels from storage began in January 2006. By the end of 2013, CEA is required to remove all the drums of plutonium-bearing by-products stored in the PEGASE premises, along with fuel elements.

In the decree of 4th September 1989, CEA was authorised to modify the PEGASE facility to create a dry storage facility for CASCAD spent fuel. On the basis of the facility's periodic safety review file, and on the advice of IRSN, ASN in June 2010 approved the continued operation of the CASCAD facility, provided that a number of measures were taken. By means of periodic meetings, ASN also ensures that steps identified following the periodic safety review are implemented and that the associated deadlines are met.

Renovation or shutdown of old facilities

BNI 37
The effluent and waste treatment station (BNI 37), notified by CEA in a letter of 27th May 1964, processes and packages liquid and solid radioactive waste from the Cadarache centre.

In 2008, ASN examined the safety options file for the reinforcements programmed by CEA to ensure the continued operation of part of the solid waste treatment stations (STDS) in BNI 37. In 2011, CEA informed ASN that further analysis of the seismic risk at the location of the facility meant that it was modifying its strategy. Given the central role of the STDS in BNI 37 for management of CEA radioactive waste, technical discussions were held in 2011 between ASN and the licensee in order to clarify the strategy chosen by CEA for this facility. These discussions in particular concerned the programme to reinforce the facility, the technical conditions envisaged by the licensee and the administrative conditions for their implementation. ASN observes that CEA's strategy with regard to this facility has been changing over the past two years. ASN reminded CEA that the facility review file must be transmitted no later than the first quarter of 2012 so that it can be examined by the Advisory Committee. ASN also informed CEA that proposals to reinforce the facility will be the subject of particularly close scrutiny during this examination.

In its decision 2011-DC-0208 of 27th January 2011, ASN stated that the effluent treatment station (STE) in BNI 37 should no longer receive radioactive effluents as of 1st January 2012. ASN also stated that use of the STE's treatment units must cease no later than two years after the facility stops receiving radioactive effluents.

The waste treatment stations on the CEA sites at Fontenay-aux-Roses (BNI 73) and Grenoble (BNI 79) provide interim storage capacity for fuel elements or high level waste in pits and/or blocks. CEA has initiated a programme to recover this waste as part of the delicensing of the Grenoble and Fontenay-aux-Roses sites (see chapter 15).

1|3|2 AREVA waste management

a) AREVA waste management strategy
The spent fuel reprocessing plant at La Hague produces most of AREVA's radioactive waste. The fuel cycle installations are described in chapter 13. The waste present on the La Hague site comprise on the one hand that resulting from reprocessing of the spent fuel from the nuclear power plants and, on the other, the waste linked to operation of the facilities of the La Hague plant itself. Most of this waste remains the property of the licensees of nuclear power plants (French, such as EDF, or foreign) which have their spent fuel processed.

b) The issues and implications

The main issues relating to the management of waste from the licensee AREVA concern:

– the safety of the storage facilities for the legacy waste present on the La Hague site. ASN also noted recurring delays in recovery of legacy waste from La Hague and the lack of an integrated view within the establishment for ranking of the legacy waste recovery projects in the light of the safety issues surrounding storage (see Chapter 13),
– the definition of solutions for waste packaging, in particular the legacy waste.

It should be recalled that the 28th June 2006 Act on the sustainable management of radioactive materials and waste requires that ILW-LL waste produced before 2015 be packaged no later than the end of 2030. ASN therefore reminded AREVA of the need to define and finalise solutions for packaging this waste within a time-frame enabling the 2030 deadline to be met. These solutions will have to be approved by ASN beforehand. Moreover, on the basis of the recommendations from the Advisory Committee issued during examination of the decommissioning conditions for BNIs 33, 38 and 47, ASN reminded AREVA of the need to continue the qualification studies for the packaging processes for the waste resulting from reprocessing of gas-cooled reactor fuels (UNGG) in order to meet the decommissioning schedules for the facilities concerned.

In September 2008, subsequent to the meeting of the Advisory Committee to deal with the BNI 118 safety review, ASN issued a decision banning bituminisation of the STE2 sludges and asked AREVA to continue to look for an alternative process for sludge bituminisation. These sludges, representing 3,400 tons of salts, were produced between 1966 and the late 1990s and are the result of reprocessing of radioactive effluents from the UP2-400 plant units or the CEA research centres. AREVA presented ASN with a project for an alternative package (known as C5) consisting of pellets of compacted waste, placed in a container filled with an inert material. After obtaining the opinions of IRSN and ANDRA, ASN asked AREVA, in decision 2011-DC-0206 of 4th January 2011, to continue with its studies and demonstrations regarding the properties of the package, in order to be able to rule on the acceptability of this package for subsequent disposal.

Moreover, in its decision 2010-DC-0176 of 23rd February 2010, ASN asked AREVA by February 2012 to present the progress of its work to define an alternative waste package, known as S5, for packaging alpha technological waste, produced primarily by the La Hague and MELOX plants. ASN considers that the S5 package does not offer sufficient guarantees for long-term storage and for disposal in deep geological formations.

c) The ECRIN facility operated by COMURHEX Malvési

The waste produced by the facility is stored on the Malvési site in former settling tanks named B1 and B2. This waste chiefly contains natural radionuclides. However, some traces of artificial radionuclides, as a result of reprocessing of spent fuels, carried out in the facility until 1983, have been detected in these ponds. The storage facilities consequently fall under the BNI regime.

In compliance with the ASN Commission's decision of 22nd December 2009, the COMURHEX company submitted a license application for the creation of a BNI at the end of 2010. ASN and its technical support organisation are currently examining this file.

On 31st December 2011, COMURHEX submitted a study to the ministers for energy, nuclear safety and radiation protection, proposing safe long-term management routes for the waste currently being stored in the B1 and B2 settling ponds in its Malvési establishment, along with the management procedures for new waste produced by operations in the Malvési facilities. This study is being examined by ASN.

1|3|3 EDF waste management

a) EDF waste management strategy

The waste produced by EDF nuclear power plants is activated waste (from reactor cores) and waste resulting from plant operation and maintenance. To this can be added the legacy waste and waste resulting from ongoing decommissioning operations. 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

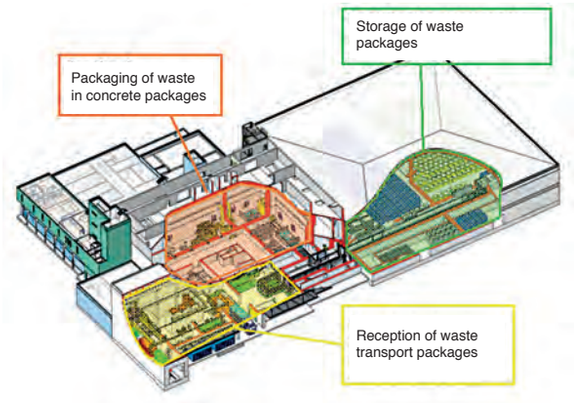
This waste comprises control rod assemblies and poison rod assemblies used for reactor operations. This is long-lived intermediate level waste produced in small quantities. It is at present stored in pools in the power plants, pending storage in the future centralised ICEDA facility located on the Bugey site, the creation of which was authorised by decree 2010-402 of 23rd April 2010. 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. In 2011, ASN continued its civil engineering inspections to ensure that a number of important civil engineering operations were being carried out correctly. More than one year after the construction work began, concreting of the floors of the main buildings has been completed. The building roof slabs and the various beams are currently being poured. ASN considers that monitoring of the construction work is satisfactory.

It must however be remembered that in its judgement of 6th January 2012, the administrative court of Lyon cancelled the building permit for the facility. This cancellation is liable to delay the anticipated facility commissioning schedule, planned by EDF for early 2014.

