Safe decommissioning of basic nuclear installations (BNIs)

1 TECHNICAL AND LEGAL REQUIREMENTS APPLICABLE TO DECOMMISSIONING

1.1 Decommissioning strategies
1.2 Legal requirements
1.3 The financing of decommissioning and radioactive waste management
  1.3.1 Reminder of legislative and regulatory provisions
  1.3.2 Review of the reports submitted by the licensees
1.4 Decommissioning issues
1.5 Complete post-operational clean-out

2 SITUATION OF NUCLEAR INSTALLATIONS UNDERGOING DECOMMISSIONING IN 2012

2.1 EDF nuclear power plants
  2.1.1 The Bremiils power plant
  2.1.2 Gas-cooled reactors (GCRs)
  2.1.3 CHOOZ A reactor (Ardennes nuclear power plant)
  2.1.4 SUPERPHÉNIX reactor
2.2 CEA installations
  2.2.1 The Fontenay-aux-Roses centre
  2.2.2 The Grenoble centre
  2.2.3 The Cadarache centre installations being decommissioned
  2.2.4 The Saclay centre installations being decommissioned
  2.2.5 The Marcoule centre installations being decommissioned
2.3 AREVA installations
  2.3.1 UP2 400 spent fuel reprocessing plant and associated facilities
  2.3.2 The COMURHEX Pierrelatte plant
  2.3.3 SICN plant in Veurey-Voroize
2.4 Other installations
  2.4.1 The Strasbourg University Reactor
  2.4.2 The Electromagnetic Radiation Laboratory (LURE)

3 OUTLOOK


The general term of decommissioning covers all the technical and administrative activities carried out following the final shutdown of a nuclear facility, in order to achieve a final predefined status in which all the hazardous substances, and radioactive substances in particular, have been removed from the facility. These activities may for example 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 facilities were built between the 1950s and the 1980s, a large number of them are being gradually shut down and then decommissioned, particularly over the past fifteen years. In 2012, about thirty nuclear facilities 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. Ensuring the safety and radiation protection of the decommissioning operations in these facilities is a major concern for ASN.

The specific aspects of decommissioning activities (change in the nature of the risks, rapid changes in the facility’s status, duration of the operations, etc.) make it impossible to implement all the regulatory principles that were applied during the facility operating period. The regulations concerning the decommissioning of nuclear facilities have progressively changed since the 1990s. They were clarified and supplemented in 2006 by the TSN Act now codified in books I to V of the Environment Code by order 2012-6 of 5th January 2012. ASN is continuing to develop the regulatory framework and the applicable doctrine for this phase in the life of basic nuclear installations (BNIs). In 2008, a report presenting ASN’s decommissioning strategy for BNIs was made publicly available. This report is based primarily on the choice of the immediate decommissioning strategy and the need to achieve a final status after decommissioning in which all hazardous materials had been removed. This report was presented to the High Committee for Transparency and Information on Nuclear Security (HCTISN) in 2009 and was published in 2010.

1 TECHNICAL AND LEGAL REQUIREMENTS APPLICABLE TO DECOMMISSIONING

1.1 Decommissioning strategies

The International Atomic Energy Agency (IAEA) has defined three decommissioning strategies for nuclear facilities, following final shutdown:

– deferred dismantling: the parts of the facility containing radioactive substances are maintained or placed in a safe state for several decades before actual decommissioning operations begin (the “conventional” parts of the facility can be decommissioned as soon as the facility is shut down);

– entombment: the parts of the facility containing radioactive substances are placed in a reinforced containment structure for a period that is long enough to reach a radiological activity level sufficiently low to envisage release of the site (the “conventional” parts of the facility can be decommissioned as soon as the facility is shut down);

– immediate dismantling: decommissioning is started as soon as the facility is shut down, without a waiting period, although the decommissioning operations can extend over a long period of time.

Many factors can influence the choice of one decommissioning strategy rather than another: national regulations, social and economic factors, financing of the operations, availability of waste disposal routes, decommissioning techniques, qualified personnel, exposure of the personnel and the public to ionising radiation as a result of the decommissioning operations, etc. Consequently, practices and regulations differ from one country to another.

Today, in accordance with IAEA recommendations, French policy aims to ensure that French BNI licensees adopt an immediate decommissioning strategy. The doctrine determined by ASN in 2009 concerning the decommissioning and delicensing of BNIs, and the corresponding applicable regulations, were recalled in the fourth report presented by France in 2012 under the Joint Convention on the Safety of Spent Fuel Management and the Safety of Radioactive Waste Management (see point 4.2 of chapter 7).

This strategy avoids placing the technical and financial burden of decommissioning on future generations. At present, 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 resulting from decommissioning operations is a crucial point that determines the correct running of the ongoing decommissioning programmes (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). French policy for the management of very low-level radioactive waste does not include a system of clearance levels for this waste, but on the contrary requires that it be managed in a specific route so that it remains isolated and traceable. This is why, with regard to the possible recycling of the waste resulting from decommissioning, ASN is attentive to
the 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. However, ASN supports initiatives to recycle this waste in the nuclear sector, and the National Radioactive Material and Waste Management Plan (PNGMDR - see chapter 16) includes a recommendation to this end.

## 12 Legal requirements

The technical provisions applicable to facilities to be shut down and decommissioned must comply with general safety and radiation protection rules, notably regarding worker external and internal exposure to ionising radiation, nuclear criticality, radioactive waste production and management, effluents discharge to the environment, and measures to reduce the risk of accidents and mitigate their consequences. Issues relating to safety and the protection of persons and the environment can be significant during clean-out or decommissioning operations, and must never be neglected, even during passive surveillance phases.

Once the licensee has decided to proceed with final shutdown and decommissioning of its facility, 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 and decommissioning (MAD-DEM) of a nuclear facility is authorised by a new decree, issued on the advice of ASN (see diagram 1). The MAD-DEM authorisation procedure for a nuclear facility is described in chapter 3.

In order to avoid fragmentation of the decommissioning projects and improve their overall consistency, the dossier submitted to support the final shutdown and decommissioning application must explicitly describe all the planned operations, from final shutdown to attainment of the targeted final state and, for each step, must describe the nature and scale of the risks presented by the facility as well as the envisaged means of managing them. The decommissioning phase may be preceded by a final shutdown preparation stage, provided for in the initial operating licence. This preparatory phase allows in particular the removal of all or part of the radioactive substances, as well as preparation for the further decommissioning operations (readying of premises, preparation of work sites, 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, etc.

The TSN Act requires that the safety of an installation during the decommissioning phase be periodically reviewed. The frequency of these reviews is normally 10 years. ASN’s objective is to check through these periodic safety reviews that the level of safety of the installation remains acceptable until it is delicensed, with the implementation of measures proportionate to the risks presented by the installation during decommissioning.

Following decommissioning, a nuclear installation can be delicensed. It is then deleted from the list of BNIs and is no longer regulated by the BNI system. To support its delicensing application, the licensee must provide a file demonstrating that the envisaged final status has 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.). Institutional controls may be implemented, depending on the final status reached. These may consist in a set of restrictions on the use of the site and buildings (use restricted to industrial uses for example) or in 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 measures.

In 2003, an ASN guide document specified the regulations for the BNI decommissioning process, after extensive work intended to clarify and simplify the administrative procedure while at the same time ensuring that safety and radiation protection are given higher priority. A fully revised version of this guide, integrating the regulatory changes introduced by the TSN Act and decree 2007-1557 of 2nd November 2007, and the work of the association WENRA, was issued in June 2010 (ASN Guide No 6, available on the web site www.asn.fr).

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**Diagram 1: Phases in the life of a BNI**

- **Regulatory phases:** Creation authorisation decree
- **Technical phases:** Final shutdown / decommissioning decree
- **Operations:** Final shutdown preparation operations
- **Decommissioning:** Final shutdown / decommissioning decree
- **Stopping point:** Stopping point*
- **Delicensing:** Stopping point

* Hold point: operation identified in the MAD-DEM decree but not authorised because insufficiently described in the initial safety analysis report submitted with the MAD-DEM authorisation application. The performance of this operation requires prior approval by ASN, in the form of a resolution by the Commission, based on a detailed safety analysis report prior to performance of the operation.
This guide is intended for nuclear licensees and its main objectives are:
- to explain 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 successive phases leading to delicensing (preparation for final shutdown, decommissioning, delicensing).

