

SAFE FINAL SHUTDOWN AND DECOMMISSIONING OF BASIC NUCLEAR INSTALLATIONS

Upon completion of their operating period, basic nuclear installations (BNIs) undergo a series of clean-up and transformation operations allowing final shutdown prior to decommissioning. The work thus performed may result, from the administrative standpoint and depending on the subsisting activity level, in the creation of a new BNI, in the delicensing of the BNI concerned into an installation classified on environmental protection grounds (ICPE) which has to be licensed or registered, or simply in a return to the public sector (for uses which may or may not be restricted), subject to possible adjusted encumbrances.

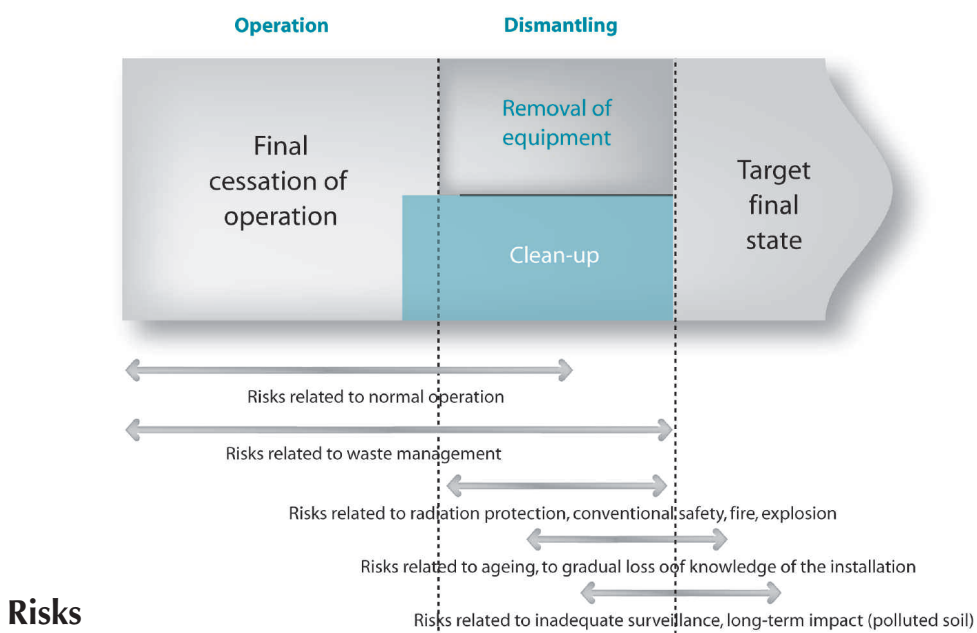
The first steps lead to removal of the fuel or nuclear materials present in the facility, which already helps reduce the risk from the nuclear safety viewpoint. This is then replaced by human radiation protection and conventional safety-related risks owing to work being done close to residual nuclear material and the numerous handling operations for removal of the waste generated by decommissioning.

The Nuclear Safety Authority (ASN) now strives to integrate relevant experience feedback from past decommissioning projects in France and abroad. The ASN encourages complete decommissioning either immediately or after slight postponement, provided that upstream of the regulatory processes, the licensee is able to present and justify the chosen decommissioning scenario, from the final cessation of production up to the final decommissioning of the installation. Regulatory practices concerning BNI decommissioning operations were updated along these lines in early 2003.

The ASN considers the current decommissioning operations as test cases, providing an opportunity for the licensees, on the one hand, to define and implement a decommissioning strategy (decommissioning level to be reached, detailed operating schedule), and, on the other hand, a management policy for the large amounts of radioactive waste that will be generated (notably the very low level waste). If carried through to their conclusion, they would also constitute examples demonstrating the technical and financial feasibilities of an entire decommissioning operation.

1 TECHNICAL AND ADMINISTRATIVE PROVISIONS

The technical provisions applicable to installations to be decommissioned must obviously be in compliance with general safety and radiation protection rules, notably regarding worker external and internal exposure to ionising radiation, criticality, the production of radioactive waste, release to the environment of radioactive effluents or measures designed to limit accident hazards and mitigate their consequences.



Safety issues, in other words protection of persons and the environment, can be significant, during clean-up or decommissioning operations, as well as during passive surveillance phases. The rapidly changing nature of the installation is a non-negligible risk factor in that it is harder than for an operating installation to guarantee that all potential risks have been consistently and exhaustively taken into account.

The above figure attempts to summarise the main risks encountered when decommissioning an installation and the periods during which these risks are highest.

The risks linked to waste management (radioactive waste disposed of inappropriately in a conventional channel, etc.) are present throughout all phases producing large quantities or a wide variety of waste.

As decommissioning proceeds, the risks identified during operation of the installation, primarily linked to the radioactive nature of the materials handled, are gradually replaced by risks more linked to radiation protection and conventional safety (decommissioning requires that the workers go into areas they were not used to visiting during operation) or risks linked to the technologies used for decommissioning and cutting the structures (often involving hot points with the concurrent risk of fire or explosion). The risks linked to the problem of the stability of partially decommissioned structures must also be taken into account, along with those linked to the obsolescence of the equipment (in particular concerning the possibility of fires breaking out in ageing electrical installations).

For complex nuclear installations, decommissioning work often lasts more than a decade, frequently coming after several decades of operation. There is thus a considerable risk linked to loss of memory of the design and operation of the installation, especially when the former licensees leave the installation, and it is vital to be able to collect and record the recollections of the persons involved in these phases, all the more so as the traceability of the design and operation of old installations is frequently less than rigorous.

With each subsequent phase in decommissioning, arises the question of the surveillance of the installation being at all times appropriate to its state and the risks entailed. It is often necessary to replace the in-service surveillance systems with other (radiological, fire) more appropriate means, either temporarily or more permanently. As it is hard to constantly check that surveillance is appropriate to the constantly changing state of the installation, there is a risk of failure to detect an incipient hazardous situation.

Once the final installation state is reached, there is still the risk of pollution being inadequately or not at all identified or poorly characterised, having a significant long-term impact on the site or its environment.