Operating and maintenance waste

Some of the waste is reprocessed by the Centraco facility in Marcoule in order to reduce the volume of ultimate waste. The other types of operating and maintenance waste are disposed of in the Aube repository and in the Morvilliers VLL repository for the particularly low level waste. It contains beta and gamma emitters but few or no alpha emitters. Some of the waste is reprocessed by the Centraco facility in Marcoule in order to reduce the volume of ultimate waste. The other types of operating and maintenance waste are disposed of in the Aube repository and in the Morvilliers

Basins B1 and B2 of the plant for conversion of natural uranium into UF_4 on the COMURHEX Malvési site



View of the ICEDA project

VLL repository for the particularly low level waste. It contains beta and gamma emitters but few or no alpha emitters.

b) The issues and implications

The main issues related to the EDF waste management strategy concern:

– *the management of legacy waste*. This primarily concerns structural waste (graphite sleeves) from the gas-cooled reactor fuels. This is low level, long-lived waste (LLW-LL) 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. Graphite waste is also present in the form of stacks in the gas-cooled reactors currently being decommissioned.
In the light of the postponed opening of the repository which was to take the graphite waste, ASN asked EDF to look at a possible intermediate graphite storage programme to accompany the gas-cooled reactor decommissioning programme (see chapter 15). ASN is waiting for the 2012 deadline on developments regarding the creation of a repository for graphite waste in order to specify its expectations on this point.
The graphite sleeves containing gas-cooled reactor fuel elements and technological waste were stored in the silos at Saint-Laurent (BNI 74) from 1971 to 1994. These silos consist of two semi-buried reinforced concrete bunkers, made leaktight by a steel liner. In 2003, following the review of the facility's baseline safety requirements, and bearing in mind EDF's undertaking to empty the silos by 2010, ASN authorised continued operation of the silos. Given the delay in the search for a site for the graphite waste repository and in response to ASN's request for definition of an alternative strategy to guarantee the safe management of this waste, EDF in July 2007 presented a solution which was to place a containment barrier around the silos. In July 2008, ASN approved the principle of a geotechnical containment around the silos, subject to the provision of a certain amount of additional data, which was subsequently made available by EDF in 2009. The geotechnical containment installation work was carried out in 2010. Following transmission by the licensee in January 2010, ASN referred the facility's periodic safety review file, modified accordingly, to IRSN. ASN in particular wants the IRSN to analyse the data concerning the effectiveness of the geotechnical containment and associated equipment. ASN will issue a position statement on this file in early 2012.

– *changes linked to the fuel cycle*. EDF fuel use policy (see chapter 12) has consequences for the fuel cycle installations (see chapter 13) and for the quantity and nature of the waste produced. This subject was examined by the Advisory Committees for reactors, for plants and for waste at the end of 2001 and 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. This file was examined on 30th June 2010 by the Advisory Committees for laboratories and plants and for waste. Following this examination. In its letter of 5th May 2011, ASN asked EDF to implement a more rigorous policy for managing its storage capacity for substances before their disposal or their treatment or reprocessing. More specifically with regard to waste, EDF must for example ensure that the available packaging containers can meet the disposal needs.

The CENTRACO low-level waste processing and packaging centre, located in Codolet near the Marcoule site (Gard *département*[4]), is operated by SOCODEI, a subsidiary of EDF. This facility was authorised by an amended decree dated 27th August 1996 and entered service in 1999. The purpose of the CENTRACO facility is to process low or very low level waste by melting of metal waste or incineration of incinerable waste such as the clothing worn by staff intervening in nuclear facilities (gloves, suits), oils, solvents, resins, etc. The melting process consists in treating primarily ferrous metal waste (valves, pumps, pipes, tools, etc.) generated by maintenance and by decommissioning of nuclear facilities.

Owing to the many deviations observed in 2008, the ASN Chairman asked the licensee to draw up a safety improvement plan for its facility. ASN also reinforced its checks to ensure that this plan was effectively implemented. Nine inspections were carried out in 2009, five in 2010 and eight in 2011.

4. Administrative region headed by a *préfet*

CENTRACO plant in Marcoule: drums and ingots before they leave for ANDRA's surface repository in Soulaines

On 12th September 2011, an explosion in the melting furnace killed one employee and injured four others, including one seriously. From its national emergency centre, which was rapidly activated following the CENTRACO accident, ASN analysed the developing situation and informed the public, with the help of the information supplied by IRSN and that supplied by the licensee and the fire brigade's specialised services.

ASN went to the site as soon as the accident happened and ordered a reactive inspection on Tuesday 13th September, in order to clarify the circumstances of the accident. This inspection lasted several days, ending on Thursday 22nd September 2011.

A judicial inquiry was opened at the same time as ASN was carrying out its investigations. During the course of this judicial inquiry and then the subsequent criminal investigation for unintentional injury and manslaughter, ASN was requisitioned to provide technical assistance to the court. During this mission, the ASN inspectors thus had access to all the documents and premises placed under seal, for the purposes of their investigations. A copy of the ASN interim technical report was transmitted to the courts at the end of 2011. This information, which is *sub judice*, could not follow ASN's usual public communication procedures.

Following the technical checks conducted by the inspectors after the accident, ASN specified that the activity contained in the furnace at the time of the accident was about 30 mega becquerels (MBq) and not 63 kilo becquerels (kBq) as had been stated by the licensee on the day of the accident. Based on the results of an analysis of a sample of metal taken from the furnace, the specific activity of the melted waste was 7.7 Bq/g and the mass of waste in the furnace about 4 tonnes. According to the results of the sample analysis, the main radionuclides present were cobalt-60 and manganese-54. Although this remains a low value, ASN did however ask the licensee for explanations regarding this under-evaluation.

On the occasion of an inspection carried out on 4th October 2011, the inspectors focused on determining the exact reasons for this erroneous value being transmitted. It appeared that this under-estimation was the result of a human error in the initial evaluation of this activity level, with the licensee's procedures subsequently being unable to either identify or correct this under-estimation before it was communicated. The licensee told the inspectors that it had identified this error the day following the accident and had mentioned it at the meeting of the local information committee (CLI) on 14th September. ASN finds it regrettable that at the session of the High Committee for Transparency and Information on Nuclear Security (HCTISN) held on 15th September 2011, the SOCODEI representative did not mention this rectified information.

ASN asked the licensee to review its operational emergency management procedures to ensure that the data transmitted, in particular the figures, be systematically checked beforehand. This appears in the inspection follow-up letter appended to this correspondence.

This accident did not lead to any dispersal of radioactivity into the environment. The premises housing the furnace were partially damaged by the accident. However, the fusion unit building containing the furnace area was not damaged. The furnace area, which was placed under seal by the public prosecutor's office for the purposes of the judicial inquiry, is not accessible.

Without prejudice to any measures that may be taken under the judicial procedure, ASN in a decision dated 27th September 2011, stipulated that it would need to issue prior approval before any restart of the melting and incineration furnaces, which were shut down shortly after the accident. As at 31st December 2011, no restart authorisation had been given.

During the course of 2012, ASN intends to examine the facility's periodic safety review file forwarded by the licensee in February 2011. This examination will be an opportunity to review the conformity of the facility, evaluate its status with respect to the best practices and examine the steps taken by the licensee to guarantee operating safety.

1|3|4 Management of waste from small-scale nuclear activities[5]

a) Management of waste from non-BNI nuclear activities

Issues and implications

The use of unsealed sources in nuclear medicine, biomedical or industrial research creates solid and liquid waste: small laboratory items used to prepare sources, medical equipment used for administration, leftovers of meals eaten by patients who had received diagnostic or therapeutic doses, etc. Radioactive liquid effluents also come from source preparation as well as from patients who naturally eliminate the radioactivity administered to them.

The diversity of waste from small-scale nuclear activities, the large number of establishments which produce it and the radiation protection issues involved have all led the public authorities to tighten the management of the waste generated by these activities.

5. Small-scale nuclear activities correspond to all installations using ionising radiation but not covered by the BNI regime. Small-scale nuclear activities concern many fields such as medicine (radiology, radiotherapy, nuclear medicine), human biology, research and industry.

Implementation of ASN decision 2008-DC-0095

ASN decision 2008-DC-0095 of 29th January 2008 lays out the technical rules to be met by the disposal of effluents and waste contaminated or potentially contaminated by radionuclides owing to a nuclear activity[6]. This decision incorporates the main provisions of the circular from the Minister responsible for Health (DGS/DHOS no.2001/323 of 9th July 2001) which only applied to medical activities.

Following consultation of the stakeholders, ASN will in early 2012 publish the guide for application of this decision, which specifies the good practices for management of effluents and waste produced by BNI nuclear activities.

On the occasion of the consultation about the ASN draft guide, the professionals pointed out that some of the requirements were not suited to their particular situation, or that there were problems with practical implementation of certain requirements, such as that concerning installation of a permanent detection system in establishments with a nuclear medicine unit. ASN notes that these problems are for example linked to the diversity of situations encountered in the various industrial, university and medical domains to which the decision applies.

ASN will make good use of the information sent to it by the stakeholders during the consultation, as well as experience feedback from its inspections, in order to propose any necessary changes to the text.

b) Management of waste containing enhanced natural radioactivity

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 under the regime of installations classified on environmental protection grounds (ICPE).

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*[7], 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) of 25th July 2006 stipulates the conditions for acceptance of waste containing enhanced natural or concentrated radioactivity in disposal facilities;
– 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 disposal centre for long-lived, low level waste.

In 2004 and 2008, ASN tasked the Robin des Bois association with carrying out two surveys, which more accurately identified the potential sources of occupational and general public exposure to ionising radiation from enhanced natural radioactivity. Under the terms of the PNGMDR, ASN in July 2009, forwarded its report on the management solutions for waste with enhanced natural radioactivity to the Ministers for Environment and Health. The conclusions of this report do not call into question the existing management solutions. However, ASN also made recommendations for improvement of management routes for disposal of this type of waste. Most of these recommendations are focused on ICPEs. On these subjects, ASN works together with the Ministry for the Environment. The PNGMDR 2010-2012 also incorporates the main recommendations made by ASN and defines late 2011 as the deadline for production of a review of implementation of the circular of 25th July 2006, and late 2012 as the deadline for provision by ANDRA of storage solutions for some of the waste containing enhanced natural radioactivity.

