SAFE DECOMMISSIONING OF BASIC NUCLEAR INSTALLATIONS

CHAPTER 15

The term decommissioning generally covers all the technical and administrative activities performed after shutdown of a nuclear installation in order to achieve a predetermined final status. These activities may in particular include equipment disassembly, clean-out of premises and soils, demolition of civil engineering structures, processing, packaging, removal and disposal of radioactive and other waste.

As many nuclear installations were built between the 1950s and the 1980s, a large number of them are being gradually shutdown and then decommissioned, particularly over the past fifteen years. In 2008, about thirty nuclear installations of all types (electricity generating or research reactors, laboratories, fuel reprocessing plants, waste treatment facilities, etc.), were shut down or were undergoing decommissioning in France. The safety and radiation protection of the decommissioning of these installations therefore gradually became major issues for ASN.

With the specific aspects of decommissioning activities (changing nature of the risks, rapid changes in the installation status, duration of the operations, etc.) ruling out implementation of all the regulatory principles that were relevant during the installation operating period, the nuclear installation decommissioning regulations have evolved gradually since the 1990s. These were clarified and supplemented in 2006 by the TSN Act.

Decommissioning is a major issue for ASN, which has gradually built up the regulations and the doctrine applicable to this phase in the life of basic nuclear installations. In 2008, it made public a report presenting its decommissioning strategy for BNIs, based primarily around the choice of the immediate decommissioning strategy and the need to achieve final status after decommissioning in which all hazardous material had been removed. This report was presented to the High Committee for Transparency and Information on Nuclear Security (HCTISN) in 2009 and should be officially published in 2010.

1 TECHNICAL AND LEGAL REQUIREMENTS APPLICABLE TO DECOMMISSIONING

1 | 1 Decommissioning strategies

IAEA has defined three strategies for decommissioning nuclear installations following their final shutdown:
– deferred decommissioning: the parts of the installation containing radioactive materials are maintained or placed in a safe state for several decades before actual decommissioning operations begin (the “conventional” parts of the installation can be decommissioned as soon as the installation is shut down);
– safe containment: the parts of the installation containing radioactive materials are placed in a reinforced containment structure for a period that is long enough to reach a radiological activity level sufficiently low to allow release of the site (the “conventional” parts of the installation can be decommissioned as soon as the installation is shut down);
– immediate decommissioning: in this case, decommissioning is started as soon as the installation is shut down, with no waiting period, although these decommissioning operations can be spread out over a long period of time.

The decision to opt for one or other of the decommissioning strategies is influenced by a large number of factors: national regulations, social and economic factors, financing of the operations, availability of waste disposal routes, decommissioning techniques and qualified personnel, exposure of the personnel and the public to ionising radiations as a result of the decommissioning operations, etc. International practices therefore differ from one country to another.

In compliance with IAEA recommendations, French policy today is for the French BNI licensees to opt for immediate decommissioning strategies.

This strategy in particular avoids placing the technical and financial burden of decommissioning on future generations. At the present time, the leading French licensees have all made a commitment to immediate decommissioning of the installations currently concerned by the decommissioning process.

ASN also believes that management of the waste produced by decommissioning is a crucial point that determines the correct running of the decommissioning programmes in progress (availability of disposal routes, management of waste streams). In this respect, the waste management procedures are systematically assessed as part of the review of the overall decommissioning strategies adopted by each licensee.

Decommissioning operations can therefore only begin if appropriate disposal routes are available for all the waste liable to be created. The example of the decommissioning

of EDF's first generation reactors is a good illustration of this problem (see point 2|1|2). With regard to the possible recycling of the waste resulting from decommissioning, ASN is attentive to the correct application of French waste doctrine, which states that contaminated waste or waste that is liable to have been contaminated in the nuclear sector may not be reused outside this sector. Waste from decommissioning may not therefore be used outside the nuclear sector. However, ASN supports approaches aimed at recycling this waste in the nuclear sector, as part of the National Radioactive Material and Waste Management Plan (PNGMDR, see chapter 16).

1|2 Legal requirements

The technical provisions applicable to installations to be shut down and decommissioned must obviously be in compliance with general safety and radiation protection rules, notably regarding worker external and internal exposure to ionising radiations, criticality, the production of radioactive waste, discharge to the environment of radioactive effluents and measures designed to reduce the risk of accidents and mitigate their consequences. Safety issues, in other words protection of persons and the environment, can be significant, during active clean-out or decommissioning operations, and must never be neglected, including during passive surveillance phases.

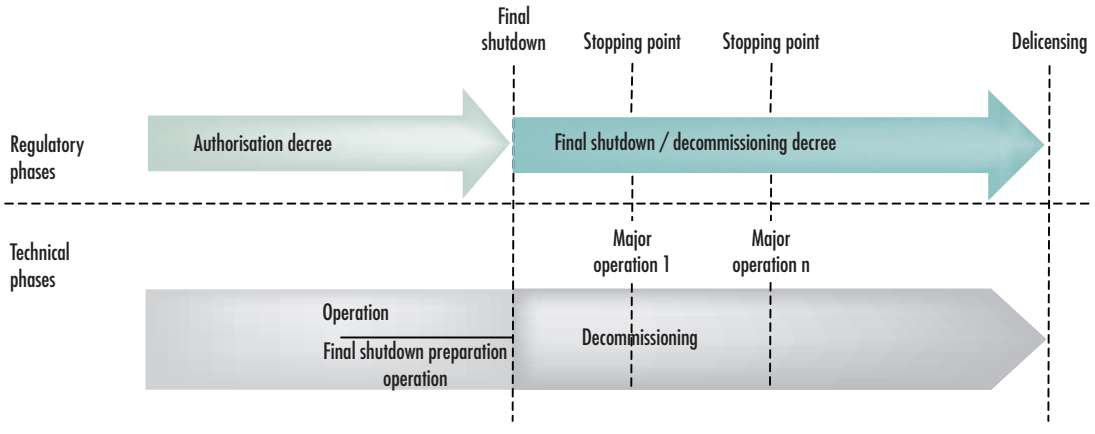
Once the licensee has decided to cease operations in its installation in order to proceed with final shutdown and decommissioning, it can no longer be covered by the regulations set by the creation authorisation decree nor the safety specifications associated with the operating phase. In accordance with the provisions of the TSN Act, final shutdown, followed by decommissioning of a nuclear installation, is authorised by a new decree, issued on the advice of ASN (see diagram 1). The final shutdown and decommissioning authorisation procedure for a nuclear installation is described in chapter 3.

In order to avoid fragmentation of the decommissioning projects and improve their overall consistency, the file submitted to support the final shutdown and decommissioning application must explicitly describe all the planned work, from final shutdown to attainment of the target final status and, for each step, must explain the nature and scale of the risks presented by the installation as well as the envisaged means of managing these risks. The decommissioning phase may be preceded by a final shutdown preparation stage, provided for in the initial operating licence. This preparatory phase in particular allows removal of all or part of the source term, as well as preparation for the decommissioning operations (readying of premises, preparation of worksites, training of staff, etc.). It is also during this preparatory phase that installation characterisation operations can be carried out: production of radiological maps, collection of pertinent data (operating history) with a view to decommissioning…

The TSN Act requires that the safety of an installation in the decommissioning phase be periodically reviewed. The frequency of these reviews is normally 10 years. When such safety reviews are performed, ASN's goal is to ensure that the installation's level of safety remains acceptable up until delicensing. As applicable, compensatory measures proportional to the risks presented by the installation during decommissioning will be taken.

Following decommissioning, a nuclear installation can be delicensed. It is then removed from the list of basic nuclear installations and no longer has BNI status. To support its delicensing application, the licensee must provide a file demonstrating that the envisaged final status has

Diagram 1: phases in the life of a BNI



indeed been reached and describing the state of the site after decommissioning (analysis of the state of the soil and remaining buildings or equipment, etc.). Depending on the final status reached, public protection restrictions may be implemented, depending on the intended subsequent use of the site and/or buildings. These may contain a certain number of restrictions on use (only to be used for industrial applications for example) or precautionary measures (radiological measurements to be taken in the event of excavation, etc.). ASN may make delicensing of a BNI dependent on the implementation of such restrictions.