The decommissioning scenario (immediate or deferred) is selected by the licensee on a case by case basis, generally in the light of comparative studies. The strategies today adopted by the licensees, CEA or EDF, are presented in points 3|1 and 3|2.

Similarly, the various technical provisions chosen for each stage in decommissioning of a nuclear installation are chosen by the licensee on a case by case basis. However, to avoid splitting up the decommissioning projects and to improve overall consistency, the ASN asks that as of final shutdown of an installation, a file be submitted, explicitly presenting all the various works envisaged from final shutdown until the target final state is reached, and demonstrating at each step the nature and scale of the risk presented by the installation and the steps taken to control it.

Finally, in the current context regarding management of industrial sites being decommissioned, it seems necessary in most cases that there should be a means of preserving the memory of the past existence of a BNI on a site, along with any utilisation restrictions corresponding to the condition of the site. The procedures for delicensing after clean-up are mentioned in chapter 16.

SAFE FINAL SHUTDOWN AND DECOMMISSIONING OF BASIC NUCLEAR INSTALLATIONS

The ASN specified the regulatory framework for BNI decommissioning operations in a note signed on 17 February 2003, following extensive work to clarify and simplify the administrative procedures, while improving the extent to which safety and radiation protection are taken into account.

New practical measures for application of article 6 ter of the above-mentioned amended decree of 11 December 1963 are now in place in order to:

- clarify the definition of the leading technical and administrative stages in decommissioning to ensure that it is better tailored to the diversity of nuclear installations;
- to encourage complete decommissioning either immediately or after slight postponement;
- encourage presentation and justification by the licensee of the decommissioning scenario chosen before initiating the regulation process, from the decision to cease operations up to complete decommissioning;
- to clarify the administrative notion of delicensing of a basic nuclear installation and the related criteria.

This revision leads to a clearer definition of the two main phases in the life of an installation, each of which is associated with a single authorisation decree, the authorisation decree for the operating phase and the final shutdown and decommissioning decree for the decommissioning phase. This creates a more balanced picture, both technically and administratively, between the importance given to the decommissioning phase and that given to the operating phase.

All these requirements are detailed in the ASN note of 17 February 2003, entitled: “regulatory procedures concerning decommissioning of basic nuclear installations”. This note is available on the ASN website, www.asn.gouv.fr

2 FINANCING OF DECOMMISSIONING AND MANAGEMENT OF RADIOACTIVE WASTE

In its previous annual reports, the ASN stressed the importance of financing the management of radioactive waste and of decommissioning. Furthermore, the ASN stated that the prospect of a change in the status and partial privatisation of EDF and AREVA requires that a system be implemented to guarantee that sufficient funds will be available, when the time comes, to finance decommissioning of the installations and management of the waste. The ASN confirmed that it will consequently exercise particular vigilance on this point.

In 2005, the ASN observed that this subject had been widely examined both in France and within the European Union.

A number of reports on this subject were published in France in 2005.

In January 2005, the Government Audit Office published a report on the “decommissioning of nuclear installations and management of radioactive waste”. This report depicts the situation at the main nuclear licensees (EDF, AREVA, CEA) and proposes a certain number of recommendations. In this respect, the ASN noted the Government Audit Office’s approach concerning the cost estimates made by the licensees and the areas of uncertainty (decisions concerning a future deep geological repository, the cost of such a repository, the future of spent fuel in particular MOX) as well as the situation regarding the dedicated assets set up by the licensees. The ASN in particular noted the following recommendations:

- taking inspiration from the best practices in the OECD countries, it would be worth reviewing the means of securing the funds intended for decommissioning and waste management;
- financial information from the companies needs to be improved, and in particular should comprise more details concerning the structure of the future costs and the cost assessments for each category

of operations, describing the scenarios on the basis of which they were calculated and giving both the gross value and discounted value of the costs in question.

The Parliamentary Office for the Assessment of Scientific and Technological Options published a report in March 2005 entitled "Research progress and prospects concerning radioactive waste management", which contains a chapter devoted to financing of radioactive waste management. The ASN is particularly attentive to the goals highlighted by this chapter, that is the need for clear, long-term financing and the creation or reinforcement of institutional and financial tools. With regard to resources, and on the basis of experience acquired abroad, the authors of the report recommend the creation of a dedicated fund by the State for waste management, with an initial contribution to it from the producers, followed by annual contributions paid in by them. The report adds that this dedicated fund should finance ANDRA's industrial and research activities, as well as research carried out into separation/transmutation. Finally, given the current context, the report rules out any notion of transfer of responsibility for and ownership of radioactive waste from the producers to a third party, even if accompanied by any fixed, compensatory sum.

In its document entitled "Update of the basic document deposited with the Financial Markets Authority on 23 September 2005", EDF stated that its Board had validated the proposition consisting in:

- when calculating the dedicated assets to be set up (in other words the financial resources that need to be set aside and identified as such) include those plants already shut down and for which dismantling has started, as well as the cost of processing the fuel present in the plant cores at the time of final shutdown;
- speeding up the rate of collection of the dedicated assets, in order to advance from the situation qualified as "embryonic" by the Government Audit Office to one in 2010 corresponding to the forecast sums felt to be necessary by EDF.

The EDF document states that this view is consistent with the conclusions of the report published in the summer of 2005, concerning the role entrusted by the State to the General Inspectorate of Finance and the General Council for Mining Engineering, with respect to the problem of dedicated assets.

The report on the mission given to the General Inspectorate of Finance and the General Council for Mining Engineering underlines the need to organise a new type of supervision implying intervention by a third-party from outside the companies (Administration, Commission, Supervisory Authority, etc.). In this respect, the report points out that the American experience could constitute a starting point for future consideration required on this subject (every two years, the US NRC reviews documents supplied by the companies assessing decommissioning costs and the adequacy of the corresponding dedicated funds).