Guide no.18: Disposal of effluents and waste contaminated by radionuclides, produced in facilities licensed under the Public Health Code.

6. The nuclear activities concerned by the decision are those mentioned in article R.1333-12 of the Public Health Code, that is all authorised or notified nuclear activities (including nuclear activities intended for medicine, human biology or biomedical research) with the exception of those carried out in the following facilities:
– basic nuclear installations mentioned in III of article 28 of Act 2006-686 of 13th June 2006 concerning transparency and security in the nuclear field (BNI);
– nuclear installations and activities mentioned in III of article 2 of Act 2006-686 of 13th June 2006 concerning transparency and security in the nuclear field (BNI), that is defence-related nuclear activities and installations;
– installations classified on environmental protection grounds subject to authorisation pursuant to articles L. 511-1 to L. 517-2 of the Environment Code (ICPE);
– installations subject to authorisation pursuant to article L153-3 of the new Mining Code

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

c) Management of mining residues and mining waste rock

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. Ore processing however was carried out in 8 plants. The former uranium mines are now almost all under the responsibility of AREVA NC.

The Mining Code applies to mining activities, both during operation of the mine and until the end of the validity of the mine title. The Environment Code applies to residue disposal areas. Finally, the Public Health Code and the Labour Code guarantee radiation protection of the public and workers.

The uranium mine workings produced two categories of products:
– mining waste rock, comprising the soil and rock excavated to access the minerals of interest;
– 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.

In France, treatment residues represent 50 million tonnes spread over 17 disposal sites. These disposal sites can cover surface areas varying from one to several tens of hectares, and enclosing from a few thousand to several million tonnes of residues. The radioactivity measurements carried out on the disposal sites give values of the same order as the measurements taken in the environment of the site.

Regulatory context

The uranium mines and their annexes are covered by the Mining Code. The mining regulator focuses primarily on operation and on conventional mining risks, without taking specific account of radiation protection issues. It also deals with the site closure conditions. Operation of the French mines is based on a system of concessions, most of which will expire on a common date in 2018, set by the Mining Code.

The mining residue disposal sites are covered by the regime of installations classified on environmental protection grounds. Decree 2006-1454 of 24th November 2006 created a specific section 1735[8] for these sites.

The Ministry for the Environment and ASN issued a circular on 22nd July 2009 defining a plan of action comprising the following working topics: monitor the former mining sites, improve understanding of the environmental and health impact of the former uranium mines and their surveillance, manage the waste rock (better identify its uses and reduce impacts if necessary), reinforce information and consultation. In a letter of 12th June 2009, the Chairman of AREVA NC undertook to implement an action plan to help apply these measures, alongside measures taken under the aegis of the State's services.

Aerial view of the Bellezane mining site, La Crouzille mining division, in 1984

Redeveloped Bellezane open-cast mines 105 and 68, former La Crouzille mining division, in 2001

Issues and current measures

The long-term behaviour of the mining residue disposal sites

Redevelopment of the uranium processing residues disposal sites consisted in placing a solid cover over the residues to provide a protective barrier to limit the risks of intrusion, erosion, dispersion of the products on the site and the risks of external and internal (radon) exposure of the surrounding populations.

Article 4 of Act 2006-739 of 28th 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. On 25th August 2009 (see ASN opinion 2009-AV-0075) ASN sent the Minister for the Environment its opinion of the studies submitted by AREVA. ASN considers that the studies concerning the residue disposal sites need to be continued and added to in the coming years.

The PNGMDR 2010-2012 is based on the opinion submitted by ASN and specifies the additional studies to be performed

8. Radioactive substances (depot, storage or disposal) in the form of solid residues of uranium, thorium or radium ore, as well as their reprocessing products containing no uranium with isotope 235 enrichment, the quantity of which is greater than 1 tonne.

by AREVA over the next few years concerning management of the residues disposal sites and the management of mining waste rock. The requests in particular concern the additional information to be provided by AREVA concerning the characterisation of mining residues, the long-term strength of the embankments surrounding the mining residue disposal sites and the long-term radiological impact of the residue stocks and waste dumps. AREVA will also have to study the feasibility and pertinence of reinforcing the quality of the covering on the mining residue disposal sites, evaluate current and future practices for mining site water treatment and the associated discharges, for example with regard to the chemical and radiological risks. Finally, AREVA will need to inventory the mining waste rock present in the public domain and evaluate its dosimetric impact.

ASN regularly follows up the requests made in accordance with the PNGMDR and periodically conducts joint reviews with AREVA NC to check the progress of the work and identify any difficulties.

At its request, ASN and the MEEDTL met with the Bois Noirs association in January 2011, which wanted to present the concerns of the residents living near the Bois Noirs-Limouzat mining site (*commune*[9] of Saint-Priest-la-Prugne) with regard to AREVA's plans to dry out the layer of water covering the mining residues. ASN asked representatives of the association to take part in the plenary sessions of the PNGMDR working group when it deals with management of former mining sites.

Reuse of waste rock in the public domain

Most of the waste rock remains on the site where it was produced (mine in-fill, redevelopment work or waste dumps). Nonetheless, mining waste rock may have been used as backfill, in earthworks or for road beds on locations near the mining sites. Although since 1984 the transfer of waste rock to the public domain has been traced and sometimes carried out in compliance with orders from the préfet to the quarry operators, the picture is incomplete with regard to transfers prior to 1984. ASN and the Ministry for the Environment asked AREVA to inventory the mining waste rock reused in the public domain, in order to verify that these uses are compatible and to reduce the impacts if necessary.

AREVA carried out helicopter-borne measurement campaigns around former French mining sites between November 2009 and the end of 2010. The areas overflown are the *départements* of Creuse, Corrèze, Saône-et-Loire, Allier, Puy-de-Dôme, Lozère, Loire, Nièvre, Morbihan and Vendée. The data then underwent statistical processing to identify the geographical areas that require verification on the ground. No situation requiring emergency intervention has so far been identified. The reconnaissance and ground verification phase began in 2011 and will continue until early 2013. The inventory of waste rock will only be known after completion of all of the ground reconnaissance operations. ASN is remaining particularly vigilant to monitoring of these various phases and to any situation which could require additional measures.

In 2011, AREVA completed its inventory of mining waste rock in the Creuse and Corrèze *départements*.

AREVA sent ASN a proposed methodology for evaluating usage compatibility and the management methods for the waste rock that could be removed. This file is currently being examined by ASN, which will issue a position statement on the acceptability of the methodology proposed by AREVA early in 2012.

ASN considers the public must be involved in the management of waste rock in the public domain, and indeed management of redeveloped former mining sites. The steps taken pursuant to the MEDDTL and ASN circular of 22nd July 2009, the PNGMDR and the GEP Limousin, make provision for involving the stakeholders in the deliberations and the measures to be taken.

The Ministry for the Environment, the Ministry for Industry and the Ministry for Solidarity, Health and the Family decided as early as 2005 to set up and finance a pluralistic expert group (GEP) to provide third-party assessment of the redevelopment of the former mining sites in the Limousin. On 15th September 2010, the GEP Limousin submitted its final report and its recommendations to the Minister for the Environment and the ASN Chairman, concerning the short, medium and long term management of former uranium mining sites in France. The GEP noted the considerable progress made in recent years on the subject of mining sites, both in the Limousin and nationally. The Group is of the opinion that this progress should be continued and be broadened in order to develop a clear perspective on the sustainable management of these sites over the next decade. The ASN Chairman and the Minister for the Environment have made a commitment to the GEP to examine the ways and means for implementation of these recommendations and to ensure follow-up as part of the remit of the PNGMDR working group. The Ministry for the Environment and ASN asked the GEP Chair in May 2011 to present its conclusions and recommendations to the local and national consultative bodies and, by the end of 2012, to evaluate the implementation of these recommendations.

ASN and the MEDDTL drafted an action plan designed to implement the main GEP recommendations. The main areas of work were presented to the GEP at its December 2011 session. They will be applied operationally.

ASN is a member of the steering committee for the national inventory of uranium mining sites, MIMAUSA (History and impact of uranium mines: summary and archives; *www.irsn.fr*), under the aegis of the Ministry for the Environment. This inventory will be supplemented by an inventory of mining waste rock by 2014, as well as by a review of the situation of the former mining sites as identified by the AREVA surveys and IRSN's verifications and measurements in the field. The local authorities were kept informed of the results of the actions taken on the former mining sites in Brittany and the Limousin.