A 2003 ASN guide specified the regulations for BNI decommissioning operations, following major work designed to clarify and simplify the administrative procedure while at the same time improving the importance given to safety and radiation protection. A fully revised version of this guide, designed to incorporate the regulatory changes brought about by the TSN Act and decree 2007-1557 of 2 November 2007, as well as the work done by the WENRA association, was finalised in 2008 and published at the beginning of 2009. This guide is intended for nuclear licensees and its main objectives are:
– to explain in detail the regulatory procedure laid down by the decree implementing the TSN Act;
– to clarify what ASN expects with regard to the content of certain items of the final shutdown and decommissioning authorisation application files, particularly the decommissioning plan;
– to explain the technical and regulatory aspects of the various phases of decommissioning (preparation for final shutdown, decommissioning, delicensing).

1|3 The financing of decommissioning and radioactive waste management

1|3|1 Reminder of regulatory provisions

Article 20 of Programme Act 2006-739 of 28 June 2006 on the sustainable management of radioactive materials and waste creates a system for securing the nuclear expenses involved in the decommissioning of nuclear installations and management of radioactive waste. This Article is clarified by decree 2007-243 of 23 February 2007 and the order of 21 March 2007 concerning the secure financing of nuclear costs.

The legal system created by these texts aims to secure the financing of nuclear costs, through implementation of the "polluter-pays" principle. It is therefore up to the nuclear licensees to take charge of this financing, by setting up a dedicated portfolio of assets capable of meeting the expected costs. This is done under the direct control of the State, which analyses the situation of the licensees and can prescribe measures, should it be seen to be insufficient or inadequate. In any case, the nuclear licensees remain responsible for the satisfactory financing of their long-term expenses.

It stipulates that the licensees must make a prudent assessment of the cost of decommissioning their installations or, for radioactive waste disposal installations, their final closure, maintenance and surveillance costs. They must also evaluate the cost of managing their spent fuels and radioactive waste (I of Article 20 of the Act of 28 June 2006). They submit three-yearly reports and annual update memos.

These costs are divided into 5 categories (I of Article 2 of the decree of 23 February 2007):
– decommissioning costs, except for long-term management of radioactive waste packages;
– spent fuel management costs, except for long-term management of radioactive waste packages;
– cost of recovering and packaging legacy waste (RCD), except for long-term management of radioactive waste packages;
– cost of long-term management of radioactive waste packages;
– cost of surveillance following disposal facility closure.

These categories are detailed in the list contained in the order of 21 March 2007.

The costs involved must be assessed using a method based on an analysis of the options that could be reasonably envisaged for the operation, on a prudent choice of a reference strategy, on consideration of residual technical uncertainties, on consideration of performance contingencies and on consideration of operating experience feedback. These cost assessments, if necessary, comprise a breakdown into variable and fixed costs and, if possible, a method explaining the breakdown of the fixed costs over time. They also, insofar as is possible, comprise an annual schedule of costs, a presentation and justification of the scenarios adopted and methods used and, if necessary, an analysis of the operations carried out, the deviations from the forecasts and consideration of operating experience feedback. The licensees must also give a concise presentation of the assessment of these costs, the extent to which the work in progress is in line with forecasts, and the possible impact of the progress of work on the costs.

On 3 January 2008, an agreement was signed by ASN and the General Directorate for Energy and Climate (DGEC) whereby ASN carries out surveillance of these long-term costs. This agreement defines:
– on the one hand, the conditions in which ASN produces the opinions it is required to issue pursuant to Article 12, paragraph 4 of the above-mentioned decree of

23 February 2007, on the consistency of the strategies for decommissioning and management of spent fuels and radioactive waste;
– on the other, the conditions in which the DGEC can call on ASN expertise pursuant to Article 15, paragraph 2 of the same decree. It in particular stipulates that as necessary, and in the same conditions as those which govern analysis of the three-yearly reports, the DGEC may call on ASN after receiving the annual update memos.

1 | 3 | 2 Review of the reports forwarded by the licensees

In 2007, all the nuclear licensees had submitted their first three-yearly reports on implementation of the provisions arising from Article 20 of the Act of 28 June 2006. ASN then sent the Government its opinion with regard to the consistency of the strategies for decommissioning and management of spent fuel and radioactive waste, presented by the licensees, in terms of nuclear safety (opinion 2007-AV-037 of 20 November 2007).

In 2008 and 2009, ASN examined the new data forwarded by the licensees in their annual update memos, with regard to:
– technical changes (perimeter, strategy, scenario, unforeseen event, etc.);
– ASN opinion 2007-AV-0037 of 20 November 2007.

The points it reviewed include those on which additional information is required in the annual update memos. Although significant efforts on the part of the licensees must be mentioned, some points are still to be cleared up, in particular concerning guarantees that there will be no need to manage legacy waste produced in delicensed BNIs, the inadequacy of certain technical data for assessing the proposed scenarios and, finally, final status targets which do not correspond to ASN policy on this subject.

In 2010, ASN will review the second three-yearly reports transmitted by the licensees.

1 | 4 Decommissioning risks

Diagram 2 presents the main risks encountered when decommissioning a nuclear installation and the periods during which these risks are highest.

The risks involved in waste management and which concern safety or radiation protection (multiplication of the number of waste storage sites, storage of irradiating waste) are present throughout the phases in which large amounts of waste are being produced and therefore in particular during the decommissioning phase.

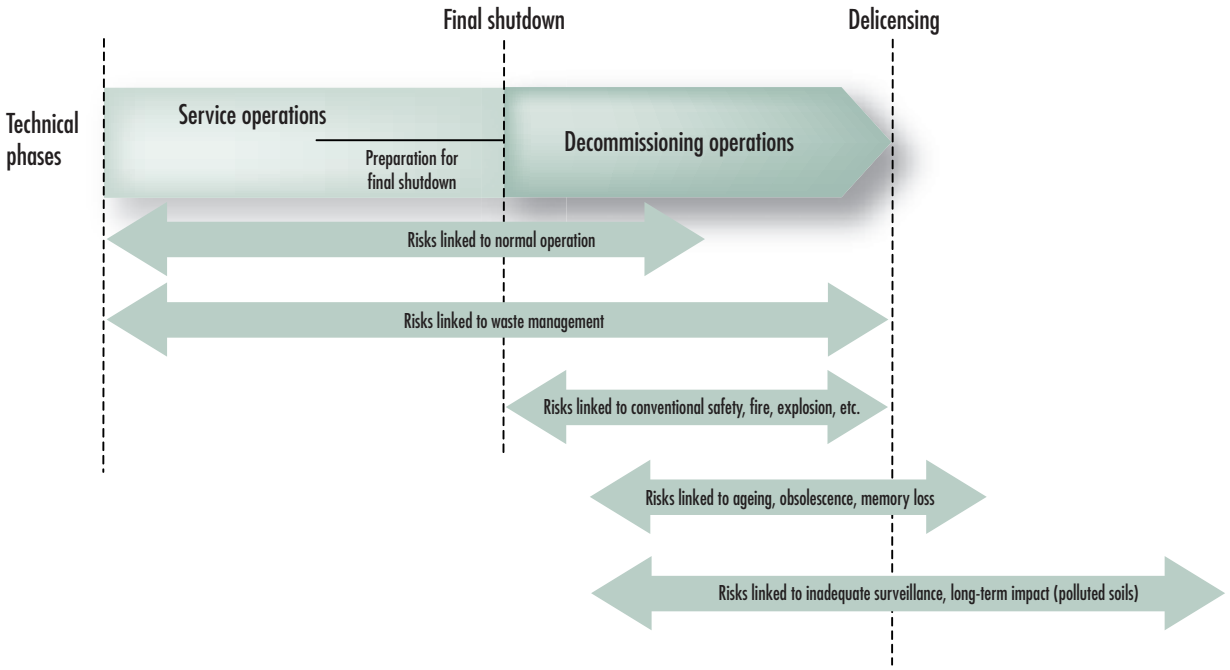
The risks present during operation of the installation change as decommissioning progresses. Even if certain risks, such as criticality, quickly disappear, others, such as those related to radiation protection (gradual removal of containment barriers) or conventional safety (numerous contractors working together, falling loads, work at height, and so on) gradually become more important. The same applies to the risk of fire or explosion ("hot spot" technique used in cutting up the structures), as well as, for example, to the risks related to human and organisational factors (organisational changes in relation to the operating phase, frequent reliance on outside contractors).