At European Union level, a number of actions are being carried out by the Commission, the Parliament and the Council, to ensure fair competition and for safety reasons. These actions consist of:

- periodic reports from the European Commission on the situation in the various countries of the Union and preparation of a recommendation concerning the steps to be taken within the Union for financing radioactive waste management and decommissioning operations;
- a report from the European Parliament on the use of financial resources intended for nuclear power plant decommissioning, currently being adopted;
- work initiated by the Council, following the failure of the directive proposals in 2003 drafted by the Commission concerning nuclear safety, radioactive waste and fuel. It entails wide-ranging discussion by the European countries on these subjects, including the financial resources to be collected, before any implementation of the appropriate instruments on a European scale. This work should reach its conclusion by the end of 2006.

Through its bilateral relations, the ASN has gained greater knowledge of the steps taken by the United States, Great Britain, Sweden, Finland and Switzerland. The ASN observes that in these countries, there is a legislative and regulatory framework regulating the financing of radioactive waste management and decommissioning. The funds are generally externalised and managed by legal enti-

ties other than the operators. Finally, in some cases (United States and Sweden in particular), the nuclear regulator plays a key role in the overall supervision of the system.

To conclude, the ASN observes that the question of financing radioactive waste management and decommissioning is assuming increasing importance in France and across the European Union.

For its part, the ASN wishes to underline the importance of the following principles:

-The financial resources must be adequate.

This presupposes identifying the future costs (perimeter) and estimating these costs as accurately as possible on the basis of duly clarified scenarios and assumptions.

-The sums gathered in the form of funds must be effectively available when the time comes. This implies that the rate at which each fund is built up is commensurate with the estimated future expenditure and deadlines and that the fund is managed in accordance with the performance targets, but nonetheless with a reasonable degree of prudence. This also presupposes protection of each fund against uses other than those for which it is created, with respect both to the managers of the company and to any creditors.

To achieve this, the system needs to be supervised. The following in particular are required:

-construct a legal and regulatory framework for the various aspects of the question;

-define and implement supervision procedures. This supervision will in particular be based on reports produced by each company and periodically revised, including the scope of the expenditure to be covered by each fund (contributions, fund performance, withdrawals, etc.) and the proposals for replenishment as applicable;

-define procedures for clear and complete information with a view to public transparency.

As in certain other countries, the Nuclear Safety Authority must help implement the measures needed to comply with these principles. More particularly, the ASN will naturally be called on concerning the scenarios and assumptions and more generally on the various aspects of the estimation methodology. However, the ASN will need to have wide-ranging powers of access, particularly within the supervision mechanism, in order to ensure that adequate funds are available for radioactive waste management and decommissioning to take place in satisfactory conditions of safety.

3 THE SITUATION OF NUCLEAR INSTALLATIONS BEING DECOMMISSIONED IN 2005

3 | 1

EDF nuclear power plants

Until recently, the generic strategy adopted by EDF for decommissioning of its nuclear power plants, was that of deferred complete decommissioning. This strategy consisted in extracting the fissile material, removing the easily recoverable parts, reducing the contained zone to a minimum and fitting out the external barrier. Complete decommissioning of the installation was then envisaged by EDF after several decades of containment, to take advantage of the natural radioactive decay. An approach of this type had its drawbacks, notably in that it could lead to a gradual loss of knowledge of the installation, as its operator departed, which could be prejudicial to the decommissioning operations. The ASN asked EDF to review this strategy and to evaluate the feasibility of reducing the time needed to undertake complete decommissioning work.

After an initial evaluation submitted in November 1999, EDF decided to revise its strategy for the EL4 reactor, undertaking to carry out complete decommissioning of the reactor soon after completion of the partial decommissioning operations currently in progress.

Then in April 2001, EDF decided to adopt this new decommissioning strategy for all its decommissioned nuclear installations (Brennilis, Bugey 1, Saint-Laurent A, Chinon A, Chooz A and Superphénix), based on complete decommissioning of the reactors, with no standby period. It thus provides for complete decommissioning of these reactors by 2025.

To ensure the success of the new complete decommissioning programme for these 9 first generation reactors, EDF is relying on the CIDEN (Deconstruction-Environment Engineering Centre), an engineering unit based in Lyons and dependent on the DIN (nuclear engineering division), which has been operational since 2001.

In addition to the data to be transmitted in the documents specific to the various sites, the ASN feels that EDF had sent all the expected answers to the Advisory Committee on 24 March 2004, concerning the decommissioning strategy to be applied to the first generation of EDF reactors.

In its letter of 30 September 2005 sent to the Chairman of EDF, ASN in particular stressed the need for EDF to ensure that reactor decommissioning takes place in good technical and economic conditions. More particularly, in the case of the first generation reactors, priority must be given to decommissioning Bugey 1 and Saint-Laurent A1 et A2, in compliance with the schedule proposed by EDF. With regard to the pressurised water reactors currently in operation, EDF must start looking at decommissioning conditions, taking account of NPP standardisation, the number of installations and the dates envisaged for their shutdown.

3 | 1 | 1

EDF responsibility as nuclear operator of installations being decommissioned

In a letter dated 9 February 2004, the Nuclear Safety Authority authorised EDF to set up a system of internal authorisations for the installations concerned by the decommissioning programme. This approach is primarily designed to meet a strong demand for constant updating of the safety reference system of an installation. Setting up such a system therefore enables the licensee to make changes to the reference system which do not compromise the safety demonstration.

In September 2005, EDF sent the initial results after 18 months of use of the internal authorisation system for the decommissioning programme. EDF incorporated experience feedback from the event which had led the ASN to suspend a decommissioning worksite at Chooz A, which was the first occasion the internal authorisations system was used. The ASN considers that the organisation put in place by EDF now works satisfactorily.

3 | 1 | 2

Monts d'Arrée plant

The EL4 nuclear reactor, which entered service on 23 December 1966, finally ceased all production of electricity on 13 July 1985. This reactor was an industrial prototype, built and operated jointly by the CEA and EDF. As part of the partial decommissioning process for this installation, the 31 October 1996 decree authorised modification of the existing installation, converting it into a facility for interim storage of its own equipment left on the site and thus created a new basic nuclear installation called EL4-D. On the basis of a study defining the various possible options for final decommissioning earlier than planned, EDF on 22 July 2003 submitted an application for final shutdown and decommissioning of the EL4-D installation.