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

From 14th to 16th September 2010, experts from the European Commission, in accordance with article 35 of the Euratom Treaty[10], carried out an independent assessment of the regulatory systems and the organisation put into place in France to check and monitor the radioactive releases from the former uranium mining sites in the Limousin *région* as well as the radioactivity levels in the environment around these former mining sites. Based on what they saw in the Limousin and in the light of the answers provided both by the authorities and by the licensee AREVA, the Commission's experts considered that the requirements of article 35 are met with regard for the French former uranium mining sites. The experts noted the high level of expertise in France on this subject and in particular underlined the quality and diversity of the tools used to inform the public. The Commission also hopes that the French authorities and the licensee will be able to share their experience with the other member States of the European Union by developing appropriate ties with these countries.

d) Management by ANDRA of waste from small-scale nuclear activities

Article L.542-12 of the Environment Code entrusts ANDRA with a public service storage mission for waste produced by small-scale nuclear activities (e.g.: research laboratories, hospitals, etc.). Until now, ANDRA has not operated any storage facilities, but has had agreements with other nuclear licensees for access to storage capacity on their facilities. On behalf of ANDRA, CEA thus stores radium lightning rods and used sealed sources for which there is currently no disposal route.

In order to obtain its own storage capacity, ANDRA submitted an application in 2011 for modification of the facilities of the Aube very low level repository (covered by the regime applicable to installations classified on environmental protection grounds) in order to create two new buildings designed to take waste from small-scale nuclear activities. This includes a building for grouping of waste packages so that they can be sent to other facilities in France for treatment and packaging, and a storage building for waste for which there are as yet no dedicated disposal facilities. ASN was approached by the Champagne-Ardenne Regional Directorate for the Environment, Planning and Housing (DREAL). ASN notified the DREAL of its opinion at the end of 2011.

ASN considers that the approach adopted by ANDRA will be such as to meet the duties entrusted to it under Article L.542-12 of the Environment Code. It should however be pointed out that, if authorised, these facilities will not be able to receive tritiated waste, owing to its characteristics. ASN considers that management solutions must be sought for this type of waste. The PNGMDR 2010-2012 thus requires that ANDRA submit a study concerning ways and means of having decay storage facilities accept tritiated waste that cannot be disposed of directly. At the end of 2011, ANDRA submitted the study required by the PNGMDR. This study is currently being examined by ASN.

1|4 Long-term management of radioactive waste

1|4|1 The very low level waste disposal facility (CSTFA)

The CSTFA, located in the Aube *département* on the *communes* of Morvilliers and La Chaise, covers an area of 45 hectares. This ICPE, licensed by order of the *préfet* dated 26th June 2003, offers a disposal capacity of 650,000 m^3 and has been in service since August 2003. Waste treatment operations, such as the compacting or packaging (solidification) of certain very low level (VLL) waste, are carried out prior to disposal.

In 2005 and 2009, ANDRA submitted applications for modifications to the operating conditions regarding the architecture of the centre's vaults, in order to optimize the use of the available volume. These modifications are subject to the supplementary orders of the *préfet* of 21st July 2006 and 26th March 2010.

1|4|2 Surface repositories for low and intermediate level, short lived waste

Most low and intermediate level waste with a short half-life (less than 30 years) is sent for final disposal in the surface waste repositories operated by ANDRA. The principle underlying these repositories is to protect the waste from hazards, notably water circulation, during what is known as the surveillance phase (by convention 300 years) until such time as its activity level has decayed sufficiently to become negligible. There are two such repositories in France.

a) The Manche repository

The Manche radioactive waste repository (CSM) covers an area of about 15 hectares at the tip of the La Hague peninsular and has a total capacity of 527,225 m^3 of waste packages. It was commissioned in 1969 and was the first radioactive waste repository to be operated in France. Operations at the CSM came to an end in July 1994 and the centre entered the surveillance phase in January 2003 (decree 2003-30 of 10th January 2003).

Isolated problems with the repository covering were identified a few years ago and required limited consolidation work. After consolidation of the "east embankment" in the summer of 2010, ANDRA proceeded to consolidate the "north embankment" in the summer of 2011. This work required authorisation by ASN and is the first step in putting a more long-lasting cover into place. In addition, ASN asked that more work be done to understand the long-term behaviour of the repository. An interim review of the modifications made to the repository cover will be presented within four years, as requested by ASN, on the basis of the opinion issued by the Advisory Committee for waste in 2009.

ASN also had this Advisory Committee examine the final safety report, the general monitoring rules, the regulation monitoring plan and the on-site emergency plan. In response to requests

10. Article 35 of the Euratom Treaty states that "each Member State shall establish facilities necessary to carry out continuous monitoring of the levels of radioactivity in air, water and soil and to ensure compliance with the basic safety standards.
The European Commission has the right of access to such facilities in order that it may verify their operation and efficiency."

from ASN, ANDRA in 2011 submitted a new version of its on-site emergency plan, the regulation monitoring plan and the general monitoring rules, which were the subject of an agreement with ASN. These modifications led ASN to undertake work to revise the prescriptions of the order governing discharges and releases.

Finally, in accordance with the recommendations of the commission assessing the situation of the Manche repository (known as the "Turpin Commission"), ANDRA in March 2008 drafted an interim version of the "Concise History" intended to preserve essential information about the CSM repository for future generations. In 2012, a reassessment will be made of the exhaustiveness and completeness of this information.

b) The low and intermediate level short-lived waste repository in the Aube

In 1992, the low and intermediate level waste repository of the Aube (CSA) took over from the Manche repository, taking full advantage of the operating experience feedback gained from it. This installation was authorised by the decree of 4 September 1989[11] and commissioned in January 1992. It is located in Soulaines-Dhuys (Aube) and has a disposal capacity of 1 million m^3 of waste, distributed among 400 disposal structures. The operations performed in the facility comprise packaging of the waste, either by injecting mortar into 5 or 10 m^3 metal containers, or by compacting 200 litre drums.

Waste containment is achieved by three consecutive barriers: the package, the covering and the ground in which the repository is engineered. The repository's activities therefore generate a very small quantity of radioactive effluents. These are regulated by the order of 21st August 2006 authorising ANDRA to discharge liquid and gaseous effluents and to intake water for the Aube repository.

In 2010, a health investigation was carried out around the repository by the Health Monitoring Institute (InVS) at the request of the "Citoyens du Coin" interest group and local elected officials. The results of this survey brought to light no link between the repository and any health effects. They were sent to the Soulaines CLI in late October 2010.

In 2010, operations in the repository were marked by the appearance of unusual cracks on the basemats of certain structures of the tranche under construction (tranche 8). According to the licensee, these anomalies are attributable to a change in the cement used for the basemat concrete. In the summer of 2011, following ASN approval, ANDRA initiated a modification concerning adaptation of the layer, the shape, the slope of the structures and injection of resin into the cracks in order to reinforce the tightness of the basemats.

In 2011, ANDRA submitted a request for modification of the facilities to allow X-ray imaging inspections, tritium degassing checks and destructive tests (core sampling of low level packages) on the site, in addition to the non-destructive checks already carried out (visual, radiological, dimensional, gamma spectrometry checks). This modification request is currently being investigated by ASN.

ASN is favourable to the idea of ANDRA acquiring its own high-performance inspection resources to ensure the quality of the packages received in its facilities.

At the end of 2010, ANDRA submitted a request to ASN for authorisation to implement a system of internal authorisations, as specified in article 27 of decree 2007-1557 of 2nd November 2007. The file thus submitted describes the type of operations concerned, the planned internal monitoring system and the ASN information procedures. This application is being examined by ASN, which will reach a decision on this subject in early 2012.

1|4|3 Management of long-lived high and intermediate level waste

The 28th June 2006 Act states that research on the management of long lived, high or intermediate level radioactive waste (HLW/ILW-LL) should be continued in three directions: separation and transmutation of long-lived radioactive elements, reversible disposal in deep geological layers and interim storage. ASN considers that studies in these three directions are on the whole proceeding satisfactorily.

a) Separation/transmutation

Separation/transmutation processes aim to isolate and then transform long-lived radionuclides in radioactive waste into short-lived radionuclides or stable elements. The transmutation of the minor actinides contained in the waste is liable to have an impact on the size of the disposal facility, by reducing both the heating power of the packages placed in it[12] and the repository inventory.