For complex nuclear installations such as nuclear power plant reactors, decommissioning work often lasts for more than a decade. It follows on from an operating period that often lasts several decades. There is consequently a very real risk of all memory of the design and operation of the nuclear installations being lost. It is vital to be able to collect and thoroughly document the knowledge and memories of the staff involved in the operating phase, particularly as the traceability of the design and operation of the older installations is not always as thorough and reliable as might be desired. The length of the decommissioning operations also involves taking account of the risks inherent in the obsolescence of certain equipment (electrical or monitoring networks for example). Depending on the stage reached in the operations, risks linked to the potential instability of partially dismantled structures must also be taken into account.

The sometimes rapid changes in the physical condition of the installation and in the risks present raise the issue of ensuring that the means of installation surveillance are adequate and appropriate at all times. It is often necessary, either temporarily or permanently, to replace the centralised operational monitoring and surveillance systems with other more appropriate resources, such as "field" radiation monitoring or fire detection devices, located as close as possible to the potential source of risks. Constantly checking the adequacy of surveillance for the rapidly and significantly changing status of the installation is a difficult exercise, and there is a very real risk of failing to detect the onset of a hazardous situation.

Following decommissioning, depending on the final status achieved by the licensee and the specific characteristics of each installation (operational history, incidents, etc.), there may be residual risks: unidentified soil pollution with a long-term impact, areas for which clean-out is technically impossible, etc. In this case, prior to delicensing of the installation, the licensee must present and

Diagram 2: main risks encountered during decommissioning



justify the envisaged procedures for continued surveillance of the installation or site.

1|5 Complete clean-out

Nuclear installation decommissioning operations lead to the gradual delicensing of the "nuclear waste zones" to "conventional waste zones". When the licensee is able to prove that there are no activation or contamination migration phenomena in all the structures making up a "nuclear waste zone", this zone can then be delicensed following any necessary "conventional" clean-out operations (cleaning of the walls of an area using appropriate products for example). However, when activation or contamination migration phenomena occurred during the operating phase, complete clean-out – that is removal of the artificial radioactivity present in the structures themselves – may require operations involving actual physical removal of the parts of these structures considered to be nuclear waste (removing the skin of a concrete wall for instance).

Operations such as these mean that within the structure concerned, a new limit has to be defined between nuclear waste and conventional waste zones. To ensure consistency with the general waste zoning doctrine, the definition of this new waste zoning limit is based on the implementation of independent, successive lines of defence. The requirements of the ASN technical guide on complete clean-out operations, published in 2006 (guide SD3-DEM-02) have been implemented in a large number of installations of various types: research reactors, laboratories, fuel fabrication plants, etc.

Nuclear installation at La Hague (Manche *département*) on which complete clean-out operations have been performed

At the end of 2008, national operating experience feedback on complete clean-out was obtained by ASN. This analysis showed that despite certain technical difficulties, the complete clean-out of civil engineering structures has proven itself and led to "conventional waste zone" delicensing of a large number of areas in nuclear installations undergoing decommissioning.

ASN is attentive to the arguments put forward by the various stakeholders and consulted them about a planned revision of the structures clean-out guide during the summer of 2009. This new version aims to meet the needs expressed with regard to modelling, delicensing of large parts, the use of innovative decontamination techniques, greater flexibility in management of deviations and in delicensing approval, while guaranteeing the rigorous nature of the strategy adopted. The final version of the revised guide will be published in 2010.

2 SITUATIONS OF NUCLEAR INSTALLATIONS BEING DECOMMISSIONED IN 2009

2|1 EDF nuclear power plants

In 1996, EDF's strategy was deferred decommissioning of its shutdown nuclear installations, that is the six gas-cooled nuclear power reactors (Bugey 1, Saint Laurent A1 and A2, Chinon A1, A2 and A3), the heavy water reactor at Brennilis, the PWR at Chooz A and the fast neutron reactor at Creys-Malville. In April 2001, at the instigation of ASN, EDF decided to change its strategy and adopt a programme of decommissioning of its first generation of plants by 2025.

This new strategy was reviewed by the relevant Advisory Committee of experts in March 2004. On the basis of this review, ASN concluded that the decommissioning strategy for the first generation reactors adopted by EDF, as well as the programme and schedule, are acceptable in terms of safety and radiation protection, provided that a certain number of requests are taken into account and that there is compliance with the undertakings made by EDF with regard to the issues of decommissioning feasibility, safety, radiation protection and waste and effluent management. In July 2009, EDF forwarded a decommissioning strategy update file. In this file, EDF confirmed the position it had adopted in April 2001. The file contains a summary of the progress of the decommissioning programme and identifies the forthcoming major milestones. Current thinking on the decommissioning strategy for the PWR reactors in operation is presented. EDF also specifies its intended orientations in the event of any delay in the availability of the graphite waste disposal route. ASN will adopt a stance in 2010 on the file forwarded by EDF.

Internal authorisations

ASN considers that operations taking place in BNIs with high stakes in terms of nuclear safety and radiation protection must obtain prior authorisation from it. Conversely, it considers that operations for which the nuclear safety and radiation protection stakes are low or non-existent must remain the responsibility of the licensee. For intermediate operations, with nuclear safety and radiation protection stakes that are significant but that do not compromise the safety scenarios used in BNI operation or decommissioning, ASN allows the licensee to assume direct responsibility for them provided that it sets up a system of enhanced, systematic internal checks, offering sufficient guarantees of quality, independence and transparency. The decision on whether or not to carry out the operations concerned must be formally authorised by the qualified members of the licensee's staff. The corresponding system is called the "internal authorisations system".

In a letter dated 9 February 2004, ASN authorised EDF to set up an internal authorisations system for the installations concerned by the decommissioning programme. This approach in particular addresses a key requirement, which is to keep the safety specifications of an installation permanently up to date.

The internal authorisations system is now regulated by decree 2007-1557 of 2 November 2007 concerning basic nuclear installations and the supervision of the transport of radioactive materials with respect to nuclear safety and by ASN decision 2008-DC-106 of 11 July 2008 which specifies ASN requirements for implementation of the provisions of this decree on the subject of internal authorisations. Pursuant to Article 3 of this decision, EDF submitted a complete file to ASN in October 2009 presenting its internal authorisations system, with a view to having it approved by the ASN Commission.

2|1|1 The Brennilis power plant

The EL4 nuclear reactor, which was commissioned on 23 December 1966, finally ceased all production of electricity on 31 July 1985. This reactor was an industrial

View of the building housing the Brennilis reactor

prototype, built and operated jointly by CEA and EDF. For partial decommissioning of this installation, the decree of 31 October 1996 authorised modification of the existing installation, transforming it into an installation for storage of its own equipment left in place, thus creating a new BNI called EL4-D. In the light of its new decommissioning strategy, EDF submitted an application on 22 July 2003 for authorisation for final shutdown and complete decommissioning of the EL4-D installation. Complete decommissioning of the EL4-D installation was authorised by decree 2006-147 of 9 February 2006.

Following a request filed by the "Sortir du nucléaire" association, the *Conseil d'État** on 6 June 2007 cancelled the decree of 9 February 2006. The installation is therefore now subject to the provisions of the decree of 31 October 1996; decommissioning operations have thus ceased. In decision 2007-DC-0067 published in its Official Bulletin of 8 October 2007, ASN specified the regulations applicable to the plant, pending the publication of a new decree authorising its final shutdown and complete decommissioning.