The costs involved must be assessed using a method based on an analysis of the options that could be reasonably envisaged for the decommissioning process, on a conservative choice of a reference strategy, on consideration of residual technical uncertainties and 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, the 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 short presentation of the assessment of these costs, showing the consistency between the work in progress and the forecast schedule, and the possible impact of the progress of the work on the costs.

On 3rd 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 required pursuant to Article 12, paragraph 4 of the above-mentioned decree of 23rd February 2007, on the consistency of the strategies for decommissioning and management of spent fuels and radioactive waste;
- on the other hand, 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 under the same conditions as those governing analysis of the three-yearly reports, the DGEC may call on ASN after receiving the annual update memos.

In 2007, all the nuclear installation licensees had submitted their first three-yearly reports pursuant to the provisions of Article 20 of the Act of 28th June 2006. ASN had given the Government its opinion on these three-yearly reports (opinion 2007-AV-037 of 20th November 2007).

In 2008 and 2009, ASN examined the new data forwarded by the licensees in their annual update memos. In 2010, ASN and the DGERC verified the methods used by the licensees to prepare the three-yearly reports and the update memos, and reminded them of the regulatory requirements applicable. The licensees submitted their second three-yearly report in 2010. ASN gave its opinion to the DGEC (opinion 2011-AV-0107 of 3rd February 2011), in which it recommends - as a general rule - better substantiation of assessment robustness and clarification of the uncertainties in the decommissioning and waste management operations that may impact costs. Furthermore, as ASN had observed the need for checks on the tools used by the licensees to assess the decommissioning costs, it recommended implementing audits, and assisted the DGERC in defining the audit programme that should be conducted over the 2011-2013 period.

ASN also informed the DGEC of its opinion on decree 2010-1673 of 29th December 2010 amending decree 2007-243 of
23rd February 2007 relative to securing of the financial costs of decommissioning. ASN reiterated the importance of maintaining the robustness of the composition of the assets dedicated to covering the decommissioning costs and the asset liquidity level in order to guarantee the effective availability of the funds.

In 2011 ASN started drafting a guide for the licensees, to specify what is required in application of the regulatory provisions relating to cost assessments.

1.4 Decommissioning issues

The risks presented by the nuclear facility when in operation change as decommissioning progresses. Even if certain risks, such as criticality, quickly disappear, others, such as those related to radiation protection or non-nuclear working safety (e.g. numerous contractors working together, falling loads, work at height, and so on) gradually become predominant. The same goes for the fire or explosion risks (technique of breaking down structures by “hot points”, that is to say those generating heat, sparks or flames).

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 produced and therefore in particular during the decommissioning phase.

Similarly, the risks associated with social, human and organisational factors (SHOF) (change in organisation with respect to the operating phase, frequent use of outside contractors) must be taken into account. For complex nuclear installations such as nuclear power plant reactors, decommissioning work often lasts for more than a decade. This follows on from an operating period that often lasts several decades. Consequently, the very real risk of the loss of the design and operating memory of the nuclear facilities must be considered.

The sometimes rapid changes in the physical condition of the facility and the risks it presents raise the question of ensuring that the means of surveillance used are adequate and appropriate at all times. It is often necessary, either temporarily or lastingly, to replace the centralised means of operating surveillance by other more appropriate means of surveillance. Following decommissioning, depending on the end-state achieved and the specific characteristics of each facility (operational history, incidents, etc.), there may be residual risks: soil pollution, areas for which clean-out is technically impossible in technically and economically acceptable conditions, etc. In this case, prior to delicensing, the licensee must present and justify the envisaged procedures for continued surveillance of the facility or site. In such cases, institutional controls are imposed to restrict the use of the site.

1.5 Complete post-operational clean-out

Nuclear facility 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 on completion of simple clean-out operations, for example on surfaces, whenever necessary (cleaning of the walls of an area using appropriate products for instance).

However, if activation or contamination migration phenomena occurred during the operating phase, complete clean-out – that is to say 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 provisions of the ASN technical guide on complete clean-out operations, published in 2006 (old guide SD3-DEM-02) have been implemented in a large number of facilities with a variety of characteristics: research reactors, laboratories, fuel fabrication plants, etc. At the end of 2008, ASN had collected feedback on complete clean-out at the national level. The analysis has shown that, in spite of certain technical difficulties, the complete clean-out approach to civil engineering structures has proved its worth. ASN took account of the arguments formulated by the various stakeholders and in June 2010 published a new version of the 2006 guide (ASN guide No.14) which aims to specify the requirements in terms of modelling, delicensing of very large structures, the use of innovative decontamination techniques, the adoption of a suitable approach to the management of deviations and the approval of delicensing, while guaranteeing rigour in the chosen strategy.
Experience feedback from the Fukushima nuclear accident

To take into account the experience feedback from the nuclear accident that occurred at the Fukushima Daiichi NPP in Japan, ASN issued resolution 2011-DC-0213 of 5th May 2011 instructing Electricité de France (EDF) to carry out stress tests on some of its BNIs.

In addition to the EDF reactors in operation, this resolution also applies to the reactors undergoing decommissioning (CHINON A1, A2 and A3, SAINT-LAURENT A1 and A2, BUGEY 1, CHOOZ A, SUPERPHÉNIX, BRENNILIS) and the Fuel storage facility (APEC) (Creys-Malville). ASN thus asked that the reports for the ten BNIs concerned be transmitted by 15th September 2012.

In the same way, ASN issued resolution 2011-DC-0224 of 5th May 2011 instructing the French Alternative Energies and Atomic Energy Commission (CEA) to carry out stress tests on some of its BNIs. The plutonium technology facility (ATPu) (Cadarache) currently undergoing decommissioning, was also the subject of resolution 2012-DC-0296 of 26th June 2012 setting out additional requirements in the light of the conclusions of the stress tests. In addition to the generic requirements, CEA was in particular asked to regularly update the estimated quantities of fissile materials present in each area within the ATPu.

For the RAPSODIE reactor (Cadarache), ASN asked that the report be submitted by 15th September 2012. All the reports requested for 15th September 2012 have been received. They are currently being examined.

2.1 EDF nuclear power plants

In 1996, EDF’s strategy was deferred decommissioning of its shutdown nuclear facilities, namely 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 to initiate the decommissioning of its first-generation plants, which is now scheduled for completion in 2036.

This new strategy was reviewed by the competent 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 submitted a decommissioning strategy update file. In this file, EDF confirmed the position it had adopted in April 2001. The file includes 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.

The conclusion after examining the file is that the principles of the strategy are basically satisfactory, but some additions are required, particularly with regard to alternative solutions for the management of graphite waste. ASN in particular stressed the importance of not having to wait for the commissioning of the low level, long-lived waste repository before decommissioning the gas-cooled reactor pressure vessels and to envisage the possibility of interim storage.

**Internal authorisations**

In a letter dated 9th February 2004, ASN authorised EDF to set up an internal authorisation system for the facilities concerned by the decommissioning programme. This approach addresses a key requirement, namely to keep the safety specifications of a facility permanently up to date.

The system of internal authorisations is now governed by decree 2007-1557 of 2nd November 2007 (see chapter 3) concerning BNIs and the regulation of the nuclear safety of the transport of radioactive substances. ASN resolution 2008-DC-106 of 11th July 2008 specifies the ASN requirements for implementation of the provisions of the above decree relative to internal authorisations. Pursuant to Article 3 of this resolution, EDF submitted a file to ASN presenting an update of its internal authorisation system, concerning decommissioning operations, with a view to having it approved by the ASN Commission. This file is being examined by ASN.

**The Brennilis power plant**

The Brennilis power plant is an industrial prototype of a heavy water-moderated, carbon dioxide-cooled nuclear power plant, operated from 1966 to 1985. Partial decommissioning operations were carried out from 1997 to mid-2007 (plugging of circuits, decommissioning of certain heavy water and carbon dioxide circuits and electromechanical components, demolition of non-nuclear buildings, etc.).

Decree 2006-147 of 9th February 2006 authorising EDF to proceed with the complete decommissioning of the facility was abrogated by the State Council on 6th June 2007 on the grounds that the impact study, in application of directive 85/337/CEE of 27th June 1985, amended, should have been made available to the public before the Government delivered the authorisation.