The 28th June 2006 Act on the sustainable management of radioactive materials and waste, as well as the PNGMDR, require that CEA coordinate research into the separation-transmutation of long-lived radioactive elements, together with other research organisations and with ANDRA, concerning the potential impact of the use of this technology on the disposal of waste. By the end of 2012, 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. At the end of 2010, CEA submitted an interim report which, for the various scenarios studied, presented the potential benefits in terms of reducing the harmfulness of the radioactive waste, the impact on the footprint of the future geological disposal facility and the impacts on the cycle installations (fuel fabrication, reactor operation, reprocessing) and on transport operations. This file is currently being examined by the ASN.

b) Storage

The 28th June 2006 Act states that storage studies must be carried out so that *"no later than 2015, new storage facilities can be created or existing facilities modified, to meet the needs, particularly in terms of capacity and duration"*. The need to extend or create interim storage facilities must be surveyed to ensure provision of adequate storage capacities for waste before its final

11. The decree of 4th September 1989 authorising the Commissariat à l'énergie atomique (CEA/ANDRA) to create a radioactive waste disposal facility at Soulaines-Dhuys and La Ville aux Bois (Aube *département*)

12. The greater the heat given off by the packages, the further apart they must be spaced in the repository and the larger the disposal footprint.

disposal. The 28th June 2006 Act gives ANDRA responsibility for continuing interim storage studies. On 31st December 2009, ANDRA submitted a file presenting storage options complementing disposal. ASN asked the Advisory Committee for waste to examine this file together with the "2009 dossier" submitted by ANDRA for the high level and intermediate level, long-lived waste disposal project. At this stage, ASN has no particular comments concerning the analysis of storage requirements prior to disposal, as presented by ANDRA. In its opinion 2011-AV 0118 of 28th July 2011 submitted to the Minister for the Environment and the Minister for Higher Education and Research, ASN does however recommend that the studies be continued by ANDRA together with the producers of the waste concerned, so that sufficient storage capacity prior to disposal of intermediate and high level, long-lived waste is available in good time.

Aerial view of the LLW/ILW-SL (low and intermediate level, short-lived waste) disposal vaults in the Aube LLW/ILW repository

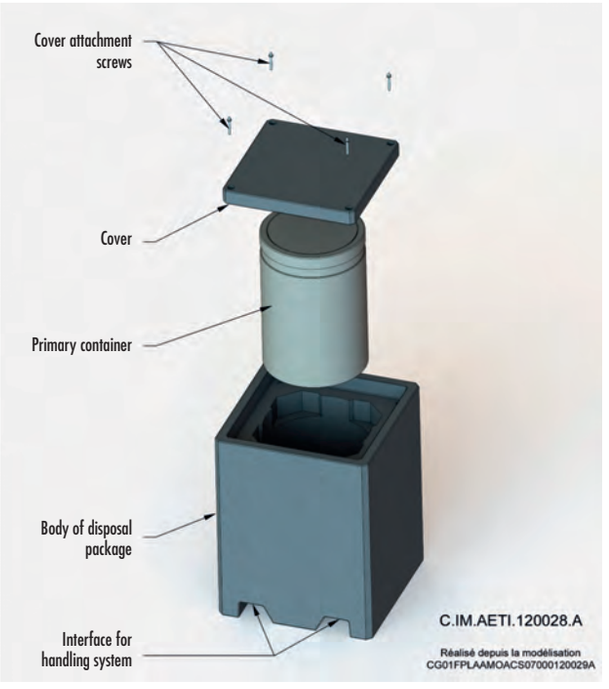
c) Disposal in deep geological formations / CIGEO (industrial geological repository centre) Project

The research work for the deep geological formation waste disposal project is being carried out in the underground laboratory in Meuse/Haute-Marne. The decree of 3rd August 1999 authorised ANDRA to create and operate this underground laboratory within the commune of Bure. In order to continue the studies needed to acquire additional data, particularly with a view to producing the creation authorisation application file for a deep repository, ANDRA presented the Ministers with a request for renewal of the authorisation to operate the laboratory for the period 2012-2030. ASN sent the Director General for the prevention of risks its opinion (no.2011-AV 0118 of 10th May 2011) on the memorandum and draft specifications for the laboratory, presented in the authorisation renewal application file. The memorandum and specifications summarise the research programme already carried out since 2004 and present that envisaged until about 2030, along with the disposal facility project milestones. In its opinion submitted on 10th May 2011, ASN recalled the benefits of continuing the research and experimentation in the Meuse/Haute-Marne underground laboratory, considering this to be essential to the acquisition of the knowledge needed to demonstrate the safety of placing high and intermediate level, long-lived radioactive waste in the same geological formation and to demonstrate the feasibility of its construction, its operation and its closure, in compliance with safety requirements. ASN also issued a certain number of recommendations for the continuation of this research and experimentation work. ASN also issued a favourable opinion (no.2011-AV0123 of 7th July 2011) on the draft decree authorising the national agency for radioactive waste management (ANDRA) to continue to operate an underground laboratory within the *commune* of Bure (Meuse), to study deep geological formations in which the disposal of radioactive waste could take place.

In accordance with the PNGDMR decree of 16th April 2008, ANDRA at the end of 2009 proposed a zone of interest to the Minister for the Environment and the Minister for Higher Education and Research, which was suitable for siting a disposal facility and in which it would conduct detailed geological investigations. On 5th January 2010, ASN gave the Government a favourable opinion on the choice of this 30 km² zone of interest for detailed reconnaissance work (ZIRA), with a view to siting of the underground installations of the future disposal facility and potential zones for siting of the surface installations (ZIIS). ASN also recalled the importance of choosing a site for disposal of high and intermediate level long lived waste, for commissioning of the disposal facility in 2025.

At the end of 2009 and pursuant to the PNGDMR decree of 16th April 2008, ANDRA also forwarded a file presenting an update of safety and reversibility options for disposal in the repository, of the inventory model for the waste packages used for design of the repository and the main design principles for the surface facilities envisaged. The file was examined on 30 November 2010 by the Advisory Committees for waste and for laboratories and plants, on the basis of the report presented by IRSN. ASN more particularly requested an examination of the pertinence of the inventory model for sizing of the repository, the design, safety and reversibility options, as well as the pertinence of the experimentation programme planned for the Meuse/Haute-Marne laboratory, in terms of it enabling ANDRA to provide the data necessary to demonstrate the safety and feasibility of the repository, in good time. ASN also stated that it wanted to see storage concepts studied in addition to those for disposal. ASN considers that the design changes following examination of the "2005 file"[13], primarily concerning aspects relating to the architecture of the facility, are not such as to modify the conclusions with regard to the feasibility of disposal. ASN notified the Ministers for the Environment, Energy and Research of its opinion (opinion no.2011-AV 0129 of 26th July 2011). ASN in particular considers that, since its examination of the 2005 file, ANDRA has developed elements concerning the design, safety and reversibility aspects ensuring management of the risks during operation of the disposal facility. ASN considers that these elements must nonetheless be clarified in the creation authorisation application file for a deep geological layer disposal facility. ANDRA will also need to make a more detailed analysis of some of the risks linked to operation of the facility. With regard to the safety of the repository after its

13. Le dossier 2005 est le dossier présenté par l'ANDRA en 2005 relatif à l'évaluation de la faisabilité d'un stockage en formation géologique profonde dans la formation argileuse étudiée au moyen du laboratoire souterrain de Bure.



Package disposal concept in CIGEO

closure, ASN recommends that ANDRA complete the justifications concerning the feasibility and the performance of the structure seals.

The CIGEO project underwent a project review, headed by Mr Laurent Stricker at the request of the General Directorate for Energy and Climate, in May 2011. This project review in particular concerned the industrial programme input data, to allow the initial facility design studies to be performed, the requirements placed upon the lead contractor, particularly with regard to safety and reversibility, the flexibility of the project so as to leave room for optimisation, as well as the project management organisation adopted by ANDRA.

ANDRA informed ASN that the conclusions of this project review are not liable to call into question the contents of the 2009 file examined. ASN also notes that, following the project review, ANDRA continued to make changes to its organisation, in order to improve project management. These changes are also in response to the comments made by ASN during its 2010 inspection at ANDRA head offices concerning the processes used in the running of the CIGEO project.

ASN, together with its technical support organisation IRSN, defined milestones for the examination of the interim files to be submitted by ANDRA before submission of the repository creation authorisation application, which should take place in early 2015. The purpose of these examinations will in particular be to study the progress made with integration of the recommendations made by ASN on the occasion of its review of the files submitted by ANDRA.

By means of inspections in the Bure underground laboratory, ASN continues to ensure that the experiments carried out as part of the research required by the 28th June 2006 Act are performed in accordance with processes guaranteeing the quality of the results obtained.

In February 2007, ASN published the safety guide for final disposal of radioactive waste in deep geological formations, replacing Basic Safety Rule III.2.f., following the favourable opinion given by the Advisory Committee for waste. In 2008, ASN set up a working group to look more closely at radiation protection values and the safety demonstration as applicable to lengthy time-scales. It conclusions were presented to the Advisory Committee for waste in March 2010. ASN observed, in particular, that the approach described in the safety guide is consistent with the doctrine applied internationally where these subjects are concerned.