A new complete decommissioning authorisation application file was submitted by EDF on 25 July 2008. This application is being reviewed in the light of the new decree of 2 November 2007 which in particular requires a systematic public inquiry for all complete decommissioning application files. This file, updated in March 2009, was considered to be acceptable in June 2009. It was the subject of a public inquiry at the end of 2009.

The Association for the Control of Radioactivity in the West (ACRO), an independent radioactivity analysis laboratory, was chosen by the Local Information Committee (CLI) to conduct an independent appraisal of the decommissioning file submitted to the CLI for its opinion.

In a decision of 8 October 2007, ASN had also asked that the licensee repackage and remove the legacy waste stored on the site for which there is or will shortly be a disposal route, within two years of publication of the decision, that is by 8 October 2009. During the course of an inspection on 13 October 2009, ASN observed that although the licensee had made considerable efforts to characterise, repackage and remove legacy waste, a limited quantity of this waste for which there is a disposal route was still stored on the site, pending the granting of a waiver to the reception facility. In its decision of 22 December 2009, ASN required that the waste awaiting waivers be removed by 30 June 2010 and that progress reports on the treatment of legacy waste requiring additional analyses be sent periodically to ASN.

2|1|2 Gas cooled reactors (GCR)

Based on the review of the EDF decommissioning strategy file by the Advisory Committee in 2004, ASN underlined the problems related to decommissioning of GCR reactors, in particular owing to the fact that no disposal route was available for graphite waste.

EDF therefore makes opening of the GCR compartments dependent on commissioning of and activated waste storage facility and irradiated graphite disposal centre (CSG). The 28 June 2006 Act on the sustainable management of radioactive materials and waste requires that the graphite disposal centre be opened in 2013.

However, owing to the time needed to reach agreement and choose a site, among other things, ANDRA does not envisage commissioning the disposal centre before 2019.

For the update of its decommissioning strategy file submitted in July 2009, ASN asked EDF to assess the consequences of the delayed opening of a disposal centre on the safety of the installations being decommissioned.

BUGEY 1 reactor

This reactor is the lead reactor for GCR decommissioning. The end of final shutdown and site preparation work continued until the end of 2008, when the installation complete decommissioning decree was obtained (decree 2008-1197 of 18 November 2008). The decommissioning work except for the compartment and the preparatory work for decommissioning of the compartment is under way.

An appraisal of the lower part of the reactor compartment took place in October 2009 in order to improve

*France's highest administrative court.

View of the Chinon nuclear site

The two compartments of the Saint-Laurent-des-Eaux NPP

understanding of the physical and radiological condition of the compartment internal structures and of waste management, to consolidate the input data and hypotheses used for the GCR structural strength file and finally, to obtain radiological and geometrical data (3D virtual visit) for performance of studies on preparatory work inside the compartment, on the one hand and on dismantling of the reactor lower internals, on the other.

CHINON A1, A2 and A3 reactors

The old CHINON A1, CHINON A2 and CHINON A3 reactors were partially decommissioned and transformed into storage facilities for their own equipment. These operations were authorised by the decrees of 11 October 1982, 7 February 1991 and 27 August 1996 as amended on 25 November 2005, respectively. The main operations carried out in 2009 were graphite samples taken from the Chinon A2 compartment and dose rate measurements on the exchangers in the Chinon A2 and Chinon A3 installations. The purpose of these operations was to conduct a radiological inventory of the installation and to continue with removal of the "shell" packages from Chinon A3 to the CSTFA.

On 29 September 2006, EDF submitted a complete decommissioning authorisation application file for the Chinon A3 installation.

This file was submitted to a public inquiry from 2 March to 2 April 2007, after which the *préfet** of the Indre et *Loire département*** approved the project.

After analysing the documents transmitted and subject to compliance with the commitments made by EDF and integration of the requests expressed during the review of the file, ASN identified no disqualifying point liable to compromise the technical feasibility of the decommissioning of Chinon A3 and considered that the measures taken to ensure the safety of the decommissioning operations were satisfactory.

Furthermore, the Chinon A3 compartment will be decommissioned after that of Bugey 1 and Saint Laurent A2 and will thus benefit from the operating experience feedback acquired.

A draft decree authorising EDF to proceed with complete decommissioning of the Chinon A3 installation was thus prepared and examined by the BNI Consultative Committee (CCINB) and by the ASN Commission. A favourable opinion on the project was issued following these consultations.

Saint-Laurent-des-Eaux A1 and A2 reactors

Final shutdown of the installation was authorised by a decree of 11 April 1994. This phase is currently being carried out and in particular involves the storage and treatment of the legacy operating waste. It will be continued and completed in compliance with the decommissioning decree for the installation.

On 11 October 2006, EDF submitted an application for a complete decommissioning authorisation for the Saint Laurent A1 and A2 reactors.

This file underwent a public inquiry from 26 January to 26 February 2007, following which the préfet of the Loir et Cher *département* approved the project.

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

After analysing the documents transmitted and subject to compliance with the commitments made by EDF and integration of the requests made during the review of the file, ASN identified no disqualifying point liable to compromise the technical feasibility of the decommissioning of Saint Laurent A1 and A2 and considered that the measures taken to ensure the safety of the decommissioning operations were satisfactory.

Furthermore, decommissioning of the Saint Laurent A2 compartments will benefit from the experience already acquired, because Saint Laurent A2 will be decommissioned after Bugey 1 while Saint Laurent A1 will be decommissioned after Bugey 1, Saint Laurent A2 and Chinon A3.

A draft decree authorising EDF to proceed with complete decommissioning of the Saint Laurent A installation was thus prepared and examined by the BNI Consultative Committee (CCINB) and by the ASN Commission. A favourable opinion on the project was issued following these consultations.

2|1|3 CHOOZ AD reactor (Ardennes nuclear power plant)

This reactor was the first PWR built in France. It was coupled to the grid on 4 April 1967 and was shut down on 30 October 1991.

For the partial decommissioning of the reactor, the decree of 19 March 1999 authorised modification of the existing installation, transforming it into an installation for storage of its own equipment, left in place, with the creation of a new BNI called CNA-D. Given the change in its decommissioning strategy, EDF on 30 November 2004 submitted an authorisation application for complete decommissioning of the installation, resulting in decommissioning decree 2007-1395 published in the Official Gazette on 29 September 2007.

The main operations carried out in 2009 concern outfitting of the drum storage building (BSF) for interim storage of waste, the continued electromechanical decommissioning of the cave housing the reactor auxiliary equipment, the continued work preparatory to decommissioning of the cave housing the reactor (decommissioning of the access hatches, removal of unnecessary cables, upgrading of the crane, etc.) and installation of new piezometers on the site.

An application file for renewal of the site's effluent discharge and water intake licenses, comprising the Chooz A and Chooz B installations, was submitted in October 2006 and was examined in accordance with the requirements of decree 95-5401 of 4 May 1995. This file underwent a public inquiry from 30 March to 30 April 2009. It was also consulted by the Belgian authorities during the course of the preliminary contacts stipulated in the 25 February 1991 convention, signed in Espoo, on environmental impact assessment in a transboundary context. The Belgian authorities and the *préfet* of the Ardennes *département* both issued a favourable opinion on the project. The new requirements regulating site discharges were published on 17 November 2009.