In 2005, EDF carried out preparatory work on the site in advance of future decommissioning work inside the reactor containment, modification of the reactor containment and reactor block ventilation system and cutting work to isolate the CO₂ system from the reactor bloc. In the light of the

inconclusive results of the clean-up operation on the effluent treatment station sub-soil already carried out and the corresponding safety risks, the work had to be suspended in order to define a new operating methodology.



Brennilis – renovation of the ventilation system

3 | 1 | 3

Gas cooled reactors (GCR)

The six GCRs which formed the first EDF nuclear power reactor population, located respectively at the Chinon, Saint-Laurent-des-Eaux and Bugey nuclear power plants, are currently at various stages of decommissioning.

- Chinon A1D, A2D and A3D reactors

The old Chinon A1, Chinon A2 and Chinon A3 reactors were partially decommissioned and transformed into storage facilities for their own equipment. These operations were authorised by the decrees of 11 October 1982, 7 February 1991 and 27 August 1996, respectively. These installations are currently in the care and maintenance phase.

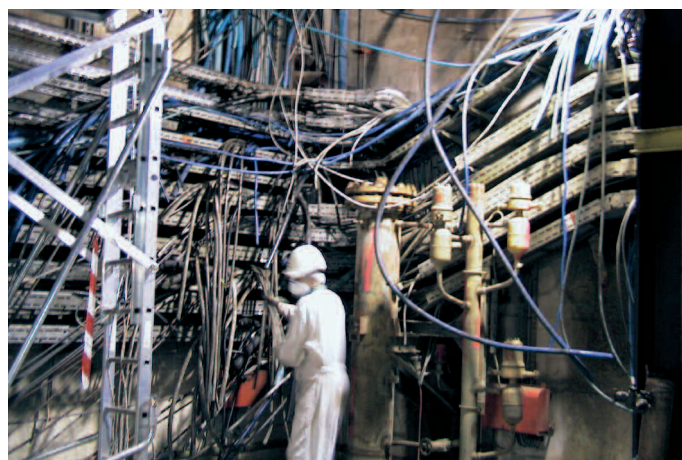


Chinon – blasting of the CHA 3 water tower

The new water intake and liquid and gaseous effluent discharge authorisation was signed on 17 August 2005. The Chinon A installations should be brought into conformity so that gaseous discharges can be measured during the forthcoming worksites. The licensee has also started the administrative formalities prior to demolition of the Chinon A pumping stations, which should take place during the course of 2006. In 2005, EDF began demolition of the conventional buildings and evacuation of nuclear waste continued in the conditions initially planned.

• **Saint-Laurent-des-Eaux A1 and A2 reactors**

The decree authorising final shutdown operations for the two reactors was signed on 11 April 1994. In 2005, EDF began core drilling of the graphite and the concrete of the caisson in order to consolidate the radiological inventory.



Saint-Laurent – cable removal worksite

• **Bugey 1 reactor**

The decree authorising final shutdown operations was signed on 30 August 1996. In 2005, the licensee completed packaging of the graphite sleeves and removal of all the containers to the Aube centre. Decommissioning work on the CO₂ treatment areas began in May 2005.

In October 2005, EDF submitted an application for the complete decommissioning authorisation. Review of these documents is currently in progress.



Bugey 1 – CO₂ area

3 | 1 | 4

Chooz A D reactor (Ardennes nuclear power plant)

The Ardennes nuclear power plant, which was coupled to the grid on 4 April 1967, finally ceased all electricity production on 30 October 1991. This reactor was the first PWR built in France. As part of the reactor partial decommissioning process, the 19 March 1999 decree authorised modification of the existing installation so that it could be converted into an interim storage facility for its own equipment left on the site, thereby creating a new basic nuclear installation called CNA-D. Owing to the change in the decommissioning strategy for this reactor, EDF submitted an application on 30 November 2004 for final shutdown and complete decommissioning of the CNA-D installation.

In 2005, EDF completed decommissioning in the main galleries and the electrical vault which in particular consisted in significantly reducing the fire load by removing decommissioned cabling. The licensee also started decommissioning work on the ventilation flue and the preparatory work for civil engineering demolition.



Chooz A – dismantling of ventilation flue

3 | 1 | 5

Superphénix reactor

The Superphénix fast neutron reactor, a sodium-cooled industrial prototype, is located at Creys-Malville. In accordance with the Government decision of February 1998, this reactor, with its rated thermal power of 3000 MW and net electrical output of 1200 MWe, is currently in its final shutdown stage. This installation is associated with another BNI, the on-site spent fuel storage unit (APEC), consisting mainly of an interim storage pool for fuel removed from the reactor vessel.

Final shutdown of the reactor was authorised by decree 98-1305 of 30 December 1998.

In early 2003, all the fuel assemblies had been removed from the reactor and stored in the APEC. At present, the reactor vessel only contains special assemblies and the lateral neutron protections which present no criticality risk. The final decommissioning operations continued and the turbine hall is now almost completely empty. To allow treatment of the sodium contained in the reactor's systems, interim storage of the existing new core in the APEC and decommissioning of the reactor installations, EDF in 2003 submitted an application for authorisation for complete decommissioning of the reactor. It also submitted an application for a water intake and effluent discharge licence for the site. In 2004, these various applications were the subject of an administrative procedure, a technical investigation and a public inquiry. They should end in the publication of a decommissioning decree cover-

ing the entire period necessary for reactor decommissioning, while specifying hold points for the technical subjects felt to be the most sensitive, and a water intake and discharge license. The draft decree was approved by the CIINB on 11 May 2005.

Spent fuel removal 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.

In 2003, EDF submitted an application for modification of the installation's authorisation decree for storage of unused Superphénix fuel and for storage within the boundary of this BNI of the blocks of sodium-impregnated concrete resulting from the destruction of the sodium in this same reactor. This application should lead to publication of a decree modifying the installation's authorisation decree. The draft decree was approved by the CIINB on 11 May 2005.