A new complete decommissioning authorisation application file was submitted by EDF on 25th July 2008. In March 2010, the investigation commission delivered an unfavourable opinion for the project, on the grounds that no urgent need to decommission the reactor block had been demonstrated and that decommissioning was premature as long as ICEDA – the activated waste packaging and interim storage facility – was not operational. It did nevertheless consider that EDF should be immediately authorized to complete the inventory of the initial radiological and chemical status of the site, complete the effluent processing station (STE) decommissioning operations, clean-out and fill in the effluent discharge channel into the River Ellez, clean out areas of diffuse pollution, and lastly, start the decommissioning of the heat exchangers following their radiological characterization.

Partial decommissioning decree 2011-886 was signed on 27th July 2011. In accordance with the provisions of this decree, EDF submitted a further complete decommissioning authorisation application in late December 2011. ASN gave its opinion on the acceptability of the file to the Minister responsible for nuclear safety and considered that in the light of the cancellation of the ICEDA building permit, the facility which EDF had proposed using for management of the waste, the file could not be submitted for public inquiry.

As stipulated in the decree, ASN authorised EDF in June 2012 to carry out clean-out of the effluent discharge channel into the River Ellez, in accordance with the defined criteria. The channel was cleaned out by EDF during the summer of 2012. To check the cleanliness of the channel thus excavated, ASN asked IRSN to take samples. The results of the analyses are expected in early 2013.

In September 2012, EDF transmitted the file for clean-out of the soils around the STE to ASN for authorisation.

Furthermore, through resolutions 2011-DC-0239 and 2011-DC-0240 of 1st September 2011, and after receiving a favourable
opinion from the CODERST (Departmental Council for the Environment and for Health and Technological Risks), ASN has regulated the conditions and limits of water intakes and effluent discharges.

2.1.2 Gas-cooled reactors (GCRs)

During the investigation of the file submitted by EDF in June 2009 concerning updating of the strategy for nuclear power plant decommissioning, ASN reaffirmed its strong support for an immediate decommissioning strategy. It nevertheless notes that where decommissioning of gas-cooled Reactors (GCR) is concerned, the question of the disposal route for graphite waste can complicate the correct implementation of this strategy.

ASN has confirmed that it is in favour of setting up a disposal centre for low-level long-lived waste, and graphite waste in particular, as quickly as possible. Depending on the progress of this project and so that decommissioning of the reactors is not dependent on the creation of the repository, ASN will issue a position statement no later than 2014, concerning the need for EDF to build an interim storage facility for the graphite waste, so that gas-cooled reactor decommissioning operations can continue.

BUGEY 1 reactor

The final shutdown work continued until the end of 2008, during which period the complete decommissioning decree for the facility was signed (decree 2008-1197 of 18th November 2008). The file concerning the strength of the reactor's internal structures is currently being examined by ASN. The nuclear decommissioning work outside the reactor vessel continued. More particularly, cutting up of piping began, using new self-containing processes authorised by ASN in 2012.

In November 2011, ASN also served EDF with formal notice to comply with Articles 21 and 22 of part V of the order of 31st December 1999 in the Bugey NPP, following the significant event which occurred on 9th August 2011, involving the presence of artificial radionuclides in a skip full of conventional rubble. In 2012, ASN carried out a follow-up inspection to verify the steps taken by EDF. Following this inspection, ASN lifted its formal notice in September 2012.

CHINON A1, A2 and A3 reactors

The old CHINON A1, CHINON A2 and CHINON A3 reactors were shut down in 1973, 1985 and 1990 respectively. Reactors A1 and A2 were partly decommissioned and transformed into facilities for the storage of their own equipment. These operations were authorised by the decrees of 11th October 1982 and 7th February 1991 respectively. The complete decommissioning of the CHINON A3 reactor was authorised by decree 2010-511 of 18th May 2010.

In this decree, ASN gave its approval in 2012 for decommissioning work on the exchangers (first step in decommissioning of the facility) of the CHINON A3 reactor. The preparatory work prior to decommissioning of the exchangers is now completed (ventilation, readying of the premises, etc.).

In order to include the exchanger decommissioning operations, EDF submitted an application for a modification to the discharge licenses. In its resolution 2012-DC-0261 of 2nd February 2012, approved by order of 21st March 2012 from the Minister responsible for nuclear safety, ASN set out the conditions for discharge of gaseous effluents into the environment. These effluents are collected and then treated. If necessary, they are also stored in tanks to allow the radioactivity to decay, with periodic measurements being taken. The content of these tanks is then released into the atmosphere via a stack. The sensors located in this stack measure the radioactivity discharged into the environment.

SAINT-LAURENT-DES-EAUX A1 and A2 reactors

Complete decommissioning of the facility, for which final shutdown was declared in April 1994, was authorised by decree 2010-511 of 18th May 2010.

The main work done in 2012 consisted in continuing to remove contaminated legacy effluents and waste and carrying out preparatory work prior to decommissioning outside the vessel of reactor A2.

EDF also carried out assessment work inside the reactor A2 vessel and in 2013 should continue this with reactor A1. This data should in particular be used to substantiate the strength of the structures of these reactors, as requested by ASN. EDF envisages starting decommissioning work outside the vessel of reactor A2 in 2013.

2.1.3 CHOOZ A reactor (Ardennes NPP)

This reactor was the first PWR built in France. It operated from 1967 to 1991.

For partial decommissioning of the reactor, the decree of 19th March 1999 authorised the modification of the existing facility to convert it into a storage facility for its own equipment left on site and thus create a new BNI called CNA-D. Its complete decommissioning was authorised by decree 2007-1395.

By resolution 2010-DC-0202 of 7th December 2010, ASN authorised the start of primary system decommissioning, apart from the reactor vessel, subject to compliance with a number of technical requirements, and thus lifted a hold point mentioned in the CHOOZ A decommissioning decree.

The steam generators were disassembled and decontaminated in 2011 and 2012. Decommissioning of the reactor vessel requires prior authorisation from ASN. EDF therefore submitted a file in 2011 and it is currently being examined by ASN.

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 storage 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 30th December 1998. In early 2003, all the fuel assemblies were removed from the reactor and stored in the APEC. Complete decommissioning
of the reactor was authorised by decree 2006-321 of 20th March 2006.

ASN has also authorised EDF to put the sodium treatment facility (TNA) into service, and to store the blocks of soda concrete produced by TNA, in its resolution 2010-DC-0187 of 6th July 2010. The sodium treatment process is carried out by hydrolysis and leads to the production of soda. This soda is then used as the primary component of the concrete packages to be produced in the cement encapsulation facility and stored for a period on the site to allow decay prior to disposal.

The treatment of sodium from the primary and secondary cooling systems in TNA is in progress and should end in 2016. Given the progress of the operations, the sodium should be completely drained in April 2013.

In June 2012, EDF also submitted the authorisation application file for draining of the components containing the oxidised sodium-potassium alloy, as required by decree 2006-321. ASN is currently examining this file.

In its resolution 2012-DC-0309 of 5th July 2012, ASN served EDF with formal notice to reinforce the emergency situation management resources on the Creys-Malville site.

**Fuel storage facility (APEC)**

This facility was commissioned on 25th July 2000 by the Ministers of Industry and Environment. The spent fuel assemblies removed from the SUPERPHÉNIX reactor are treated and placed in the APEC pool.

The perimeter of the facility also includes a storage area for soda concrete packages from the TNA.

EDF plans to submit the APEC periodic safety review file in 2013.

### 2.2 CEA installations

In December 2006, the Advisory Committees for plants (GPU) and for waste (GPD) issued their opinions on the overall decommissioning strategy for CEAs 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 CEAs decommissioning strategy will be updated and reassessed every five years. At the request of ASN, CEA delivered an interim report on the updating of its strategy, justifying the chosen deadlines and explaining the reasons, technical or otherwise, for the many delays with respect to the schedule. In response, ASN reiterated its position concerning the priority given to immediate decommissioning, the clean-out levels to be reached, the use of institutional controls, and recalled the schedule objectives for certain decommissioning operations.