2|1|4 SUPERPHÉNIX reactor

The SUPERPHÉNIX fast neutron reactor, a sodium-cooled industrial prototype, is located at Creys-Malville. This installation is associated with another BNI, the fuel

Operators working on decommissioning a ventilation flue on the Chooz reactor

Positioning a cut stack on a semi-trailer during decommissioning of the Superphénix reactor

evacuation facility (APEC), consisting mainly of a storage pool for fuel removed from the SUPERPHÉNIX reactor vessel. The final shutdown authorisation for this reactor was given in decree 98-1305 of 30 December 1998. In early 2003, all the fuel assemblies were removed from the reactor and stored in the APEC. Complete decommissioning of the installation was authorised by decree 2006-321 of 20 March 2006, Article 4 of which states that commissioning of the sodium treatment installation, called TNA, and of all the systems required for it to operate, must be authorised by ASN. The sodium treatment process using hydrolysis consists in injecting liquid sodium into an aqueous soda flow in order to produce soda. This soda is then used as the primary component of the concrete packages to be produced in the cement encapsulation facility and stored on the site to allow decay prior to disposal. The TNA commissioning tests began in September 2008 and will end at the beginning of 2010. ASN will only authorise industrial commissioning of the TNA installation after analysing the results of these tests. The storage facility for the soda concrete blocks resulting from sodium treatment must also be commissioned prior to commissioning of the TNA installation and is currently being reviewed.

Treatment of the secondary system pumps in the MDG facility, dedicated to decommissioning of the large removable components of the reactor vessel, was completed in September 2009. Treatment of the primary pump intermediate exchanger of the reactor vessel will require authorisation from ASN, in particular in the light of the operating experience feedback from treatment of the secondary components.

Furthermore, most of the lateral neutron protections in the vessel have been removed. Only 92 of them are still to be taken away to the APEC storage pool.

Fuel evacuation facility (APEC)

This facility was commissioned on 25 July 2000 by the Ministers for Industry and the Environment. Spent fuel removed from the SUPERPHÉNIX reactor and washed is placed in the APEC pool.

Within its perimeter, the installation now comprises the storage area for the soda concrete packages resulting from treatment of the sodium contained in the SUPERPHÉNIX reactor, for which siting was authorised by decree 2006-319 of 20 March 2006.

2 | 2 CEA installations

In December 2006, the Advisory Committees for plants and for waste issued their opinions on the overall decommissioning strategy for CEA's civil installations. This was considered to be on the whole satisfactory from the safety standpoint. The decommissioning schedules for the installations concerned are consistent with the strategy adopted. ASN considers that they should enable an acceptable level of safety to be maintained in these installations until they are delicensed. The documents outlining CEA's decommissioning strategy will be updated and reassessed every 5 years.

2 | 2 | 1 The Fontenay-aux-Roses centre

CEA's first research centre, located in Fontenay-aux-Roses (Hauts-de-Seine *département*) is continuing to move away from nuclear activities to concentrate on research into the life sciences. Since January 2008, the laboratories clean-out and installations decommissioning programme has been built around a project called Aladin. This project will be spread over 10 years, until 2018, and will use the operating experience feedback from the Grenoble Passage project. Decommissioning of the two installations present on the site, the PROCESS BNI (BNI 165) and the SUPPORT BNI (BNI 166), was authorised by decrees published in the Official Gazette of 2 July 2006. ASN considers that the BNI clean-out operations carried out so far, were on the whole satisfactory. Before administrative delicensing of the centre's BNIs, ASN will be required to adopt a stance on the overall radiation status of the site, for which the licensee has undertaken major work to identify radiation traces arising from past experimentation and to rehabilitate the soil.

The PROCESS installation (BNI 165)

This installation will be the first to be decommissioned. The clean-out operations of the shielded lines are continuing: 2 of the 6 shielded lines have now been totally cleaned out.

The SUPPORT installation (BNI 166)

The purpose of this installation is initially to support the decommissioning operations of the PROCESS BNI, before being decommissioned in turn.

Decontamination of the plutonium chemistry laboratory in Fontenay-aux-Roses by an operator wearing a ventilated vinyl suit with protective breathing apparatus

This BNI is used for storage and evacuation of radioactive effluents from the site as well as the treatment of solid waste, storage in a decay pit of irradiating drums pending evacuation and storage of drums of low and very low level waste awaiting shipment to a repository.

Raising of the CIRCE container of high-level effluents should have begun in September 2008 but in the end only started in mid-2009 following containment problems.

In order to improve the layout of its activities and thus the safety of its installation, CEA will in 2010 be submitting a file for installation of a new waste drum characterisation line.

2|2|2 The Grenoble centre

The CEA Grenoble centre was inaugurated in January 1959 and the site's nuclear activities grew in line with the development of reactor technologies. Research activities were gradually transferred to other centres, with focus then being placed on fundamental and technological research into the field of non-greenhouse gas emitting energies (solar, fuel cell), health (biotechnologies) and communications (micro and nanotechnologies).

The site housed six nuclear installations which since then have been gradually phased out, moving to the decommissioning phase with the ultimate aim of delicensing. After delicensing of the Siloette reactor (BNI 21) in 2007, decommissioning of the CEA Grenoble nuclear installations continued in 2009. Complete delicensing of the site is scheduled for 2012.

ASN considers that clean-out and decommissioning of the installations in the Grenoble centre are proceeding correctly, with the decommissioning worksites being properly managed.

During its inspections, ASN noted that CEA Grenoble was making increasing use of outside companies, whether for operation of the installations, the engineering studies linked to the decommissioning work, or the work itself. Despite the gradual drop in the level of risk and in operating problems, ASN asked CEA Grenoble to maintain a level of resources enabling it to ensure complete control of its installations.

Radioactive effluent and solid waste treatment station and decay storage (BNI 36 and 79)

Decommissioning of the radioactive effluent and solid waste treatment station (STEDS – BNI 36) was authorised by decree 2008-980 of 18 September 2008, which was published in the Official Gazette on 21 September 2008. The decommissioning operations should continue until 2012. A part of the installation is now dismantled and its North zone is used for characterisation and for collection of the decommissioning waste pending shipment for disposal.

BNI 79 (STED), which is within the boundary of BNI 36, is a decay storage facility for high level (HL) waste. Removal from storage of the HL waste containers is continuing despite the problems encountered with disposal route availability, to ensure compliance with the 31 December 2010 deadline. Decommissioning of this BNI was authorised by the same decree as that which authorised decommissioning of BNI 36 (see above).

Active material analysis laboratory (LAMA – BNI 61)

This laboratory ended its scientific research duties in 2002. It was used to receive experimental fuels with no further purpose, taken from the Siloé and Mélusine reactors following their shutdown. It takes part in the clean-out operations for the STEDS and is engaged in its own clean-out work.

The small amount of remaining source term is mainly in the very high level (VHL) containments.

Decommissioning of the LAMA was authorised by decree 2008-981 of 18 September 2008 and published in the Official Gazette of 21 September 2008.

MÉLUSINE reactor (BNI 19)

Mélusine is a former pool type reactor operated by CEA. Final shutdown was declared in 1994. The decree authorising CEA to modify the Mélusine reactor prior to its decommissioning and delicensing was published in the Official Gazette in January 2004. The clean-out work has been completed and in mid-2009, CEA submitted a file applying for BNI delicensing, which is currently being reviewed by ASN.

SILOÉ reactor (BNI 20)

This former research reactor, currently undergoing decommissioning and clean-out, was primarily used for technological irradiation of structural materials and nuclear fuels. Since the decree of 26 January 2005, authorising final shutdown and decommissioning of the installation, operations are continuing but are behind schedule, given that activation of the pool block was greater than had been anticipated in the decommissioning scenario. CEA thus submitted an application pursuant to Article 32 of the "procedures" decree, requesting extension of the decommissioning work from 5 to 6 years. The corresponding decree appeared in the Official Gazette on 2 February 2010.

2 | 2 | 3 The Cadarache centre installations being decommissioned

ASN considers that decommissioning of the Cadarache centre installations is proceeding relatively satisfactorily. The example of the decommissioning of the Harmonie reactor, delicensed in 2009, illustrates the feasibility of complete decommissioning. However, all relevant lessons must be learned from the incident that occurred in the plutonium technology facility (ATPu) and which was notified by CEA on 6 October 2009.

RAPSODIE reactor and fuel assembly shearing laboratory (LDAC)

Final shutdown of Rapsodie, an experimental fast neutron reactor which ceased operations in 1983, was declared in 1985. The work designed to partially decommission the reactor, which began in 1987, was interrupted in 1994 following a fatal accident during washing of a sodium tank. This accident, which emphasizes the risks involved in decommissioning operations, necessitated rehabilitation and partial clean-out work, which was completed at the end of 1997. Since then, clean-out and decommissioning work limited to certain equipment items has been resumed, along with waste removal. Renovation and refurbishment work has also been carried out.