1|4|4 Management of long-lived low level waste

Long-lived, low level waste (LLW-LL) comprises two main categories: graphite waste resulting from the decommissioning of the gas cooled reactor (UNGG) nuclear power plants, and radium-bearing waste, from the radium industry and its offshoots. ASN considers that the existing stores for this type of waste do not meet current safety requirements.

In June 2008, ANDRA was asked by the Government to begin a campaign to search for a potential site for a LLW-LL radioactive waste repository in areas with suitable geology. ASN sent the Government a favourable opinion concerning ANDRA's approach to analysing the geological context of the *communes* proposing to host a repository (opinion no.2009-AV-0068 of 15th January 2009). ASN stated that there was nothing, from a geological standpoint, to rule out continued investigation into the siting of a LLW-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 2010, following the failure of the process to search for LLW-LL waste disposal sites, the HCTISN decided to set up the "GT FAVL" working group, tasked with reviewing the available information and the consultation process linked to the creation of the LLW-LL disposal facility. For its part, ASN observed that the deadlines set by the law (commissioning of the repository initially scheduled for late 2013) were too tight and that the "commune" was not the appropriate level for candidatures, in the light of the implications of the project. At its May 2011 interview with the HCTISN working group in charge of experience feedback from the siting process, ASN recommended that the Government and the State be more closely involved in the decision-making process. ASN also recalled that it considered that for safe management of LLW-LL waste, it was important that a solution be defined for this waste in the short term.

The PNGMDR 2010-2012 thus sets new orientations for the LLW-LL waste disposal project. ANDRA must continue its search for a site for the centre, increasing dialogue with the various stakeholders and considering the various possible disposal scenarios, in particular by more closely examining the possibility of separate management of radium-bearing and graphite wastes. By 2012, ANDRA is required to propose a model waste inventory to be considered for the design and sizing of the disposal facility.

1|4|5 Package acceptance in the disposal facilities

In May 1995, in basic safety rule III.2.e, ASN defined requirements concerning approval of the low-level radioactive waste packages in surface repositories. In order to control the quality of the packages it receives on its sites, ANDRA issues package approvals on the basis of a technical file submitted by the waste producer. ANDRA also verities the quality of the packages by means of checks on the packages received in its facilities and through audits and monitoring missions at the waste package producers. These evaluations can if necessary lead to suspension or withdrawal of approval. A summary of the quality of the packages received by the CSFMA is sent to ASN by ANDRA every year.

In 2007, ANDRA for example detected a quality defect on the packages resulting from pyrolysis mineralisation of organic effluents. Production was then suspended. The appraisal carried out by AREVA showed that a modification to the process was the reason for the anomalies detected. 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. An arrangement such as this is now incorporated into the draft decision on radioactive waste packaging currently being finalised.

For intermediate to high level waste packages, ANDRA has not yet defined specifications. Pursuant to the decree of 12th May 1981, AREVA NC must therefore request ASN's approval of the packaging methods for the various types of waste. In 2011, on the basis of IRSN and ANDRA opinions, ASN approved packaging on the La Hague site:
– of solutions of fission products from the R7 and T7 units resulting from the reprocessing of spent fuels from UNGG type gas-cooled reactors, using the cold-crucible technique (CSD-U);
– of intermediate level effluents by vitrification (CSD-B);
– of technological waste and structural elements, sheared into small sections and compacted into cakes (CSD-C) containing dissolver bottom residues. ASN decision 2011-DC-0248 of 25th October 2011 sets out the requirements applicable to the production of this type of CSD-C packages.

By means of its inspections, ASN checks that ANDRA takes adequate steps to ensure the quality of the packages accepted in its disposal facilities. During an inspection in early 2011 at ANDRA head offices, the ASN inspectors reminded ANDRA of the need to tighten up monitoring of the waste producers, in order to ensure the conformity of the packages received in its facilities. In 2011, ASN also carried out an inspection on the quality assurance of the packages from the R7 unit at La Hague. The inspectors carried out spot checks on various package quality and production monitoring indicators. Control of the CSD-B package specifications was considered to be satisfactory.

Type A radioactive waste package

As part of the revision of the general regulations applicable to BNIs, ASN has begun to draft a decision clarifying the requirements regarding waste packaging and the conditions for issue of approval and for monitoring of the producers by ANDRA. This text was opened to consultation on the ASN website in 2010. It will be finalised after the publication of the order defining the technical provisions applicable to BNIs.

ASN exercises particular vigilance in ensuring that the packages produced are in conformity with the conditions of the authorisations and approvals issued. It thus considers that the role of ANDRA in the approvals issue process and in monitoring of the waste package producers is vital to guaranteeing the package quality necessary to comply with the safety demonstration of the waste repositories. ASN therefore considers that ANDRA must acquire the appropriate means to enable it to carry out destructive checks on waste packages, or have them carried out.

2 MANAGEMENT OF SITES AND SOILS CONTAMINATED BY RADIOACTIVITY

A site contaminated 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. For several decades now, the public authorities have devoted continuous efforts to the management of contaminated sites and soils

Contamination by radioactive substances can be the result of industrial, medical or research activities involving radioactive substances. It can concern the places where these activities are carried out, but also their immediate or more remote vicinity. The activities concerned are generally either "nuclear activities" as defined by the Public Health code, or activities concerned by enhanced natural radioactivity, as covered by the order of 25th May 2005. However, most of the sites contaminated by radioactive substances and today requiring management in fact concern past industrial activities, dating back to a time when radioactive hazards were not perceived in the same way as at present. The main industrial sectors from which the radioactive contamination today identified originated are: radium extraction for medical and parapharmaceutical needs, from the early 20th century up to the end of the 1930s; the manufacture and application of luminescent radioactive paint for night vision and the industries working ores such as monazite or zircons. A site contaminated by radioactive substances is managed on a case by case basis, requiring a precise diagnosis of the site and the contamination. Several complementary contaminated site inventories are available to the public: the ANDRA national inventory which comprises the sites identified as contaminated by radioactive substances (the June 2009 edition is available on the *www.andra.fr.* website) as well as the databases available on the web portal of the Ministry for the Environment (*www.sites-pollues.ecologie.gouv.fr*) dedicated to contaminated sites and soils.

In 2011, ASN continued its work with a view to formally writing up the basic principles of its doctrine in the area of management of sites polluted by radioactive substances. It considers that the exposure of individuals to ionising radiation as a result of operations to manage sites polluted by radioactive substances must be kept as low as reasonably achievable in the light of current technology and of economic and social factors. This is why the prime objective is to remove as much radioactive contamination as possible. ASN also believes that the solution involving the contamination being maintained in-situ should not be considered the reference solution for management of sites contaminated by radioactive substances and that this option can only be an interim solution or reserved for cases in which complete clean-out cannot be contemplated owing, in particular, to the volume of waste to be excavated.

ASN also considers that the management of contaminated sites requires public involvement when choosing the solution adopted, in order to create a climate of trust and minimise conflicts.

2|1 Regulatory framework

Article 14 of Planning Act 2006-739 of 28th June 2006 on the sustainable management of radioactive materials and waste states that ANDRA has particular responsibility 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. ANDRA thus has a state subsidy which contributes to financing the missions of public interest entrusted to it. The French National Funding Commission for Radioactive Matters (CNAR), was set up within ANDRA in 2007. The commission is chaired by the executive director of ANDRA and includes representatives from the supervising ministries (Ministries in charge of Environment, Energy and Health), ASN, IRSN, the Association of Mayors of France, environmental defence associations and qualified key figures. The commission met twice in 2011, for example to decide on the allocation of public funds for management of contaminated sites considered to be high-priority, such as Orflam-Plast, Gif-sur-Yvette, Isotopchim, for monitoring the Radium Diagnosis operation and, occasionally, to take charge of certain waste. Since 2010, a scaled-down CNAR has been in place for day to day management of the Radium Diagnosis operation (see following paragraph).

The circular of 17th November 2008 from the Ministry for the Environment, intended for the préfets, describes the applicable administrative procedure for managing sites polluted by radioactive substances covered by the ICPE regime or the Public Health Code, whether the party responsible is solvent or defaulting. In any case, the préfet relies on the opinion of its services, the ASN and the ARS, to validate the rehabilitation project before it is implemented and the objectives for clean-out and for protection of the general public and the workers, pending removal of the contamination or after rehabilitation of the site. He may also recommend public protection or other restrictions.

2|2 Revision of the contaminated sites management methodology guide

The methodology guide for the management of sites potentially contaminated by radioactive substances, produced by ASN, the MEDDTL and IRSN, to update the methodology guide for management of industrial sites potentially contaminated by radioactive substances, which was issued in October 2000, was published on the websites of these entities in late 2011. This new guide describes how to deal with the various situations liable to be encountered when rehabilitating sites (potentially) contaminated by radioactive substances. It is consistent with the methodology chosen for chemical pollution (circulars from the Ministry of the Environment to the Préfets, dated 8th February 2007). A draft version of this guide was opened for consultation from November 2010 to February 2011. ASN, the MEDDTL and IRSN then analysed more than 450 comments sent in by the licensees, administrations, technical experts and other players. The draft guide was also presented to the "SFRP 2011" National Radiation Protection Conference in Tours from 20th to 23rd June 2011, where it received a favourable reception, as well as at the 14th ICEM (International conference on environmental remediation and radioactive waste

management) held in Reims from 20th to 25th September 2011. This draft was also presented in Canada (ICRER 2011) and the United States in April 2011 (12th Superfund).