3 | 2

CEA installations

Following a request from the ASN, the CEA in June 2004 forwarded several documents enabling the ASN to assess the overall decommissioning strategy for the CEA's civil installations, particularly with respect to consistency and management of the corresponding waste. The ASN envisages referring the matter to the Advisory Committee for laboratories and plants in 2006.

3 | 2 | 1

Fontenay-aux-Roses site

The CEA research centre is located in the town of Fontenay-aux-Roses, bordering on the towns of Châtillon and Plessis-Robinson, in the Hauts-de-Seine *département*¹. It covers an area of 13.8 hectares.

This centre comprises four BNIs, which pursued research activities in the fields of chemical engineering, analytical chemistry, storage of radioactive waste and transuranic elements. The laboratory for plutonium-based fuel studies (RM2) and the plutonium chemistry laboratory (LCPu) are currently being cleaned-up. Only the radioactive liquid effluent and solid waste treatment station and the interim storage facility for radioactive solid waste are still operating.

The Fontenay-aux-Roses research centre will be decommissioned in around 2010. In view of this decision and the accompanying clean-up operations, the CEA is preparing to group its nuclear activities in the Fort part of the installation, which presupposes modification of the existing BNI perimeters, a process which has already been started. The final shutdown, decommissioning and perimeter modification application dossier for the basic nuclear installations at the Fontenay-aux-Roses centre was sent to the ASN in December 2003. A public inquiry from May to June 2004 was carried out accordingly. The approval process of the draft decrees which should lead to the creation of two BNIs in place of the four original BNIs mentioned above are still following their course.

• Radioactive effluent and solid waste treatment station and solid waste interim storage station (also see chapter 13)

Despite the closure of some workshops (incineration, evaporation), the Radioactive effluent and solid waste treatment station (BNI 34) continues to evacuate radioactive effluent from the site and to treat solid waste, in particular as part of the site decommissioning operations. BNI 34 also stores effluent from past practices, for which the disposal channel is not yet operational. The solid waste interim storage station (BNI 73) stores irradiating drums in decay pits, pending removal, and provides

1. Administrative division of the size of a county.

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interim storage of low and very low level waste drums waiting for shipment to a repository. BNI 73 is carrying on the removal of the irradiating drums of solid waste from the decay pits. Shutdown of these BNIs is included in the decommissioning dossier for the CEA's Fontenay-aux-Roses site.

• Plutonium chemistry laboratory (LCPu)

Until July 1995, the plutonium chemistry laboratory (LCPu) at the CEA Centre in Fontenay-aux-Roses was used for research and development work on spent fuel reprocessing and waste treatment methods.

Final shutdown of this installation began in July 1995 and is continuing pending the publication of the final shutdown and decommissioning order for the entire Fontenay-aux-Roses site. This will involve recovering, processing and removing the radioactive materials present in the installation.

The Petrus high-level tanks were characterised in June 2004, confirming that their content was indeed liquid. The operations to empty these tanks were approved by an internal authorisation in 2005. This work will be carried out in 2006.

• Laboratory for plutonium-based fuel studies

This radio-metallurgical laboratory, located on the CEA site at Fontenay-aux-Roses, comprised two units, RM1 and RM2, located in two separate buildings. The activities of the spent fuel analysis laboratory ended in 1984.

Cleanup operations took place from 1991 to 1995.

In 1999, the CEA provided an end-of-cleanup report for the RM1 part and a more detailed decontamination plan for the RM2 part. The CEA sent the ASN a clean-up report concerning the floor in the filters room as experience feedback. Decommissioning will be regulated by a common decommissioning order covering the CEA site at Fontenay-aux-Roses (see previous point).

3 | 2 | 2

Grenoble site

The Grenoble research centre (Isère) is located in an industrial zone north-west of the town, at the confluence of the Drac and the Isère rivers. It covers an area of 128 hectares.

The main activities of this Centre are fundamental and applied research in non-nuclear fields (condensed state physics, biology, electronics and materials) and applied research into development of nuclear reactor technologies, mainly focused on safety (thermal hydraulic aspects). The Centre also houses a unit of the INSTN (National Teaching Institute for Nuclear Science and Techniques).

• Effluent and solid waste treatment station and decay storage

The effluent and solid waste treatment station (STEDS - BNI 36) is phasing its activities out until the end of 2010. The solid waste and liquid effluent treatment and packaging functions have ceased. The STEDS is still taking in and providing interim storage for waste, primarily that resulting from clean-up of the BNIs in the centre, before taking them away to alternative disposal routes. One of the major activities in 2005 was removal of the high-level waste bins from the installation's decay pits (BNI 79). The high-level packages stored in these pits were recovered for sorting and optimisation of their contents prior to repackaging. This will enable some of the packages to be sent to ANDRA's Aube repository or to the CEDRA BNI for waste with sufficiently decayed radioactivity levels. For packages for which the level is still too high for removal through the above-mentioned channels, the CEA envisages storing them in ventilated pits in BNI 72 (STED at CEA Saclay).

The CEA will present its final shutdown and decommissioning dossier for this installation at the end of 2006.

• Active material analysis laboratory (LAMA)

This laboratory ended its scientific research duties in 2002. It takes part in the clean-up operations for the Mélusine reactor and is engaged in its own clean-up work. Updating of the safety case and the general operating rules to take account of modifications to the installation, particularly shutdown of the non-irradiated uranium interim store, is currently being reviewed.

The CEA will present the final shutdown and decommissioning dossier for this installation at the end of 2006.

• Siloette reactor

Siloette is a pool-type 100 kWth reactor, primarily used to train operational personnel for the nuclear power generating plants. This reactor has been in the decommissioning phase since mid-2002. All the fuel and the beryllium still present in the installation were removed and the two pools in the installation were drained. All the moving equipment still in the pools has been removed. The decree authorising final shutdown and decommissioning of the reactor was signed on 26 January 2005.