The LDAC, located within the same BNI as the Rapsodie reactor, was designed for inspection and examination of spent fuel from the Rapsodie reactor or other fast neutron reactors. This laboratory has been shut down since 1997. It has been cleaned-out, is under surveillance and awaiting decommissioning.

In 2007, ASN approved a revised version of the safety requirements for the operations involved in preparing final shutdown, enabling the licensee to carry out a number of reactor auxiliary equipment clean-out and dismantling operations. In 2008, CEA submitted a file applying for final shutdown and complete decommissioning. ASN informed CEA its file could not be accepted as it stood. A revised version of the file should be submitted in 2010.

HARMONIE reactor

Operation of the HARMONIE reactor ceased in 1996. It was a calibrated neutron source used primarily for calibrating detectors and studying the properties of certain materials. The decree authorising CEA to proceed with final shutdown and decommissioning was published on 8 January 2004. Following the operations to cut up the reactor block and take away the waste generated by decommissioning in 2005, the reactor slab, which had been activated by the neutron flux during operation, was subject to complete clean-out in 2006. 2007 and 2008 were mainly devoted to demolition of the building civil engineering works and operations designed to return the site to its natural state.

The installation was delicensed on 10 June 2009 with publication in the Official Gazette of the ministerial order of 26 May 2009 implementing ASN decision 2009-DC-0133 of 31 March 2009.

Enriched uranium processing facilities (ATUE)

The ATUE provided conversion into sinterable oxide of the uranium hexafluoride from the isotopic enrichment plants. They were also used for the chemical reprocessing of fuel element fabrication scraps to recover the enriched uranium they contain. The facility was also equipped with a low level organic liquid incinerator. Production in the facilities ended in July 1995 and the incinerator was shut down at the end of 1997.

The decree authorising final shutdown and decommissioning of the installation was published in February 2006. The year 2006 saw completion of the decommissioning phase for the process equipment.

These civil engineering structural dismantling and complete clean-out phases are continuing. The licensee also began a programme to characterise the soil outside the buildings, in order to detect any traces of pollution, for subsequent treatment.

ASN considers that the licensee will need to remain vigilant with regard to schedule compliance if it is to meet the deadline stipulated in its final shutdown and decommissioning decree.

The plutonium technology facility (ATPu) and the chemical purification laboratory (LPC).

The ATPu produced plutonium-based fuel elements, initially intended for fast neutron or experimental reactors and then, as of the 1990s, for PWRs using MOX fuel. The activities of the LPC were closely associated with those of the ATPu: physical and chemical checks and metallurgical examination of plutonium-based products, processing of effluents and waste contaminated with alpha emitters. Since 1994, AREVA NC has been the industrial licensee operating the ATPu and the LPC. From a regulatory standpoint, CEA nonetheless remains the nuclear licensee for these installations.

Given that it was impossible to demonstrate that these installations were immune to the seismic risk, AREVA NC put an end to commercial activities within the ATPu in August 2003. Since then, CEA has been involved in a final shutdown and decommissioning process for the two installations. The corresponding application files, sent to ASN in 2006, were the subject of a public inquiry at the beginning of the summer of 2008 and resulted in the Official Gazette publishing final shutdown and decommissioning decrees 2009-262 and 2009-263 on 6 March 2009.

Following the cessation of commercial production in 2003, AREVA NC initiated the recovery and packaging of the fabrication scrap and materials contained in the ATPu and LPC. This phase, which is necessary in order to reduce the risks inherent in these materials prior to decommissioning of the installations, was to end on 31 December 2006. As it became clear that it would be impossible to meet this deadline, CEA wished to postpone it to 31 December 2008. ASN considered that this was too long and that decommissioning needed to be completed as rapidly as possible and it issued decision 2007-DC-0036 of 21 March 2007, setting 30 June 2008 as the deadline for processing and evacuation of the materials and scrap from the ATPu and LPC. On 1 July 2008, ASN carried out an inspection in these installations, in order to check compliance with the above-mentioned decision. The inspectors were able to see that all the nuclear materials concerned by this decision had been repackaged and evacuated from the installations, mainly to the AREVA NC facility at La Hague.

On 6 October 2009, CEA Cadarache informed ASN that the amounts of plutonium in the installation's glove boxes had been underestimated at about 8 kg during the installation operating period, whereas the quantities recovered to date stood at about 22 kg and CEA estimated that the total quantity could even reach 39 kg at the end of decommissioning. Following the ASN inspection of 9 October 2009, CEA was sent formal notice of non-compliance with the notification procedures stipulated in the regulations, as the licensee had been aware of this situation since June 2009. ASN also upgraded the incident from the licensee's initial level 1 rating on the INES scale, to level 2.

ASN also issued an initial decision 2009-DC-0160 on 14 October 2009 suspending the decommissioning operations in progress in the installation, and a second decision 2009-DC-0161 on 19 October 2009 defining the conditions for resumption of the work.

On 3 November 2009, ASN authorised resumption of the work by CEA on 22 of the 220 glove boxes still to be decommissioned in the installation. Restart of a second series of operations could be authorised at the beginning of 2010.

2|2|4 The Saclay centre installations being decommissioned

ASN considers that the clean-out and decommissioning operations leading to delicensing of the two Saclay particle accelerators were carried out in compliance with satisfactory methodology and regulations, which should be extended to the other installations, particularly old installations or parts of installations, the decommissioning of which had been postponed for a considerable time.

High activity laboratory (LHA)

The high activity laboratory (LHA) comprises several units equipped for research and production assignments on various radionuclides. Following the decommissioning and clean-out work authorised by decree 2008-979 of 18 September 2008, published in the Official Gazette on 21 September 2008, only two laboratories will probably remain and will be covered by the ICPE system. Dismantling work has begun on the active effluent intercells tanks.

CELIMENE cell

The CELIMENE cell, adjoining the EL3 reactor, was commissioned in 1965 for review of the fuels from this reactor. This cell is now attached to the spent fuel testing laboratory (LECI). The last fuel rods were removed in 1995 and a number of partial clean-out operations conducted until 1998. Decommissioning operations are scheduled from 2012 to 2015.

2|3 AREVA installations

2|3|1 The UP2-400 spent fuel reprocessing plant and the associated facilities

The situation in the UP2-400 is described in chapter 13. The former UP2 400 reprocessing plant and the associated facilities (BNI 33, 38, 47 and 80), which have been shutdown since 2004, are scheduled for decommissioning. As the final shutdown preparatory work is already well-advanced, ASN had informed AREVA NC that it wanted to see the decommissioning application files for the UP2-400 plant installations submitted rapidly. The first final shutdown and decommissioning application file for BNI 80 (HAO), was submitted at the beginning of 2008. This application was subject to a public inquiry in October 2008 and resulted in the Official Gazette publication of final shutdown and decommissioning decree 2009-961 on 31 July 2009.

In October 2008, AREVA NC submitted three final shutdown and decommissioning authorisation applications for BNIs 33, 38 and 47. These files are currently being reviewed by ASN.

AT1 pilot reprocessing plant

The AT1 pilot plant reprocessed fuel from the RAPSODIE and PHÉNIX fast breeder reactors from 1969 to 1979. It is part of BNI 38 (STE-2).

Clean-out of this installation began in 1982, and was completed in 2001. In 2001, ASN duly took note of the end of clean-out, exclusive of civil works, and of transition to the surveillance stage. This installation is not however delicensed as its complete decommissioning will be part of the decommissioning application for the UP2-400 plant as a whole.