In addition to drafting this guide, ASN continued its work on clarifying the kinds of restrictions that could be recommended by ASN in the event of management of a site contaminated by radioactive substances and covered by neither the ICPE nor the BNI regimes, in particular in the case of small-scale nuclear activities.

2|3 The Radium Diagnosis operation

In October 2010, the State decided to carry out diagnoses in order to detect and if necessary treat any radium pollution resulting from past activities. This operation concerns 84 sites in the Ile-de-France region and 50 sites in the provinces that have accommodated activities associated with radium, and necessitating diagnosis. Discovered by Pierre and Marie Curie in 1898, radium has been used in certain medical (the first cancer treatments) and craftwork activities (clock-making until the 1950s, due to its property of radioluminescence; manufacture of lightning arresters and cosmetic products).

These medical or craftwork activities, which are not linked to the nuclear industry, can have left traces of radium on certain sites. The diagnosis of the sites having accommodated an activity that used radium is a continuation of the many actions engaged by the State in recent years, such as the rehabilitation of sites on which research and radium extraction activities were carried out at the beginning of the 20th century, or the recovery of radioactive objects from private households, etc.

This operation is free of charge for the occupants of the premises concerned: the diagnosis consists in taking systematic measurements to detect the presence of any traces of radium or to confirm the absence of radium. These measurements are taken by a team of IRSN specialists, accompanied by an ASN coordinator, who first of all makes contact with the occupant in order to describe the operation. On completion of this diagnosis, the occupants are informed verbally of the results, with subsequent written confirmation by post. If traces of contamination are detected, rehabilitation operations are performed by ANDRA free of charge, with the agreement of the property owners. Ultimately, each person concerned is given a certificate guaranteeing the results of the operation.

At the end of 2011, twelve sites in the Ile-de-France region had been or are still being investigated, representing 146 diagnoses (one diagnosis per apartment or house or commercial property).

The sites which underwent diagnosis are residential buildings with common areas, apartments and/or commercial premises, one abandoned industrial site undergoing demolition and private houses.

Five sites were also declared free of contamination. These were sites on which buildings were constructed subsequent to the date of handling of the radium. Checks revealed that no parts of the old building or its annexes, and thus no radium contamination, were still present on the premises.

Of the 146 diagnoses performed by IRSN, 130 premises are free of contamination and 16 diagnoses detected traces of radium: three apartments, five houses, three commercial premises, one abandoned industrial site, one cellar and the common areas of a residential building.

The rehabilitation operations are nearly completed in one apartment and the abandoned industrial site. They will shortly be starting in three private houses, one apartment and a commercial property. The other sites are being studied prior to the rehabilitation work. This should make all these sites compatible with unrestricted use.

Experience feedback, more than one year after the operation started, shows that it is relatively well accepted by the occupants and environmental protection associations. The vast majority of the premises diagnosed are clear of radiological contamination. The pollution levels recorded are low and confirm that there is no health risk; the maximum dosimetry received is less than 2.4 mSv/year (added value), which is approximately the same order of magnitude as the dose received per year by the French population from naturally occurring sources of radioactivity.

In relation to the initial calendar, the end of the first phase in the Ile-de-France region was delayed for two reasons. On the one hand, the number of diagnoses to be performed proved to be higher than expected. An old address for a site which used to house an activity employing radium may now correspond to the location of several private homes. Similarly, a residential building may involve a large number of diagnoses if it comprises numerous apartments and cellars.

In addition, there were delays owing to the pollution clean-up operations, some of which are technically more complex than initially anticipated and which lead to the clean-out objectives having to be adapted. There are no high levels of contamination, but it does appear to be more diffuse than expected and thus entails work over larger areas, taking more time.

The Radium Diagnosis operation will be continued in the Ile-de-France *région* in 2012.

Radium Diagnosis operation poster

2|4 The main subjects examined by ASN

2|4|1 Coudraies district 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. The aim in this district is to clean out land that can be cleaned and to demolish the two houses that cannot be subject to this type of work. Requirements for the Coudraies district were incorporated in May 2007 into the local development plan for Gif-sur-Yvette. Radiological monitoring was continued in 2011.

Following on from the steps taken by the State to manage the contaminated sites in the district, a house bought up by the State was demolished in September 2010. A technical meeting was held in the Gif-sur-Yvette Town Hall on 26th May 2011 in the presence of the mayor, ANDRA and ASN, at which various redevelopment scenarios were presented, along with their cost. A public meeting, in September 2011, was an opportunity for ANDRA to present local residents with the future scenario which could be chosen for the fate of this property.

In early 2012, ASN will notify its opinion on the file presented by ANDRA for rehabilitation of this site.

ANDRA purchased a second property in June 2010. In 2011, however, the rehabilitation of this plot had not yet been started.

2|4|2 Clos rose district in Gif-sur-Yvette (Essonne)

Following a request from a local resident and after analysing the history of the district, ASN began work to clarify the situation regarding a few plots of land in the Clos rose district of Gif-sur-Yvette, near the Federal Mogul industrial site, on which there was radiological contamination. The results were presented to the inhabitants in the last quarter of 2010 and at the CNAR of 7th December 2010. Of 11 plots investigated, two houses have radon activity concentrations above 400 Bq/m^3. Additional investigations were carried out in 2011 to identify the radon transfer pathways in these houses and to take the steps necessary to reduce these radon activity concentrations.

2|4|3 Making safe the Isotopchim site in Ganagobie (Alpes-de-Haute-Provence *département*)

From 1987 to the end of 2000, the Isotopchim Company in Ganagobie (Alpes-de-Haute-Provence *département*), was involved in carbon-14 and tritium labelling of molecules intended for medical and industrial applications. In 2000, the company went into bankruptcy, leaving the environment significantly contaminated, with considerable chemical and radioactive waste remaining on the site. Since December 2002, ANDRA has been working to clean up the site. Priority refrigerated waste was packaged and removed to CEA's Marcoule centre from March to June 2008. Continuation of clean-out and rehabilitation work is now being examined by the CNAR. Steps were taken to improve security in July 2009. In 2010, the premises were emptied of their contents and all bulky waste (furniture, papers, etc.) was removed as VLL waste.

Three types of waste still need to be removed in accordance with the provisions validated by the CNAR on 20th September 2011: sludges contaminated with carbon 14 will be removed to the CSFMA towards the end of 2012, solid chemical waste will be inventoried, in order to define the disposal methods. Finally, additional analyses were initiated with a view to defining the disposal routes for the remaining liquid radioactive chemical products. ASN is paying close attention to ensuring that ANDRA immediately initiates the measures to allow removal of the liquid waste for which there is no disposal route, as soon as its interim storage facility is operational. ASN considers that it is essential for this removal to take place as rapidly as possible. The continued clean-out and final redevelopment work on the site is in effect dependent on this complete removal of waste. The CNAR of 20th September 2011 also requested a study for future decommissioning of this facility.

2|4|4 Rehabilitation of the site of the former Pierre et Marie Curie school at Nogent-sur-Marne (Val-de-Marne *département*)

The Pierre et Marie Curie school was built on a former radium extraction site. The land is currently unused. This matter was referred to the CNAR of 8th December 2009, which adopted a rehabilitation project involving partial excavation of the contaminated land and the construction of public sports facilities on top. At the request of ASN, the CNAR nonetheless felt it necessary to ensure that the redevelopment of the site should not hinder subsequent operations in areas where residual contamination may persist and recommended that the municipality evaluate the possibility of more extensive extraction of contaminated material to attain more far-reaching clean-out objectives.

ASN was required to validate the various phases of the work and defined check-points after each phase. The first phase, which began on 19th October 2010, consisted primarily in removing the bulky items from the former school premises. It ended in early 2011. ASN inspected the site on 4th March 2011.

A local information and monitoring committee (CLIS), of which ASN is a member, was set up by the Val-de-Marne *Préfet* and met for the first time on 6th May 2011. The second phase, which consisted in soil clean-out work, began following this CLIS meeting. ASN will be required to check that the clean-out objectives have been met.