### 2.2.1 The Fontenay-aux-Roses centre

CEAs first research centre, located in Fontenay-aux-Roses (Hauts-de-Seine département) since 1946, is continuing to move away from nuclear activities in order to concentrate on research into the life sciences. The decommissioning of the two BNIs present on the site, the PROCÉDÉ facility and the SUPPORT facility was authorised by decree 2006-772 and 2006-771 of 30th June 2006. Since January 2008, the laboratories clean-out and facilities decommissioning programme has been organised around a project called "Aladin". This project uses the experience feedback from the Grenoble "Passage" project. These operations were initially planned to last about ten years, but CEA has already informed ASN that, due to the strong presumption of radioactive contamination underneath one of the buildings, the decommissioning operations will be extended until 2021 for the PROCÉDÉ facility and until 2025 for the SUPPORT facility. These dates are announced without awaiting for any major contingencies that could arise during the works.

Before the administrative delicensing of the centre's BNIs, ASN has asked CEA to provide a radiological characterisation of the soils and propose a solution for their remediation if necessary. The rehabilitation work is ongoing and the results of the hydrogeological study that started in 2009 should be submitted in 2013. In its resolution 2012-DC-0259, ASN also asked CEA to submit a file for a revision of its discharge authorisation dating from 1988, no later than 31st December 2012, so that the decommissioning operations could be included. The file was received by ASN on 14th January 2013.

The on-site emergency plan was also updated at the end of the first quarter of 2012 and is currently being examined.

### The PROCÉDÉ facility

This BNI, which comprises two buildings (buildings 18 and 52/2), housed nuclear fuel reprocessing research and development activities. These activities were stopped in 1985 for building 52/2 and in 1995 for building 18.

The decommissioning operations for the PÉTRUS assembly, one of the largest shielded lines in building 18, subject to ASN authorisation by resolution 2011-DC-0245 of 11th October 2011, will be delayed owing to studies carried out prior to the ventilation modifications necessary for these operations.

In 2012, work to characterise the soil under building 18 of BNI 165 was carried out in order to define the soil remediation strategy to be adopted.

### The SUPPORT facility

The purpose of this facility is first to support the decommissioning operations of the PROCÉDÉ facility, before itself being decommissioned.

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 irradiated drums pending evacuation and storage of drums of low and very low level waste pending shipment to a repository.

With a view to improving the organisation of its activities and hence the safety of its facility, CEA installed and started-up a new waste drum characterisation line called SANDRA B, in 2011.
Activities linked to the development of nuclear reactors were initially carried out in the CEA Grenoble centre, inaugurated in January 1959.

As from the 1980’s, the nuclear activities were gradually transferred to other centres. Now the Grenoble centre conducts its research and development in the fields of renewable energies, health and microtechnology.

In 2002 the CEA centre in Grenoble launched a site delicensing programme. This project, called "Passage", aimed for nuclear activities to be completely over by 2012.

The site housed six nuclear facilities which have been gradually taken out of service, and are in the decommissioning phase in order to be delicensed. The delicensing of the SILOETTE reactor was declared in 2007 and that of the MÉLUSINE reactor in 2011.

The departure of part of the CEA teams from the "Passage" project must not negatively impact the running of the operations. ASN thus asked CEA Grenoble to remain vigilant and maintain the means enabling it to ensure maximum control over the safety of its facilities, in spite of the gradual reduction of the risks in terms of worker safety and radiation protection.

Radioactive effluent and solid waste treatment station and decay storage facility (STED)

The STED decommissioning operations were authorised for a period of eight years by decree 2008-980 of 18th September 2008.

The STED, included within the perimeter of BNI 36, is a decay storage facility for high-level (HL) waste, which was completely emptied in 2010. There is currently no HL waste on the site.

The buildings have either already been demolished or are undergoing dismantling in accordance with the above-mentioned decree. After the discovery of explosive devices dating from the early 20th century, CEA set up a specific organisation in 2012 to secure the soil clean-out worksites. Soil treatment by excavation resumed in the last quarter of 2012.

Active Material Analysis Laboratory (LAMA)

The LAMA was commissioned in 1961. This laboratory conducted post-irradiation studies of uranium and plutonium based nuclear fuels, and structural materials from nuclear reactors. The scientific research activities ended in 2002.

Decommissioning of the LAMA was authorised by decree 2008-981 of 18th September 2008. Part of the facility (the basement) was delicensed in 2011 using the internal authorisation system, for which the procedures were stipulated in ASN resolution 2010-DC-0178.

CEA is continuing the clean-out of the very high level (VHL) cells and could use this procedure for the delicensing of the VHL cells by 2013.

SILOÉ Reactor

SILOÉ is a former research reactor, currently undergoing decommissioning and clean-out, which was primarily used for technological irradiation of structural materials and nuclear fuels. Since decree 2005-78 of 26th January 2005, authorising final shutdown and decommissioning of the facility, the operations concerned have been ongoing. All the internal structures have been dismantled, but the activity level of the pool block turned out to be higher than predicted in the initially envisaged decommissioning scenario. Despite a one-year extension to the operations time initially prescribed in decree 2010-111 of 1st February 2010, CEA reported further difficulties in treating the basemat in 2011 (migration of low level contamination within the basemat). ASN refused to propose delicensing as-is and asked the CEA to present a new strategy for completing the basemat clean-out work.

CEA transmitted its new strategy in early 2012. This consists in the complete demolition of the reactor building, in order to deal with the contamination spots located in the basemat. To enable CEA to finalise its clean-out work, ASN suggested to the Minister responsible for nuclear safety a further extension to the period authorised by the final shutdown and decommissioning decree be issued.

ASN considers that decommissioning of the Cadarache centre facilities is proceeding satisfactorily on the whole. The example of the decommissioning of the HARMONIE reactor, delicensed on
10th June 2009, illustrates the feasibility of complete decommissioning.

Nevertheless, all the lessons must be drawn from the malfunctions associated with the ATPu incident (discovery of an underestimation of the quantity of fissile materials retained in the glove-boxes) and declared by CEA on 6th October 2009. CEA indicated that ways of improving the quality of the information feedback chain had been identified. It pointed out that further to this incident, it had established a new procedure for immediate information feedback, up to CEA General Administrator level if justified by the nature of the incident.

**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 had begun 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 operations have 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 final shutdown and complete decommissioning application file, which ASN felt to be incomplete. In June 2012, CEA sent ASN a revised version of its decommissioning strategy, proposing three successive phases, comprising: removal of the remaining sodium from the reactor block, clean-out of buildings and galleries, then decommissioning of the reactor block. All of these operations will be covered by the decommissioning authorisation application file that CEA will be submitting in order to obtain the final shutdown and decommissioning decree.

**Enriched uranium processing facilities (ATUEs)**

The ATUEs converted the uranium hexafluoride (UF₆) from the isotopic enrichment plants into sinterable oxide. 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 1993 and the incinerator was shut down at the end of 1997.

The facility’s final shutdown and decommissioning authorisation decree 2006-154 of 8th February 2006 stipulates completion of the work within five years.

The year 2006 saw completion of the decommissioning phase for the process equipment.

The phases of structural dismantling and complete clean-out of the civil engineering continued from that time, but with several interruptions due to technical and economic difficulties. Owing to these difficulties, the licensee submitted a decree modification application file in June 2010 requesting a five-year extension of the time scale to complete these works.

Owing to the significant increase in the duration of the planned decommissioning operations (ten years instead of the five initially anticipated, the significant rise in the quantity of very low level waste produced and the modification of the final status, the modifications envisaged by the licensee were felt to be significant enough to require a new authorisation. The licensee was thus asked to submit a complete authorisation modification application file as rapidly as possible, so that it can undergo the public consultations provided for by the Act on “transparency and nuclear security”.

Pending transmission of this file and its examination prior to the modification of the final shutdown and decommissioning decree for the facility, the provisions of the initial decree of 2006 remain applicable and the clean-out and decommissioning operations continue within this regulatory framework.

**Plutonium technology facility (ATPu)**

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 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 operator in charge of facility operation and is now responsible for its decommissioning. From a regulatory standpoint, CEA nonetheless remains the nuclear licensee for these installations.

Because it was impossible to demonstrate the seismic resistance of these facilities in accordance with the standards in effect¹ AREVA NC ended the commercial activities of the ATPu in August 2003. CEA has since then been involved in a final shutdown and decommissioning process for the two facilities. 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 publication of final shutdown and decommissioning decrees 2009-262 (LPC) and 2009-263 (ATPu) on 6th March 2009.