Caesium 137 and strontium 90 source fabrication installation (ÉLAN IIB)

The ÉLAN IIB (BNI 47) installation manufactured caesium 137 and strontium 90 sources until 1973. The initial decommissioning operations undertaken by the Technicatome firm ended in November 1991. A large number of renovation and maintenance operations took place during 2002 and 2003 (upgrading of the ventilation system, radiation mapping, etc.) with a view to decommissioning operation resumption. All the installation upgrade work and the work preparatory to decommissioning of the installation was carried out during 2004 and 2005. In October 2008, AREVA NC submitted a final shutdown and decommissioning application for BNI 47 jointly with BNIs 33 and 38.

2|3|2 SICN plant in Veurey-Voroize

Two nuclear installations, BNIs 65 and 90, located on the site of the SICN company (AREVA group) in Veurey-Voroize, constitute this former nuclear fuel fabrication plant. Fuel fabrication ceased at the beginning of this century. Final shutdown operations took place between 2000 and the end of 2005. The decrees authorising the decommissioning operations were published in February 2006, thus enabling work to start.

In 2009, equipment decommissioning continued. After the complete clean-out operations (see point 1|5), it was possible to delicense a large number of areas from the waste zoning viewpoint. Nonetheless, the licensee had to deal with a number of problems with implementing its complete clean-out methodology, because some of the older design buildings were incompatible with easy and optimum use of this methodology. The strategy therefore changed and entails the demolition of certain buildings on the site, contrary to what had been initially planned in the project.

A review of the file describing the management strategy for the site floors and soil, polluted by former activities, is also continuing. Following this review, steps will be taken to determine the nature of the restrictions to be put into place for administrative delicensing of the BNIs.

ASN considers that the decommissioning of the SICN site at Veurey-Voroize is proceeding satisfactorily, despite the technical difficulties inherent in this type of work.

2|4 Other installations

2|4|1 The Strasbourg University reactor

Very similar in design and characteristics to the CEA Ulysse reactor at Saclay, the Strasbourg University reactor (RUS - BNI 44) at Louis Pasteur University was mainly used for experimental irradiations and the production of short-lived radioisotopes.

The decree authorising Louis Pasteur University in Strasbourg to proceed with final shutdown and decommissioning was published in the Official Gazette of 22 February 2006. Decommissioning work began in the second half of 2006 and ended in August 2008. A BNI delicensing application is currently being reviewed.

ASN considers that the decommissioning work was satisfactory and that the ambitious clean-out goals were on the whole met.

2|4|2 Electromagnetic radiation laboratory (LURE)

The electromagnetic radiation laboratory (LURE), located at the heart of the Orsay campus (Essonne département), is an installation producing synchroton radiation (high-power X-rays) for a wide variety of research applications. It comprises six particle accelerators.

In January 2007, following a phase from 2004 to 2008 to prepare for final shutdown, the LURE licensee (CNRS) submitted an application for authorisation to decommission its installation, with the exception of the CLIO and PHIL accelerators, which are to be kept in operation. Review of this application resulted in MAD-DEM (final shutdown and decommissioning) decree 2009-405 dated 14 April 2009. After decommissioning of BNI 106, the final status will consist of cleaned-out empty premises returned to the Paris Sud XI University. The LURE was linked to CEA's Saclay local information committee, which became the "local information committee for the Saclay BNIs".

3 OUTLOOK

The regulations concerning the decommissioning of nuclear installations have changed considerably since the 1990s. The current legal context, tailored to the issues of decommissioning and to the growing number of nuclear installations undergoing decommissioning:

– gives an exhaustive picture of the decommissioning of each nuclear installation, from shutdown to delicensing;
– ensures the flexibility and responsiveness necessary for performance of the decommissioning operations, with the stringency that this type of operation demands, in particular through the system of internal authorisations;
– throughout the life of the installations, ensures financing of their decommissioning and management of the associated waste.

Over and above the individual decommissioning of each installation, ASN ensures that the licensees' overall strategies are coherent in taking account of nuclear safety and radiation protection constraints. The scale of the decommissioning programmes in progress (several tens of installations concerned) demands rigorous planning, taking account of all the parameters related to safety and radiation protection: installation ageing, sequencing of operations, choice of technical scenarios, safety priorities, etc.

Other parameters, on which the decommissioning strategies are based, are also essential: availability of waste disposal routes, waste flow management (in particular according to the capacity of each solution), management of uncertainties and technical difficulties, organisational and 'project' risk management measures, etc. ASN therefore examined the decommissioning strategies of EDF and CEA in 2004 and 2006 respectively. The updated EDF strategy will be examined in 2010.

Today, even if the decommissioning activities on the nuclear installations have reached the industrial stage, there is still considerable room for improvement. In particular, in the coming years, ASN will focus on:

– ensuring the consistency of the decommissioning strategies used by the nuclear licensees;
– developing tools for better assessment of the estimates made by the licensees concerning the cost of decommissioning;
– checking improvements in how human and organisational factors are taken into account during decommissioning operations;
– checking implementation of all the rules introduced by the TSN Act on transparency and public involvement in decommissioning projects.

In 2010, ASN will concentrate in particular on the following subjects:

– the consequences for the EDF GCR decommissioning programme of the delay in opening the graphite waste disposal centre;
– review of the authorisation application for final shutdown and decommissioning of the AREVA UP2-400 plant in La Hague;
– the conditions for resumption of the ATPu decommissioning operations following the incident notified on 6 October 2009 and the lessons to be learned from this incident.

Finally, in 2010, ASN will be continuing its international involvement on the subject of decommissioning. It will in particular be taking part in the work of IAEA and NEA on the subject and will continue to work with its European counterparts within the WENRA association in order to finalise common reference levels for decommissioning.

4 FORMER INSTALLATIONS REMOVED FROM THE BNI LIST AS AT 31.12.2009

Installation Location	BNI	Type of installation	Commis-sioned	Final shutdown	Final regulatory procedures	Current status
NÉRÉIDE FAR*	(former BNI 10)	Reactor (500 kWth)	1960	1981	1987: removed from BNI list	Decommissioned
TRITON FAR*	(former BNI 10)	Reactor (6,5 MWth)	1959	1982	1987: removed from BNI list and classified as ICPE	Decommissioned
ZOÉ FAR*	(former BNI 11)	Reactor (250 kWth)	1948	1975	1978: removed from BNI list and classified as ICPE	Confined (museum)
MINERVE FAR*	(former BNI 12)	Reactor (0,1 kWth)	1959	1976	1977: removed from BNI list	Dismantled at FAR and reassembled at Cadarache
EL 2 SACLAY	(former BNI 13)	Reactor (2,8 MWth)	1952	1965	Removed from BNI list	Partially decommissioned, remaining parts confined
EL 3 SACLAY	(former BNI 14)	Reactor (18 MWth)	1957	1979	1988: removed from BNI list and classified as ICPE	Partially decommissioned, remaining parts confined
PEGGY CADARACHE	(former BNI 23)	Reactor (1 kWth)	1961	1975	1976: removed from BNI list	Decommissioned
CÉSAR CADARACHE	(former BNI 26)	Reactor (10 kWth)	1964	1974	1978: removed from BNI list	Decommissioned
MARIUS CADARACHE	(former BNI 27)	Reactor (0,4 kWth)	1960 in Marcoule, 1964 in Cadarache	1983	1987: removed from BNI list	Decommissioned
LE BOUCHET	(former BNI 30)	Ore processing	1953	1970	Removed from BNI list	Decommissioned
GUEUGNON	(former BNI 31)	Ore processing	1965	1980	Removed from BNI list	Decommissioned
STED FAR*	(former BNI 34)	Processing of liquid and solid waste	Before 1964	2006	2006: removed from BNI list	Integrated into BNIs 165 and 166
HARMONIE (Cadarache)	(former BNI 41)	Reactor (1 kWth)	1965	1996	2009: removed from BNI list	Decommissioned
ALS	(former BNI 43)	Accelerator	1958	1996	2006: removed from BNI list	Cleaned-out – public protection restrictions (***)
SATURNE	(former BNI 48)	Accelerator	1966	1997	2005: removed from BNI list	Cleaned-out – public protection restrictions (***)
ATTILA** FAR*	(former BNI 57)	Reprocessing pilot	1968	1975	2006: removed from BNI list	Integrated into BNIs 165 and 166
LCPu FAR*	(former BNI 57)	Plutonium chemistry laboratory	1966	1995	2006: removed from BNI list	Integrated into BNIs 165 and 166
BAT 19 FAR*	(former BNI 58)	Plutonium metallurgy	1968	1984	1984: removed from BNI list	Decommissioned
RM2 FAR*	(former BNI 59)	Radiometallurgy	1968	1982	2006: removed from BNI list	Integrated into BNIs 165 and 166
LCAC GRENOBLE	(former BNI 60)	Fuels analysis	1975	1984	1997: removed from BNI list	Decommissioned
STEDs FAR*	(former BNI 73)	Solid waste storage facility	1989		2006: removed from BNI list	Integrated into BNIs 165 and 166