• Mélusine and Siloé reactors

Mélusine is a pool reactor operated by the CEA at its Grenoble Centre. It was finally shut down in 1994.

The decree authorising the CEA to modify the Mélusine reactor prior to its decommissioning and delicensing was published in the Official Gazette in January 2004. The installation's pool is now empty and the its ceramic tiles and the ends of the neutron channels were removed as well. The building and ventilation decommissioning work continued in 2005.

The Siloé reactor, located on the CEA site in Grenoble, has been shut down since 23 December 1997. In 2004, the CEA forwarded a summary of the decommissioning operations which had begun in 1999. Pool drainage was completed in February 2005. The decree authorising final shutdown and decommissioning of the reactor was signed on 26 January 2005. Decommissioning, particularly electromechanical decommissioning, began in 2005.

3 | 2 | 3

The Cadarache site installations being decommissioned

• Rapsode reactor and Fuel assembly shearing laboratory (LDAC)

Rapsodie, a fast neutron experimental reactor, was shut down on 15 April 1983. Final shutdown was declared on 28 May 1985. As from 1987, this installation has been undergoing work, which led to its partial decommissioning.

This work was interrupted in 1994, further to a fatal accident which occurred during the cleaning of a sodium tank. This accident, which emphasizes the risks involved in decommissioning operations, necessitated rehabilitation and partial cleanup processes, which were completed by the end of 1997. Since then, the clean-up, limited decommissioning and waste removal work has resumed and the installation has now reached the servicing and surveillance phase. Renovation and refurbishment work has also been carried out.

Installed at Cadarache, the LDAC, which is part of the BNI comprising the Rapsodie reactor, carried out tests and reviews on spent fuel irradiated in Rapsodie or in other fast neutron reactors. This laboratory has been shut down since 1997. It is cleaned-up, under surveillance and awaiting decommissioning.

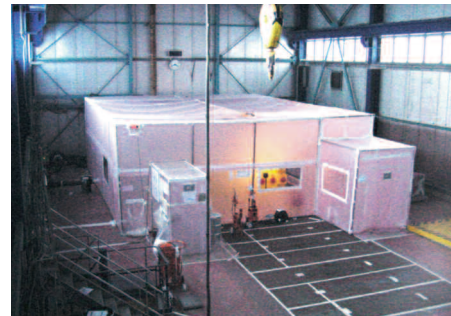
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In 2002 and 2003, the CEA sent the ASN the updated General Operating Rules (RGEs) and an updated safety reference system which covered the Rapsodie reactor, the LDAC and the neutron radiography reactor in a single document. The 2005 review of these documents found that the justifications were insufficient, in particular with respect to the forthcoming clean-up operations. A revised version of the installation's safety reference system should be forwarded to the ASN at the end of 2005.

• **Harmonie reactor**

The Harmonie reactor, a source of graded neutrons, mainly used for detector calibration and investigation of the properties of certain materials, installed on the CEA Cadarache site, has been shut down since 1996. After removal of the depleted uranium, the experimental rigs, the fuel and the sources it contained, it was decommissioned on 18 December 1997.

The decree authorising the CEA to proceed with final shutdown and decommissioning was published on 8 January 2004. The operations covered by this decree are in progress. Reactor block cutting, reactor hall clean-up and waste removal were carried out in 2005.



Reactor hall with reactor block cutting hatch – Harmonie

• **Enriched uranium processing facilities (ATUE)**

The ATUE at the CEA Cadarache Centre 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. In April 2002, the ASN authorised the clean-up of the incineration line.

In March 1998, the CEA provided a request for final shutdown and decommissioning of this BNI, which was updated in 2003. The decree authorising these operations should be published in 2006.

• **Cadarache irradiator (IRCA)**

The Cadarache irradiation installation was designed to test the resistance of PWR safety-related electrical equipment to gamma radiation. Since the installation has not functioned since June 1995, the licensee decided to shut it down in March 1996. The sources it contained were removed and sent to the Grenoble centre in April 1996.

The decree authorising the CEA to proceed with final shutdown and decommissioning was published on 8 January 2004. The operations covered by this decree were carried out during 2004, after which, the CEA sent the ASN a BNI delicensing application based on a residual environmental impact assessment. A draft conventional encumbrance on behalf of the State was transmitted to the ASN in 2005.

3 | 2 | 4

The Saclay site installations being decommissioned

• **High activity laboratory (LHA)**

The high activity laboratory (LHA) comprises several units equipped for research and production assignments on various radionuclides.

The ASN was informed of clean-up work end on cells 12 and 16. In 2005, cells 11 and 15 were being cleaned-up. Cells 0 and 2 were however still in operation. The ASN asked the licensee to send it a final shutdown and decommissioning dossier by early 2006.

• **CELIMENE cell**

The CELIMENE cell, adjoining the EL3 reactor, was commissioned in 1965 for review of the fuel from this reactor. This cell is now attached to the spent fuel analysis laboratory. The last fuel rods were removed in 1995 and a number of partial clean-up operations conducted until 1998. Decommissioning of the installation, currently under surveillance, is not planned before about 2010.

• **Saturne accelerator**

Saturne was a particle accelerator, located at the CEA Saclay Centre, dedicated to fundamental and applied research, circulating proton, deuteron, helium, or even heavier ion beams.

The decree authorising final shutdown and decommissioning of this installation was published in October 2002. The operations covered by this decree ended in February 2004. A request for BNI delicensing was sent to the ASN, along with a draft conventional encumbrance on behalf of the State. All the radioactive waste resulting from decommissioning was sent to the authorised channels. The encumbrance and the delicensing decision were signed in October 2005. The installation was therefore removed from the list of BNIs on 18 October 2005.

• **Saclay linear accelerator (ALS)**

The Saclay linear accelerator is located on the Orme des Merisiers site on the Saclay plateau. It is operated by the CEA. It has been shut down since 1996 and is currently in a “closure of operation” stage.

The decree authorising the CEA to carry out the shutdown and decommissioning operations on the ALS installation was published in January 2004. The operations covered by this decree ended in February 2004. The results of final shutdown and decommissioning were sent to the ASN. The final waste resulting from these operations was being taken away in 2005.