A first phase consisted in recovering and packaging the manufacturing discards and the materials contained in the ATPu and the Chemical Purification Laboratory (LPC). This phase, which is necessary to reduce the risks inherent in these materials prior to decommissioning of the installations, ended in the first

¹. The unsatisfactory resistance of the ATPu to the reference earthquake was confirmed by the stress tests requested by ASN further to the Fukushima accident in March 2011 and submitted by CEA in September 2011. This stress test confirmed the need to decommission and clean-out this facility as early as possible and plans for additional emergency management measures.
SAFE DECOMMISSIONING OF BASIC NUCLEAR INSTALLATIONS (BNIs)

half of 2008. The nuclear materials removed were repackaged and removed from the facilities, essentially being transferred to the AREVA NC La Hague site.

On 6th 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. This significant incident, evidencing deficiencies in the procedures for fissile material accounting and tracking, was rated level 2 on the INES scale by ASN.

Further to this incident, two ASN resolutions issued in October 2009 suspended the ongoing decommissioning operations in the facility and defined the conditions for work resumption. Two ASN resolutions issued in October 2010 define the technical requirements governing the decommissioning operations.

Following the violation report issued by ASN on 9th October 2009, CEA was sentenced by the Aix-en-Provence courts on 14th March 2012 to pay a fine of 15,000 euros for failure by a BNI corporate licensee to immediately notify an incident or accident. CEA did not appeal this decision.

During the years 2010, 2011 and 2012, ASN gradually authorised CEA to resume the decommissioning activities on the basis of specific safety analysis files. The latest approval for partial resumption of decommissioning on the ATPu was granted to CEA Cadarache on 5th June 2012.

ASN is very attentive to the integration of experience feedback from the incident of 2009, particularly in the aspects relating to the estimation of fissile material quantities and criticality safety.

The Les Amis de la Terre association, the Collectif Antinucléaire 13, and some private individuals, appealed to the Conseil d'État (Council of State) in February 2011 to suspend the decommissioning activities.

By order of 18th March 2011, the interim relief judge rejected the suspension request, having considered it unfounded.

In a decision of 25th June 2012, the Conseil d'État rejected the request for cancellation of the decree authorising decommissioning of the ATPu.

AREVA NC continued with the decommissioning programme in 2012 and it is scheduled to run until 2014, when CEA is to take over these activities in order to complete the decommissioning process.

During its inspections carried out in 2012, ASN in particular checked the steps taken for surveillance of the contractors working on the decommissioning sites, and compliance with radiation protection requirements.

In 2013, the conditions for gradual shutdown of the AREVA NC activities, with a view to their transfer to CEA, will be the subject of particularly close attention from ASN.

Chemical Purification Laboratory (LPC)

Operation of the LPC, which primarily carried out the treatment of effluents and analysis of ATPu production, was stopped in 2003. The operations for final cessation of operations carried out as from 2003 consisted notably in removing the radioactive material present in the facilities by emptying and rinsing the effluent tanks and treatment equipment.

The LPC final shutdown and decommissioning decree is decree 2009-262 of 6th March 2009. The requirements applicable to all decommissioning operations were stipulated by ASN resolution of 26th October 2010.

The decommissioning plan makes provision for six steps. The first step, of an estimated duration of seven years, is currently under way: it consists in removing the first containment barrier within which the nuclear material was prepared.

The decree of 6th March 2009 includes two hold points for this step, subject to the prior agreement of ASN, relative firstly to the decommissioning of the cryogenic processing unit, and secondly to the active tanks and associated equipment.

On 20th October 2011, ASN issued two resolutions, designed on the one hand to completely lift the hold point concerning decommissioning of the cryogenic processing unit and, on the other, to partially lift the hold point concerning decommissioning of the active tanks, by only authorising decommissioning of the annular tanks without bitumen and the associated equipment.

These resolutions also include additional requirements, relating in particular to safety and the prevention of criticality risks in the tank decommissioning operations.

Furthermore, while examining this file, ASN issued a resolution on 27th March 2012 modifying the requirements applicable to the LPC decommissioning operations, concerning the conditions for operation of the tanks awaiting decommissioning.

The resolution lifting the last part of the hold point concerning decommissioning of the active tanks was issued on 6th November 2012, authorising CEA to proceed with decommissioning of the annular tanks with bitumen.

2/2/4 The Saclay centre installations being decommissioning

The site decommissioning plan includes two BNIs that are definitively shut down, two ICPEs (Installations Classified on Environmental Protection Grounds), namely EL2 and et EL3, which were previously BNIs but which have not been completely dismantled due to the absence of a disposal route for low level, long-lived waste, and three BNIs in operation but with sections having ceased their activity, in which operations to prepare for final shutdown are currently being carried out.

High Activity Laboratory (LHA)

The LHA comprises several laboratories intended for research into or production of various radionuclides. On completion of the decommissioning and clean-out work authorised by decree 2008-979 of 18th September 2008, only two laboratories should remain under the ICPE system by 2018. Dismantling work on the active effluent inter-cell tanks is continuing.

In 2012, given the problems linked to the operations involving subcontracting, CEA submitted a new clean-out strategy for the cell containing the TOTEM line, the former shielded line
intended for the fabrication of sealed sources. This application is currently being examined.

ASN has asked the licensee to improve monitoring of the outside contractors in charge of carrying out all the decommissioning work.

In 2013, the licensee should define the clean-out methodology for the premises.

**ULYSSE reactor**

Built in 1961 in the CEA Saclay centre, this reactor was used for teaching and experimental purposes. Operating authorisation was granted on 16th June 1967. The total energy delivered in operation is around 115 MWh, which is low.

The end of reactor operation was declared on 9th February 2007, and the final shutdown and decommissioning application was submitted in June 2009. ASN gave its opinion in 2010, considering that the file was admissible, but asked that some additional information be integrated before the public inquiry. CEA transmitted the additional information and the file was submitted for public inquiry in the first quarter of 2012. CEA proposed a new organisation which consists in complete subcontracting of BNI decommissioning and operation. This triggered numerous questions from the CLI and the public. This file is currently being examined.

**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. Experimental clean-out methods using the ASPILASER technique were tested in this cell in 2009. There was no events of particular note in 2012.

### Decommissioning work on the ATPu and the LPC

### The Marcoule centre installations being decommissioning

The Marcoule centre is the CEA centre of excellence for the back-end fuel cycle and in particular for radioactive waste. It plays an important role in research pursuant to the 1991 Bataille Act and then the 28th June 2006 Programme Act on the sustainable management of radioactive materials and waste.

**PHÉNIX Reactor**

The PHÉNIX reactor, built and operated by CEA in collaboration with EDF, is a sodium-cooled fast neutron reactor demonstrator. Authorised by decree of 31st December 1969, first divergence of the reactor took place in 1973. During the final shutdown of the facility in 2009, a set of "end of life" tests were conducted. These tests were designed to supplement current knowledge of sodium-cooled fast neutron reactors, with a view to the development of "Generation IV" nuclear power plants. These tests were also part of the studies of the prototype facility mentioned in Article 3 of the 28th June 2006 Act 2006-739 on the management of radioactive materials and waste.

The decommissioning authorisation application file was transmitted to ASN in December 2011. Prior to obtaining the decommissioning authorisation decree, preparatory operations prior to final shutdown are required and are in progress.

For examination of the decommissioning application, CEA also decided to anticipate the plant's next periodic safety review by submitting its file to ASN at the end of 2012. The stress test report for the PHÉNIX plant, following the Fukushima accident, was transmitted by CEA on 15th September 2011. This stress test was the subject of ASN resolution 2012-DC-0293 of 26th June 2012 setting additional requirements designed to increase the facility's robustness to extreme situations and defining the associated deadlines.
2.3 AREVA installations

2.3.1 UP2 400 spent fuel reprocessing plant and associated facilities

HAO/Sud (INB 80)

The situation of 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 shut down since 2004, are scheduled for decommissioning.

The final shutdown and decommissioning decree 2009-961 for the HAO (BNI 80) was signed on 31st July 2009. This decree provides for three steps. The first step, planned to continue until the end of 2015, is in progress. It aims to carry out the majority of the decommissioning operations of the HAO / South facility, while the HAO / North facility, still in operation, is to be decommissioned during a second phase.

The above-mentioned final shutdown and decommissioning decree of 31st July 2009 provides for four hold points to be approved by ASN prior to the continuation of operations.