4 FORMER INSTALLATIONS REMOVED FROM THE BNI LIST AS AT 31.12.2009 (continuation)

Installation Location	BNI	Type of installation	Commis-sioned	Final shutdown	Final regulatory procedures	Current status
ARAC SACLAY	(former BNI 81)	Fabrication of fuel assemblies	1981	1995	1999: removed from BNI list	Cleaned-out
IRCA	(former BNI 121)	Irradiator	1983	1996	2006: removed from BNI list	Cleaned-out – public protection restrictions (***)
FBFC PIERRELATTE	(former BNI 131)	Fuel fabrication	1990	1998	2003: removed from BNI list	Cleaned-out – public protection restrictions (***)
SNCS OSMANVILLE	(former BNI 152)	Ioniser	1983	1995	2002: removed from BNI list	Cleaned-out – public protection restrictions (***)
URANIUM WAREHOUSE MIRAMAS	(former BNI 134)	Uranium bearing materials warehouse	1964	2004	2007: removed from BNI list	Cleaned-out – public protection restrictions (***)
SILOETTE GRENOBLE	(former BNI 21)	Reactor (100 kWth)	1964	2002	2007: removed from BNI list	Cleaned-out – public protection restrictions (***)

(*) Fontenay-aux-Roses – (**) Attila: reprocessing pilot located in a unit of BNI 57 – (***) Restrictions: conventional restrictions on behalf of the State were applied to the plots concerned.

5 LIST OF BASIC NUCLEAR INSTALLATIONS FINALLY SHUTDOWN AS AT 31.12.2009

Installation Location	BNI	Type of installation	Commis-sioned	Final shutdown	Final regulatory procedures	Current status
CHOOZ AD (FORMER CHOOZ A)	163 (former BNI 1, 2, 3)	Reactor (1040 MWth)	1967	1991	2007: final shutdown and decommissioning decree	Decommissioning in progress
CHINON A1D (FORMER CHINON A1)	133 (former BNI 5)	Reactor (300 MWth)	1963	1973	1982: Chinon A1 confinement decree and creation of the Chinon A1D storage BNI	Partially decommissioned, modified to BNI for storage of waste left on-site (museum)
CHINON A2D (FORMER CHINON A2)	153 (former BNI 6)	Reactor (865 MWth)	1965	1985	1991: partial decommissioning decree for Chinon A2 and creation of the Chinon A2D storage BNI	Partially decommissioned, modified to BNI for storage of waste left on-site
CHINON A3D (FORMER CHINON A3)	161 (former BNI 7)	Reactor (1360 MWth)	1966	1990	1996: partial decommissioning decree for Chinon A3 and creation of the Chinon A3D storage BNI	Partially decommissioned, modified to BNI for storage of waste left on-site
MÉLUSINE GRENOBLE	19	Reactor (8 MWth)	1958	1988	2004: final shutdown and decommissioning decree	Decommissioning in progress
SILOÉ GRENOBLE	20	Reactor (35 MWth)	1963	1997	2005: final shutdown and decommissio-ning decree	Decommissioning in progress
RAPSODIE CADARACHE	25	Reactor (40 MWth)	1967	1983		Preparation for final shutdown
EL 4D (FORMER EL4 BRENNILIS)	162 (former BNI 28)	Reactor (250 MWth)	1966	1985	1996: decree ordering decommissioning and creation of the EL-4D storage BNI 2006: final shutdown and decommissio-ning decree 2007: decision of the *Conseil d'État* cancelling the 2006 decree	Partially decommissioned, modified to BNI for storage of waste left on-site
SPENT FUEL REPROCESSING PLANT (UP2) (LA HAGUE)	33	Transformation of radioactive materials	1964	2004	2003: boundary change	Preparation for final shutdown
STED AND HIGH LEVEL WASTE STORAGE UNIT (GRENOBLE)	36 and 79	Waste treatment and storage facility	1964/1972	2008	18.09.2008: final shutdown and decommissioning decree	Decommissioning in progress
EFFLUENT AND SOLID WASTE TREATMENT STATION (STE2) AND FORMER PILOT REPROCES-SING PLANT FOR SPENT FUEL FROM FAST NEUTRON REACTORS (AT1) (LA HAGUE)	38	Effluent and waste treatment facility	1969	1979		Preparation for final shutdown

5 LIST OF BASIC NUCLEAR INSTALLATIONS FINALLY SHUTDOWN AS AT 31.12.2009 (continuation)

Installation Location	BNI	Type of installation	Commis-sioned	Final shutdown	Final regulatory procedures	Current status
STRASBOURG UNIVERSITY REACTOR	44	Reactor (100 kWth)	1967	1997	2006: final shutdown and decommissioning decree	Decommissioning in progress
BUGEY 1	45	Reactor (1920 MWth)	1972	1994	2008: final shutdown and decommissioning decree	Decommissioning in progress
ST-LAURENT A1	46	Reactor (1662 MWth)	1969	1990	1994: final shutdown decree	Final shutdown in progress
ST-LAURENT A2	46	Reactor (1801 MWth)	1971	1992	1994: final shutdown decree	Final shutdown in progress
ÉLAN II B LA HAGUE	47	Fabrication of Cs 137 sources	1970	1973		Preparation for final shutdown
HIGH ACTIVITY LABORATORY (LHA) SACLAY	49	Laboratory	1960	1996	2008: final shutdown and decommissioning decree	Decommissioning in progress
ATUE CADARACHE	52	Uranium processing	1963	1997	2006: final shutdown and decommissioning decree	Decommissioning in progress
LAMA GRENOBLE	61	Laboratory	1968	2002	2008: final shutdown and decommissioning decree	Decommissioning in progress
SICN VEUREY-VOROIZE	65 and 90	Fuel fabrication plant	1963	2000	2006: final shutdown and decommissioning decree	Decommissioning in progress
HAO (HIGH LEVEL OXIDE) FACILITY LA HAGUE	80	Transformation of radioactive materials	1974	2004	2009: final shutdown and decommissioning decree	Decommissioning in progress
ATPu CADARACHE	32	Fuel fabrication plant	1962	2003	2009: final shutdown and decommissioning decree	Decommissioning in progress
LPC CADARACHE	54	Laboratory	1966	2003	2009: final shutdown and decommissioning decree	Decommissioning in progress
SUPERPHÉNIX CREYS-MALVILLE	91	Reactor (3000 MWth)	1985	1997	2006: final shutdown and decommissioning decree	Decommissioning in progress
COMURHEX PIERRELATTE	105	Uranium chemical transformation plant	1979	2009		Preparation for final shutdown
LURE	106	Particle accelerators	SINCE 1956 TO 1987	2008		Preparation for final shutdown
PROCESS FAR*	165	Grouping of former process installations	2006		2006: final shutdown and decommissioning decree	Decommissioning in progress
SUPPORT FAR*	166	Waste packaging and processing	2006		2006: final shutdown and decommissioning decree	Decommissioning in progress

(*) Fontenay-aux-Roses: creation of BNIs 165 and 166 to replace BNIs 34, 57 59 and 73 and performance of shutdown and decommissioning operations for BNIs 165 and 166 following grouping of the buildings under the delicensing project for the Fontenay-aux-Roses site.