ALS before dismantling



ALS after dismantling

3 | 2 | 5

The La Hague installations being decommissioned

• **AT1 pilot reprocessing facility**

The AT1 pilot reprocessing facility, operated by the CEA, on the COGEMA La Hague site, was used to reprocess spent fuel from the Rapsodie and Phenix fast neutron reactors, between 1969 and 1979. It forms part of BNI 33 (UP2 400 plant).

Decommissioning of this installation began in 1982, and was completed in 2001. In 2001, the ASN duly took note of the end of clean-up, exclusive of civil works, and of transition to the surveillance stage.

• **Caesium 137 and strontium 90 source fabrication facility (Élan IIB)**

SAFE FINAL SHUTDOWN AND DECOMMISSIONING OF BASIC NUCLEAR INSTALLATIONS

The ELAN II B installation, a CEA installation operated by COGEMA on the La Hague site, 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, radiological 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. Radiological reconnaissance work was carried out in 2005 and the licensee sent the ASN the final shutdown dossier at the end of 2005. The CEA's provisional target is to complete decommissioning in 2013.

•UP2 400

COGEMA announced its decision to no longer reprocess spent fuel in the UP2 400 as of 1 January 2004 and to effect final shutdown (see chapter 13).

3 | 3

Other installations

3 | 3 | 1

The Société Normande de Conserve et Stérilisation (SNCS) irradiator

The SNCS ionisation plant, located at Osmanville (Calvados), authorised by decree on 17 October 1990, was used for the sterilization of foodstuffs and medico-surgical equipment.

In 1995, the cobalt 60 sources contained in the installation were transferred to ionisers operated by the Ionisos company.

The licensee presented an application for final shutdown and decommissioning of the installation, with the ultimate aim of removing the installation from the list of BNIs. The corresponding decree was signed on 27 March 2002.

The decision to delicense the installation was signed at the end of 2002 and should be followed by conventional encumbrances on behalf of the State, which have yet to be signed.

3 | 3 | 2

The Strasbourg University reactor

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

The ASN asked the Université Louis Pasteur to provide it with considerable data by June 2003, to supplement the files transmitted for the formal notice of November 2001 and concerning the provision of a final shutdown and decommissioning file.

At the end of 2003, the ASN informed the Minister for Youth Affairs, National Education and Research, with responsibility for this reactor, of the need to finance complete decommissioning in the very near future. In 2004, he informed the ASN that he agreed to immediate decommissioning.

The final shutdown and decommissioning dossier was reviewed in 2005, and a draft authorising decree has been prepared.

3 | 3 | 3

SICN plant in Veurey-Voroize

Two nuclear installations, BNIs 65 and 90, grouped together on the site of the SICN site in Veurey-Voroize, make up this establishment. Work involving the fuel elements used in experimental reactors and fabrication of fuel pellets with all enrichment levels has now finally ceased. The decommissioning operations continued in 2005 (mainly removal of nuclear materials to the appropriate channels) and a pilot worksite, the purpose of which is to define the techniques to be used to clean up the site, began in 2005. A dossier presenting the strategy for managing the outdoor areas outside the BNI buildings (soil) is currently being reviewed.



Adjustment of a bush hammering robot (pilot worksite)

3 | 3 | 4

COGEMA interim storage facility at Miramas

The COGEMA Miramas establishment (BNI 134) was created in 1983. It is a warehouse for solid and stable compounds of natural enriched or depleted uranium, and uranium hexafluoride (UF_6). Store clearance operations took place from the end of 2002 to the end of 2003 and the warehouse was completely empty of nuclear materials by 1 January 2004. A final shutdown and decommissioning dossier was sent to the ASN in 2004. A draft decree authorising final shutdown and decommissioning of the installation has been prepared. In 2005, clean-up and radiological mapping were carried out.

4 OUTLOOK

In 2003, the ASN redefined how BNI decommissioning operations were managed, with the aim of encouraging the licensees to proceed with early decommissioning of those installations already shut down. The ASN also asked EDF and the CEA to produce dossiers giving an overall description of the their strategy and schedule for decommissioning of the many shut down installations, giving safety and radiation protection justifications. In 2004, the ASN concluded its review of EDF's overall decom-

missioning strategy for the first generation reactors and in 2006 will adopt a stance on the overall decommissioning strategy for the CEA's civil installations.

In this context, the ASN is satisfied with the 2005 supplementary budget act provision for a 50% reduction in the BNI tax for installations being decommissioned. This measure, which has no impact on the State budget, will primarily benefit the Research sector in the coming years.

Finally, in 2005, much thought and discussion was given over to the question of financing radioactive waste management and decommissioning, both in France and across the European Union. This subject has assumed increasing importance in the context of the changing status and partial privatisation of EDF.

For its part, the ASN underlines the importance of the following principles:

- the financial resources must be sufficient;
- the sums collected in the form of funds must be effectively available when the time comes.

To achieve this, the system must be supervised and the following in particular are necessary:

- construct a legal and regulatory framework for the various aspects of the question;
- define and implement supervision procedures;
- establish the procedures for clear and complete information with a view to public transparency.

The ASN will contribute to implementation of the measures needed to comply with these principles.