The first of these hold points concerns the recovery and packaging operations for the waste contained in the HAO silo and in the organised disposal of hulls (SOC). Between July and December 2010, the licensee sent ASN a set of files relative to the safety of these operations, which are subject to a technical examination. In a resolution of 13th March 2012, ASN partially lifted this hold point, by authorising the licensee to carry out preparatory operations prior to recovery and packaging of waste from the HAO silo and the organised disposal of hulls facility. A second draft resolution concerning complete lifting of the hold point is currently under preparation.

INB 33, 38 and ÉLAN IIB (INB 47)

AT1 pilot reprocessing plant

The AT1 pilot plant reprocessed fuel from the RAPSODIE and PHENIX fast breeder reactors from 1969 to 1979. It is part of BNI 38 (STE2).
The three draft decrees were sent to the MSNR in October 2012, for communication to the licensee in compliance with the ASN. The Nuclear Safety and Radiation Protection Mission (MSNR) within the Ministry of Ecology, Sustainable Development, and Energy, that delivers the decisions. Since 1961, the activity of the COMURHEX Pierrelatte plant on the Tricastin nuclear platform has been the chemical conversion of uranium (fluorination of uranium tetrafluoride, UF₄, into uranium hexafluoride, UF₆). This step precedes the enrichment of UF₆ carried out by EURODIF.

The COMURHEX Pierrelatte plant comprises several facilities with different administrative statuses: there are ICPEs ensuring the fluorination of natural uranium, and BNI 105 which fluorinates reprocessed uranium. This BNI definitively stopped operation at the end of 2008. A project for the creation of a new facility to take over from BNI 105 is being studied.

At ASN’s request, the licensee of BNI 105 submitted a final shutdown and decommissioning application file in May 2011. ASN judged this file inadmissible, mainly due to the inadequacy of the impact study. Moreover, the coexistence on the same site of a BNI and various ICPEs with associated risks and possessing a number of common equipment items, considerably complicates administrative monitoring and regulation of the facilities, currently ensured by the DREAL (Regional Directorate for the Environment, Planning and Housing) for the ICPEs, and ASN for the BNI. In addition, this situation is not in conformity with the provisions of the TSN Act, which in such cases provides for all the facilities to be included within the perimeter of the BNI, and for ASN to regulate all the facilities, including the ICPEs.

Consequently, to bring the administrative situation of BNI 105 into conformity with the applicable requirements, ASN decided in October 2011 to propose a draft decree to the ministers responsible for nuclear safety, modifying the perimeter of BNI 105 in order to include all the site’s facilities in it. This decree was signed on 26th April 2012 and published in the Official Gazette on 28th April 2012. ASN asked that a new final shutdown and decommissioning authorisation application be submitted. The licensee should do so in early 2013.

### 2 | 3 The COMURHEX Pierrelatte plant

Since 1961, the activity of the COMURHEX Pierrelatte plant on the Tricastin nuclear platform has been the chemical conversion of uranium (fluorination of uranium tetrafluoride, UF₄, into uranium hexafluoride, UF₆). This step precedes the enrichment of UF₆ carried out by EURODIF.

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### 2 | 3 SICN plant in Veurey-Voroize

The former nuclear fuel fabrication plant of Veurey-Voroize, operated by the Société industrielle de combustible nucléaire (SICN – AREVA Group) consists of two nuclear facilities, BNIs 65 and 90. Fuel fabrication ceased definitively at the beginning of the years 2000. Final shutdown operations took place between 2000 and the end of 2005. The decrees authorising decommissioning operations were signed on 15th February 2006 (decree 2006-191 and decree 2006-190), thus enabling the operations concerned to begin.

The civil engineering structural clean-out operations continued in 2010. On completion of these operations it was possible to delicense a large number of areas from the waste zoning viewpoint. Nonetheless, the licensee had to deal with a certain number of difficulties with applying its complete clean-out methodology on the buildings which were of an old design. The licensee had to change its strategy and demolish certain buildings on the site, contrary to what had been initially planned in the project.

Following the review of the file describing the management strategy for the site floors and soils, polluted by the past activities, ASN
asked the licensee to take steps to determine the nature of the institutional controls to be put into place during administrative delicensing of the BNIs.

The inspections carried out by ASN in 2010 revealed a lack of rigour in the monitoring of the decommissioning worksites.

During the inspections carried out in 2011, ASN had samples taken from the soils and ground water in order to assess the level of radiological and chemical contamination of the areas outside the site. These analyses confirmed the order of magnitude of the contamination levels measured by the licensee.

During one of these inspections, pipes that still contained contaminated effluents were discovered, necessitating additional work to eliminate these structures. At the request of ASN, the licensee notified a significant event in July 2011, further to this discovery.

As the deadline set by the decree for finalising the decommissioning operations had been exceeded and not all these operations had been completed, ASN also served formal notice on the SICN company, in a resolution of 13th March 2012, to complete the decommissioning and clean-out work on the Veurey-Voroize site, by removing these pipes within six months from notification of this resolution.

The ASN inspectors, who carried out a further inspection of the facility in September 2012, observed that this work was on track for completion. The last waste resulting from the clean-out operations still has to be removed from the site to appropriate disposal routes.

As the decommissioning work has been completed, delicensing of the facilities can now be envisaged. To do this, the licensee is required to submit the delicensing application file in 2013, as stipulated in Article 40 of decree 2007-1557 of 2nd November 2007.

Given that the site contains residual contamination of the soil and groundwater, the impact of which is acceptable for the future (industrial) type of use envisaged, the licensee shall also propose the establishment of institutional controls designed to restrict the use of the soil and groundwater and to guarantee that the usage of the land remains compatible with the state of the site. The delicensing of the two BNIs can only be declared when these institutional controls have effectively been put into place by the Prefect of the Isère département, following the review procedure which in particular includes a public inquiry.

2.4 Others 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) was mainly used for experimental irradiations and the production of short-lived radioisotopes.

The decree authorising Louis Pasteur University of Strasbourg to proceed with the final shutdown and decommissioning operations was signed on 15th February 2006 (decree 2006-189). Decommissioning work began in the second half of 2006 and ended in mid-2009. In 2010, ASN continued its review of the file for the installation to be removed from the list of BNIs. Pursuant to the TSN Act, ASN consulted the Government services, the 21 municipalities situated within less than five kilometres of the installation, and the CLI which was instituted in July 2010 by the Conseil Général of the Bas-Rhin département. Institutional controls were signed in July 2012 in order to retain a record of a past nuclear activity. The delicensing decision was approved by the Minister responsible for nuclear safety in an order of 31st October 2012.

2.4.2 The Electromagnetic Radiation Laboratory (LURE)

The LURE, located at the heart of the Orsay campus, is a facility producing synchrotron radiation (high-power X-rays) for a wide variety of research applications. It comprises six particle accelerators.

In January 2007, following a final shutdown preparation phase that lasted from 2004 to 2008, the LURE licensee, the CNRS (French National Centre for Scientific Research) 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
The main actions to be carried out by ASN in 2013 will firstly be the continuing development of the regulatory framework for decommissioning, and secondly closer monitoring of certain installations. ASN will thus concentrate on finalising the polluted soils clean-out guide for sites being decommissioned and the complete clean-out methodologies guide, following publication of the BNI order.

In 2013, ASN will continue its inspections of installations undergoing decommissioning. It will in particular focus on:

- finalising its opinion concerning the draft final shutdown and decommissioning (MAD DEM) decrees for the nuclear facilities of the UP2 400 plant at La Hague;
- examining the complete decommissioning authorisation application for the Brennilis NPP, to be completed by the licensee, paying particular attention to the evolution of the administrative situation of ICEDA;
- paying particular attention to CEA’s finalisation of the decommissioning operations concerning the ATUE, as rapidly as possible;
- examining the stress test reports transmitted by EDF for its facilities being decommissioned, following the Fukushima accident and issuing additional instructions designed to increase the robustness of the facilities to extreme situations;
- reviewing the preparatory operations for final shutdown of the installations that will soon be shut down and decommissioned (PHÉNIX, COMURHEX, EURODIF).

The announcement of the pushing back of several decommissioning deadlines has led ASN to ask the CEA for an interim report on the updating of its decommissioning strategy (see point 2[2]). ASN will endeavour to examine the information communicated by CEA as part of this update and expected for the end of 2012.