2|4|5 Établissements Charvet in l'Ile 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. The Charvet company (butchery waste transit operations) is the current owner of the site, which is today closed and to which access is prohibited. The Charvet company is eligible for financing under France's recovery plan, and is part of the project to

develop an eco-district on the Ile-Saint-Denis island. The rehabilitation project consists of partial excavation of the contaminated soil, allowing development of a park or equivalent use, and taking account of the possibility of subsequent intervention on a part of the site where the contaminated soil and rubble is to be stored. The clean-out work will take place in two phases, the first under the responsibility of the Charvet SA company, the second after handover to the public establishment for land management of the Ile-de-France region (EPFIF).

The first phase, completed at the end of 2012, consisted in sorting of the contaminated waste from the conventional waste and removal from site. The waste sorting and packaging facility was inspected by ASN on 30th June 2010. The volume of rubble generated is far greater than anticipated and the waste also contains small amounts of asbestos. Removal of the rubble has so far not been completed, as funding has not yet been found for the extra costs generated by the greater than expected volume of waste. Discussions are in progress between the State and the Charvet company for financing of this operation.

During validation of the rehabilitation scenario, the CNAR in September 2009, also decided that it was necessary to take further the hydro-geological surveys of the site to decide on the risk of pollution of groundwater and to stipulate appropriate management methods and procedures.

A CLIS is currently being set up. ASN will sit on it as a member representing the public administrations. The CLIS will meet once the land has been transferred from the Charvet company to the EPFIF.

2|4|6 Former Curie laboratories in Arcueil (Val de Marne *département*)

By order of the *préfet* on 20th 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 therefore validated the waste sorting objectives, designed to ensure their removal via appropriate disposal routes. After an unauthorised entry to the site in June 2010, site security was reinforced. Because the budget allocated to the work had been exceeded, the local education authority, which was the client for the work on this site, decided to suspend the work and terminated the contracts during the summer of 2010, while security was provided round the clock. Following a public call for bids, all the contracts should be placed by the end of the first half of 2012. A contractors' camp was also installed on the site in mid-December 2011. A hydrogeological survey was started in late 2011 and should be completed by the end of January 2012.

2|4|7 Orflam-Plast in Pargny-sur-Saulx (Marne *département*)

Since 1934, the Pargny-sur-Saulx site has in turn accommodated lighter flint production by extraction of the thorium contained in imported monazite ore and the production of pure thorium nitrate. After the liquidation of the Orflam-Plast company, the Orflam site was transferred to State ownership on 24th November 2008.

Since early 2008, rehabilitation of the site has been managed by the 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 sediments, water and aquatic fauna. The results of these analyses enabled a resumption of fishing to be authorised in the lake at the end of August 2009. Spectrometry mapping was carried out by a helicopter on 29th and 30th June 2009 over a 60 km² area. The investigations confirmed the presence of contaminated waste in the areas already identified. However, no new area showing signs of thorium activity significantly higher than the local background level was found. At the end of 2009, the CNAR ruled on the rehabilitation scenarios for the contaminated areas both off and on the site. A local information and monitoring commission (CLIS) was set up at the end of 2009. The "pond" site was completely cleaned up in 2010, and fishing was once again authorised in July 2010. The rehabilitation work on the "peupleraie" site, with a multi-layer cover put into place, was carried out in 2011. Work on the plant site should resume in 2012. ASN and the DREAL are working in close collaboration on this matter. Specific restrictions for the plant, "peupleraie" and pond sites will be implemented and are currently being drawn up by the DREAL and ASN.

Evacuation of waste from the Orflam-Plast plant

2|4|8 The Boucau site (Pyrénées-Atlantiques *département*)

The Boucau site in the Pyrénées-Atlantiques département is a former industrial site which used to carry out ore crushing activities. Crushing of monazite, an ore naturally rich in radionuclides, which took place primarily between 1973 and 1980, led to radioactive contamination of a part of the site. The activity continued until 1993, albeit with smaller quantities of monazite. The licensee of this site is currently the Agriva company, which has submitted a file indicating its intention to cease operations. Decontamination and radioactivity containment steps have been taken by the Agriva company, in accordance with the criteria set by order of the préfet in 2000. The Regional council, which is the owner of the Port of Bayonne, wishes to acquire the corresponding land. With regard to the cessation of operations file, ASN sent the DREAL its opinion of 3rd October 2011 concerning clean-out of this site and the conditions in which the current uses of the site could be modified. ASN in particular recalled that clean-out of land contaminated by radioactive substances must be taken as far as possible in order to reduce any potential impacts. It also observed that information on the radiological status of the site and on the anticipated possible reuse was not precise enough to be able to rule on the acceptability of these future uses of the site. Given the information of which it was made aware, ASN recommended implementing restrictions on the use of and access to the most heavily contaminated part of the land.

2|4|9 Support for the State's regional services

Pursuant to the circular of 17th November 2008, ASN may be asked by the DREAL for an opinion on the rehabilitation objectives of a site. In 2011, in addition to the sites previously mentioned, ASN responded to the inter-departmental regional directorate for environment and energy in the Ile-de-France region (DRIEE) concerning the plans for rehabilitation of CEA's sites (rehabilitation of part of the former plant site at Le Bouchet and clean-out of the sludge pits of the Orme des Merisiers landfill storage site.

Together with the DREALs, ASN also takes part in monitoring the phosphogypsum disposal sites.

2|5 International action concerning management of contaminated sites and soil

From 21st to 25th March 2011 ASN took part in the annual seminar of the Environmental Protection Agency (EPA) on the subject of sites contaminated by radioactivity and covered by federal "Superfund" financing. ASN has been regularly invited to these conferences since 2004, offering it an opportunity to share experience about contaminated sites, decommissioning of facilities and emergency situations with its American and other counterparts. ASN presented its draft methodology guide for management of contaminated sites and soils and the Radium Diagnosis operation.

Visit to the Savannah site in the United States – March 2011

3 OUTLOOK

Generally speaking, ASN considers that the French radioactive waste management system, built around a specific body of legislative and regulatory texts, a national radioactive materials and waste management plan and an agency dedicated to the management of radioactive waste, is capable of regulating and implementing a structured and coherent national waste management policy.

In 2011, ASN continued with its actions aimed at ensuring that radioactive waste is managed safely, from the moment it is first produced. ASN thus regulates its management within the nuclear installations and periodically assesses the strategies put in place for this purpose by the licensees. ASN in particular remains attentive to ensuring that the licensees recover the legacy waste stored on their sites. ASN notes that the licensees are late in doing this or are experiencing technical difficulties, leading to postponement of the dates for removal from storage of legacy waste on the La Hague and CEA sites. In addition, in 2012, ASN will continue to follow attentively the retrieval from storage of wastes presenting the greatest safety challenges.

With regard to the long-term management of radioactive waste, ASN is encouraged by the way ANDRA operates its disposal facilities. ASN considers that there must eventually be safe disposal routes for all waste. To this end, it is of the opinion that France should be provided with a facility to allow disposal of low level long-lived waste. ASN will therefore attentively follow the process of searching for a site and the development of disposal facility design.

With regard to high and intermediate level, long-lived waste, ASN considers that key steps in the development of the disposal project will be reached in the next few years. In its opinion issued on the file submitted by ANDRA in 2009, ASN determined the main areas for work that needed to be taken further before the creation authorisation application, which should be submitted at the end of 2014. ASN in particular recommended that ANDRA further analyse certain risks linked to operation of the facility, clarify the technical measures to be taken to manage these risks and use demonstrators to complete its understanding of the damage resulting from the excavation of major structures and to qualify the techniques for sealing the drifts and the connections between the surface and the underground facility. ASN remains vigilant in ensuring that ANDRA provides the expected elements.

Together with the stakeholders, 2012 will be more particularly devoted to drafting the new edition of the PNGMDR for the period 2013-2015. This work will be an opportunity to present the progress made in the management of radioactive waste, as linked to the provisions of the previous plan and to define new objectives for continuous improvement of radioactive materials and waste management. ASN will thus ensure that the OPECST recommendations are taken into account and that this work is in line with the requirements of the European directive on radioactive waste recently adopted[14]. ASN will also continue its involvement in work being done on these topics internationally, in particular within ENSREG and the WENRA club of nuclear regulator associations.

ASN has focused more closely on contaminated sites and soils since 2009 and this will continue in 2012, together with the administrations concerned and the other stakeholders. After consultation, ASN issued several opinions in 2011 on polluted site rehabilitation projects and was particularly closely involved in operational oversight of the Radium Diagnosis operation. At the end of 2011, ASN, the Ministry for the Environment and IRSN, published the revised methodology guide for management of sites and soils contaminated by radioactive substances. This publication will be the opportunity in 2012 for ASN to fix its doctrine concerning polluted site and soil rehabilitation principles. 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, in particular owing to the volume of waste to be excavated. Finally, in 2012, ASN will continue to oversee the diagnosis operations on sites liable to have housed activities utilising radium in the Ile-de-France region.

14. Council directive 2011/70/EURATOM of 19th July 2011 establishing a community framework for the responsible and safe management of spent fuel and radioactive waste.