5 LIST OF BASIC NUCLEAR INSTALLATIONS DELICENSED AS AT 31.12.2005

Installation LOCATION	BNI	Type of installation	Commission- ed	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 10)	REACTOR (250 kWth)	1948	1975	1987: 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 reas- sembled at Cadarache
EL 2 SACLAY	(former BNI 13)	REACTOR (2,8 MWth)	1952	1965	Removed from BNI list	Sealed source
EL 3 SACLAY	(former BNI 14)	REACTOR (18 MWth)	1957	1979	1988: removed from BNI list and classified as ICPE	Partially decommission- ed, remaining parts confined
PEGGY CADARACHE	(former BNI 23)	REACTOR (1 kWth)	1961	1975	1976: removed from BNI list	Decommissioned
CÉSAR CADARACHE	(former BNI 26)	REACTOR (10 kWth)	1964	1974	1978: removed from BNI list	Decommissioned
MARIUS CADARACHE	(former BNI 27)	REACTOR (0,4 kWth)	1960 IN MARCOULE, 1964 IN CADARACHE	1983	1987: removed from BNI list	Decommissioned
LE BOUCHET	(former BNI 30)	Ore processing	1953	1970	Removed from BNI list	Decommissioned
GUEUGNON	(former BNI 31)	Ore processing		1980	Removed from BNI list	Decommissioned
SATURNE	(former BNI 48)	Accelerator	1958	1997	2005: removed from BNI list	Cleaned up – encum- brances (***)
ATTILA** FAR*	57	Reprocessing pilot	1966	1975		Decommissioned
BAT 19 FAR*	(former BNI 58)	Plutonium metallurgy	1968	1984	1984: removed from BNI list	Decommissioned
LCAC GRENOBLE	(former BNI 60)	Fuels analysis	1968	1984	1997: removed from BNI list	Decommissioned
ARAC SACLAY	(former BNI 81)	Fabrication of fuel assemblies	1975	1995	1999: removed from BNI list	Cleaned up
FBFC PIERRELATTE	(former BNI 131)	Fuel fabrication	1983	1998	2003: removed from BNI list	Cleaned up – encum- brances (***)
SNCS OSMANVILLE	(former BNI 152)	Ioniser	1990	1995	2002: removed from BNI list	Cleaned up

(*) Fontenay-aux-Roses - (**) Attila: reprocessing pilots located in the BNI 57 cell - (***) Encumbrances: conventional encumbrances on behalf of the State were taken out on the plots concerned.

SAFE FINAL SHUTDOWN AND
DECOMMISSIONING OF BASIC NUCLEAR INSTALLATIONS

6 LIST OF BASIC NUCLEAR INSTALLATIONS FINALLY SHUTDOWN AS AT 31.12.2005

Installation LOCATION	BNI	Type of installation	Commission- ed	Final shutdown	Final regulatory procedures	Current status
CHOOZ AD (FORMER CHOOZ A)	163 (former BNI nos 1, 2, 3)	REACTOR (1040 MWth)	1967	1991	1999: partial decommissioning decree for Chooz A and crea- tion of the Chooz AD interim storage BNI	Partially decommission- ed, modified to BNI for interim storage of waste left on-site
CHINON A1D (FORMER CHINON A1)	133 (former BNI n° 5)	REACTOR (300 MWth)	1963	1973	1982: Chinon A1 confinement decree and creation of the Chinon A1D interim storage BNI	Partially decommission- ed, modified to BNI for interim storage of waste left on-site (museum)
CHINON A2D (FORMER CHINON A2)	153 (former BNI n° 6)	REACTOR (865 MWth)	1965	1985	1991: partial decommissioning decree for Chinon A2 and creation of the Chinon A2D interim storage BNI	Partially decommission- ed, modified to BNI for interim storage of waste left on-site
CHINON A3D (FORMER CHINON A3)	161 (former BNI n° 7)	REACTOR (1360 MWth)	1966	1990	1996: partial decommissioning decree for Chinon A3 and creation of the Chinon A3D interim storage BNI	Partially decommission- ed, modified to BNI for interim storage of waste left on-site
MÉLUSINE GRENOBLE	19	REACTOR (8 MWth)	1958	1988	2004: decommissioning authorisation decree	Decommissioning in progress
SILOÉ GRENOBLE	20	REACTOR (35 MWth)	1963	1997	2005: decommissioning authorisation decree	Final shutdown in progress
SILOETTE GRENOBLE	21	REACTOR (100 kWth)	1964	2002	2004: decommissioning authorisation decree	Final shutdown in progress
RAPSODIE CADARACHE	25	REACTOR (40 MWth)	1967	1983		Decommissioning in progress
EL 4D (FORMER EL4 BRENNILIS)	162 (former BNI n° 28)	REACTOR (250 MWth)	1966	1985	1996: decree ordering decom- missioning and creation of the EL-4D interim storage BNI	Decommissioning in progress
AT1 LA HAGUE	33	Fast fuel reprocessing	1969	1979		Cleaned up
HARMONIE CADARACHE	41	REACTOR (1 kWth)	1965	1996	2004: final shutdown and decommissioning decree	Decommissioning in progress
ALS SACLAY	43	Accelerator	1965	1996	2004: final shutdown and decommissioning decree	Decommissioning in progress
STRASBOURG UNIVERSITY REACTOR STRASBOURG	44	REACTOR (100 kWth)	1967	1997		Final shutdown in progress
BUGEY 1	45	REACTOR (1920 MWth)	1972	1994	1996: final shutdown decree	Final shutdown in progress

6 LIST OF BASIC NUCLEAR INSTALLATIONS FINALLY SHUTDOWN AS AT 31.12.2005 (CONTINUATION)

Installation LOCATION	BNI	Type of installation	Commission- ed	Final shutdown	Final regulatory procedures	Current status
ST-LAURENT A1	46	REACTOR (1662 MWth)	1969	1990	1994: final shutdown decree	Final shutdown in progress
ST-LAURENT A2	46	REACTOR (1801 MWth)	1971	1992	1994: final shutdown decree	Final shutdown in progress
ÉLAN II B LA HAGUE	47	Fabrication of Cs 137 sources	1970	1973		Decommissioning in progress
HIGH LEVEL LABORATORY (LHA) SACLAY	49	Laboratory	1960	1996		Final shutdown in progress – some cells still active
ATUE CADARACHE	52	Uranium processing	1963	1997		Clean-up in progress
LCPU FAR*	57	Plutonium chemistry laboratory	1966	1995		Final shutdown in progress
RM2 FAR*	59	Radiometallurgy	1968	1982		Decommissioning in progress
SUPERPHÉNIX CREYS-MALVILLE	91	Reactor (3000 MWth)	1985	1997	1998: final shutdown decree	Final shutdown in progress

(*) Fontenay-aux-Roses