### 3 OUTLOOK

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<table>
<thead>
<tr>
<th>Installation Location</th>
<th>BNI</th>
<th>Type of installation</th>
<th>Commissioned</th>
<th>Final shutdown</th>
<th>Last regulatory acts</th>
<th>Current status</th>
</tr>
</thead>
<tbody>
<tr>
<td>IDE FAR* (former BNI 10)</td>
<td></td>
<td>Reactor (500 kWh)</td>
<td>1960</td>
<td>1981</td>
<td>1987: removed from BNI list</td>
<td>Decommissioned</td>
</tr>
<tr>
<td>TRITON FAR* (former BNI 10)</td>
<td></td>
<td>Reactor (6.5 MWth)</td>
<td>1959</td>
<td>1982</td>
<td>1987: removed from BNI list and classified as ICPE</td>
<td>Decommissioned</td>
</tr>
<tr>
<td>ZOÉ FAR* (former BNI 11)</td>
<td></td>
<td>Reactor (250 kWth)</td>
<td>1948</td>
<td>1975</td>
<td>1978: removed from BNI list and classified as ICPE</td>
<td>Confined (museum)</td>
</tr>
<tr>
<td>MINERVE FAR* (former BNI 12)</td>
<td></td>
<td>Reactor (0.1 kWth)</td>
<td>1959</td>
<td>1976</td>
<td>1977: removed from BNI list</td>
<td>Dismantled at FAR and reassembled at Cadarache</td>
</tr>
<tr>
<td>EL 2 SACLAY (former BNI 13)</td>
<td></td>
<td>Reactor (2.8 MWth)</td>
<td>1957</td>
<td>1974</td>
<td>1978: removed from BNI list and classified as ICPE</td>
<td>Partially decommissioned, remaining parts confined</td>
</tr>
<tr>
<td>EL 3 SACLAY (former BNI 14)</td>
<td></td>
<td>Reactor (18 MWth)</td>
<td>1960</td>
<td>1980</td>
<td>1983: removed from BNI list</td>
<td>Decommissioned</td>
</tr>
<tr>
<td>PEGGY CADARACHE (former BNI 23)</td>
<td></td>
<td>Reactor (1 kWth)</td>
<td>1961</td>
<td>1975</td>
<td>1976: removed from BNI list</td>
<td>Decommissioned</td>
</tr>
<tr>
<td>CÉSAR CADARACHE (former BNI 26)</td>
<td></td>
<td>Reactor (10 kWth)</td>
<td>1964</td>
<td>1974</td>
<td>1978: removed from BNI list</td>
<td>Decommissioned</td>
</tr>
<tr>
<td>MARIUS CADARACHE (former BNI 27)</td>
<td></td>
<td>Reactor (0.4 kWth)</td>
<td>1960</td>
<td>1980</td>
<td>1983: removed from BNI list</td>
<td>Decommissioned</td>
</tr>
<tr>
<td>LE BOUCHET (former BNI 30)</td>
<td>BNI 34</td>
<td>Ore processing</td>
<td>Before 1964</td>
<td></td>
<td>2006: removed from BNI list</td>
<td>Integrated into BNI 166</td>
</tr>
<tr>
<td>GUEUGNON (former BNI 31)</td>
<td></td>
<td>Ore processing</td>
<td>1965</td>
<td>1980</td>
<td>Removed from BNI list</td>
<td>Decommissioned</td>
</tr>
<tr>
<td>STED FAR* (former BNI 34)</td>
<td></td>
<td>Processing of liquids and solid waste</td>
<td>Before 1964</td>
<td>2006</td>
<td>2006: removed from BNI list</td>
<td>Integrated into BNI 166</td>
</tr>
<tr>
<td>HARMONIE CADARACHE (former BNI 41)</td>
<td></td>
<td>Reactor (1 kWth)</td>
<td>1965</td>
<td>1996</td>
<td>2009: removed from BNI list</td>
<td>Destruction of ancillaries building</td>
</tr>
<tr>
<td>ALS SACLAY (former BNI 43)</td>
<td></td>
<td>Accelerator</td>
<td>1958</td>
<td>1996</td>
<td>2006: removed from BNI list</td>
<td>Cleared-out, institutional controls***</td>
</tr>
<tr>
<td>SATURNE SACLAY (former BNI 48)</td>
<td></td>
<td>Accelerator</td>
<td>1966</td>
<td>1997</td>
<td>2005: removed from BNI list</td>
<td>Cleared-out, institutional controls***</td>
</tr>
<tr>
<td>ATTILA** FAR* (former BNI 57)</td>
<td></td>
<td>Reprocessing pilot</td>
<td>1968</td>
<td>1975</td>
<td>2006: removed from BNI list</td>
<td>Integrated into BNIs 165 and 166</td>
</tr>
<tr>
<td>LPCU FAR* (former BNI 57)</td>
<td></td>
<td>Plutonium chemistry laboratory</td>
<td>1966</td>
<td>1995</td>
<td>2006: removed from BNI list</td>
<td>Integrated into BNIs 165 and 166</td>
</tr>
<tr>
<td>BAT 19 FAR* (former BNI 58)</td>
<td></td>
<td>Plutonium metallurgy</td>
<td>1968</td>
<td>1984</td>
<td>1984: removed from BNI list</td>
<td>Decommissioned</td>
</tr>
<tr>
<td>RM2 FAR* (former BNI 59)</td>
<td></td>
<td>Radio-metallurgy</td>
<td>1968</td>
<td>1982</td>
<td>2006: removed from BNI list</td>
<td>Integrated into BNIs 165 and 166</td>
</tr>
<tr>
<td>LCAC GRENOBLE (former BNI 60)</td>
<td></td>
<td>Fuels analysis</td>
<td>1975</td>
<td>1984</td>
<td>1997: removed from BNI list</td>
<td>Decommissioned</td>
</tr>
<tr>
<td>STEDS FAR* (former BNI 73)</td>
<td></td>
<td>Radioactive waste decay storage</td>
<td>1989</td>
<td></td>
<td>2006: removed from BNI list</td>
<td>Integrated into BNI 166</td>
</tr>
</tbody>
</table>
### APPENDIX 1 LIST OF BASIC NUCLEAR INSTALLATIONS DELICENSED AS AT 31.12.2012 (CONTINUATION)

<table>
<thead>
<tr>
<th>Installation Location</th>
<th>BNI</th>
<th>Type of installation</th>
<th>Commissioned</th>
<th>Final shutdown</th>
<th>Last regulatory acts</th>
<th>Current status</th>
</tr>
</thead>
<tbody>
<tr>
<td>ARAC SACLAY</td>
<td>(former BNI 81)</td>
<td>Fabrication of fuel assemblies</td>
<td>1981</td>
<td>1995</td>
<td>1999 : removed from BNI list</td>
<td>Cleaned-out</td>
</tr>
<tr>
<td>IRCA CADARACHE</td>
<td>(former BNI 121)</td>
<td>Irradiator</td>
<td>1983</td>
<td>1996</td>
<td>2006 : removed from BNI list</td>
<td>Cleaned-out, institutional controls***</td>
</tr>
<tr>
<td>FBFC PIERRELATTE</td>
<td>(former BNI 131)</td>
<td>Fuel fabrication</td>
<td>1990</td>
<td>1998</td>
<td>2003 : removed from BNI list</td>
<td>Cleaned-out, institutional controls***</td>
</tr>
<tr>
<td>SNCS OSMANVILLE</td>
<td>(former BNI 152)</td>
<td>Ioniser</td>
<td>1983</td>
<td>1995</td>
<td>2002 : removed from BNI list</td>
<td>Cleaned-out, institutional controls***</td>
</tr>
<tr>
<td>MIRANAS URANIUM WAREHOUSE</td>
<td>(former BNI 134)</td>
<td>Uranium bearing materials warehouse</td>
<td>1964</td>
<td>2004</td>
<td>2007 : removed from BNI list</td>
<td>Cleaned-out, institutional controls***</td>
</tr>
<tr>
<td>SILOETTE (GRENOBLE)</td>
<td>(former BNI 21)</td>
<td>Reactor (100 kWth)</td>
<td>1964</td>
<td>2002</td>
<td>2007 : removed from BNI list</td>
<td>Cleaned-out, institutional controls***</td>
</tr>
<tr>
<td>MÉLUSINE (GRENOBLE)</td>
<td>(former BNI 19)</td>
<td>Reactor (8 MWth)</td>
<td>1958</td>
<td>1988</td>
<td>2011 : removed from BNI list</td>
<td>Cleaned-out</td>
</tr>
<tr>
<td>STRASBOURG UNIVERSITY REACTOR</td>
<td>(former BNI 44)</td>
<td>Reactor (100 kWth)</td>
<td>1967</td>
<td>1997</td>
<td>2012 : removed from BNI list</td>
<td>Cleaned-out, institutional controls***</td>
</tr>
</tbody>
</table>

(*) Fontenay-aux-Roses centre - (**) ATTILA: reprocessing pilot located in a unit of BNI 57 - (***) Private law documents have been signed by the State and the licensee for the cleaned-out parcels, to conserve a record of the former nuclear activity.

<table>
<thead>
<tr>
<th>Installation Location</th>
<th>BNI</th>
<th>Type of installation</th>
<th>Commissioned</th>
<th>Final shutdown</th>
<th>Last regulatory acts</th>
<th>Current status</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHOOZ AD (FORMERLY-CHOOZ A)</td>
<td>163 (former BNI 1, 2, 3)</td>
<td>Reactor (1,040 MWh)</td>
<td>1967</td>
<td>1991</td>
<td>2007: Final shutdown / decommissioning decree</td>
<td>Decommissioning in progress</td>
</tr>
<tr>
<td>CHINON A1D (FORMERLY-CHINON A1)</td>
<td>133 (former BNI 5)</td>
<td>Reactor (300 MWh)</td>
<td>1963</td>
<td>1973</td>
<td>1982: CHINON A1 confinement decree and creation of the CHINON A1D storage BNI</td>
<td>Partially decommissioned, changed into a BNI for storing waste left in place (museum)</td>
</tr>
<tr>
<td>CHINON A2D (FORMERLY-CHINON A2)</td>
<td>153 (former BNI 6)</td>
<td>Reactor (865 MWh)</td>
<td>1965</td>
<td>1985</td>
<td>1991: Partial decommissioning decree for CHINON A2 and creation of the CHINON A2D storage BNI</td>
<td>Partially decommissioned, changed into a BNI for storing waste left in place</td>
</tr>
<tr>
<td>CHINON A3D (FORMERLY-CHINON A3)</td>
<td>161 (former BNI 7)</td>
<td>Reactor (1,360 MWh)</td>
<td>1966</td>
<td>1990</td>
<td>2010: Decommissioning decree</td>
<td>Decommissioning in progress</td>
</tr>
<tr>
<td>SILOÉ (GRENOBLE)</td>
<td>20</td>
<td>Reactor (25 MWth)</td>
<td>1963</td>
<td>1997</td>
<td>2010: modification of final shutdown and decommissioning decree</td>
<td>Decommissioning in progress</td>
</tr>
<tr>
<td>RAPSODIE CAUDARACHE</td>
<td>25</td>
<td>Reactor (40 MWth)</td>
<td>1967</td>
<td>1983</td>
<td></td>
<td>Preparation for final shutdown</td>
</tr>
<tr>
<td>SPENT FUEL REPROCESSING PLANT (UP2) LA HAGUE</td>
<td>33</td>
<td>Transformation of radioactive substances</td>
<td>1964</td>
<td>2004</td>
<td>2003: Boundary change</td>
<td>Preparation for final shutdown</td>
</tr>
<tr>
<td>STE2 LA HAGUE</td>
<td>38</td>
<td>Effluent treatment facility</td>
<td>1964</td>
<td>2004</td>
<td></td>
<td>Preparation for final shutdown</td>
</tr>
<tr>
<td>BUGEY 1</td>
<td>45</td>
<td>Reactor (1,920 MWth)</td>
<td>1972</td>
<td>1994</td>
<td>2008: Final shutdown / decommissioning decree</td>
<td>Decommissioning in progress</td>
</tr>
<tr>
<td>ST-LAURENT A1</td>
<td>46</td>
<td>Reactor (1,662 MWth)</td>
<td>1969</td>
<td>1990</td>
<td>2010: Decommissioning decree</td>
<td>Decommissioning in progress</td>
</tr>
<tr>
<td>ST-LAURENT A2</td>
<td>46</td>
<td>Reactor (1,801 MWth)</td>
<td>1971</td>
<td>1992</td>
<td>2010: Decommissioning decree</td>
<td>Decommissioning in progress</td>
</tr>
</tbody>
</table>
APPENDIX 2 LIST OF BASIC NUCLEAR INSTALLATIONS FINALLY SHUT DOWN AS AT 31.12.2012 (CONTINUATION)

<table>
<thead>
<tr>
<th>Installation Location</th>
<th>BNI</th>
<th>Type of installation</th>
<th>Commissioned</th>
<th>Final shutdown</th>
<th>Last regulatory acts</th>
<th>Current status</th>
</tr>
</thead>
<tbody>
<tr>
<td>ÉLAN II B LA HAGUE</td>
<td>47</td>
<td>Caesium-137 source fabrication</td>
<td>1970</td>
<td>1973</td>
<td>Preparation for final shutdown</td>
<td></td>
</tr>
<tr>
<td>HIGH ACTIVITY LABORATORY (LHA) SACLAY</td>
<td>49</td>
<td>Laboratory</td>
<td>1960</td>
<td>1996</td>
<td>2008: Final shutdown / decommissioning decree</td>
<td>Decommissioning in progress</td>
</tr>
<tr>
<td>ATUE CADARACHE</td>
<td>52</td>
<td>Uranium Processing</td>
<td>1963</td>
<td>1997</td>
<td>2006: Final shutdown / decommissioning decree</td>
<td>Decommissioning in progress</td>
</tr>
<tr>
<td>LAMA (GRENOBLE)</td>
<td>61</td>
<td>Laboratory</td>
<td>1968</td>
<td>2002</td>
<td>2008: Final shutdown / decommissioning decree</td>
<td>Decommissioning in progress</td>
</tr>
<tr>
<td>HAO (HIGH LEVEL OXIDE) FACILITY LA HAGUE</td>
<td>80</td>
<td>Transformation of radioactive substances</td>
<td>1974</td>
<td>2004</td>
<td>2009: Final shutdown / decommissioning decree</td>
<td>Decommissioning in progress</td>
</tr>
<tr>
<td>LPC CADARACHE</td>
<td>54</td>
<td>Laboratory</td>
<td>1966</td>
<td>2003</td>
<td>2009: Final shutdown / decommissioning decree</td>
<td>Decommissioning in progress</td>
</tr>
<tr>
<td>SUPERPHÉNIX CREYS-MALVILLE</td>
<td>91</td>
<td>Reactor (3,000 MWth)</td>
<td>1985</td>
<td>1997</td>
<td>2009: Final shutdown / decommissioning decree</td>
<td>Decommissioning in progress</td>
</tr>
<tr>
<td>COMURHEX PIERRELATTE</td>
<td>105</td>
<td>Uranium chemical transformation plant</td>
<td>1979</td>
<td>2009</td>
<td>Preparation for final shutdown</td>
<td></td>
</tr>
<tr>
<td>LURE ORSAY</td>
<td>106</td>
<td>Particle accelerators</td>
<td>To 1956 at 1987</td>
<td>2008</td>
<td>2009: Final shutdown / decommissioning decree</td>
<td>Decommissioning in progress</td>
</tr>
<tr>
<td>PROCÉDÉ FAR*</td>
<td>165</td>
<td>Grouping of former process installations</td>
<td>2006</td>
<td>2006</td>
<td>2006: Final shutdown / decommissioning decree</td>
<td>Decommissioning in progress</td>
</tr>
<tr>
<td>SUPPORT FAR*</td>
<td>166</td>
<td>Waste packaging and processing</td>
<td>2006</td>
<td>2006</td>
<td>2006: Final shutdown / decommissioning decree</td>
<td>Decommissioning in progress</td>
</tr>
</tbody>
</table>

(*) Fontenay-aux-Roses: creation of BNIs 165 and 166, in place of BNIs 34, 57, 59 and 73 and implementation of shutdown and decommissioning operations on BNIs 165 and 166 following the grouping of the buildings for the Fontenay-aux-Roses site delicensing project.
SAFE DECOMMISSIONING OF BASIC NUCLEAR INSTALLATIONS (BNIs)