NUCLEAR RESEARCH FACILITIES AND VARIOUS NUCLEAR INSTALLATIONS

CHAPTER 14

This chapter presents ASN's appraisal of the safety of nuclear research installations and of installations not linked directly to the nuclear electricity generating industry. The installations in question are, essentially the basic nuclear installations (BNIs) belonging to the civil part of the CEA – the French Alternative Energies and Atomic Energy Commission, (research reactors, irradiation reactors, laboratories, nuclear material storage facilities, waste and effluent treatment plants, etc.), BNIs belonging to other research establishments (the Institut Laue-Langevin reactor) and some other BNIs (facilities producing radiopharmaceuticals, particle accelerators, etc.), which are neither power reactors nor facilities involved in the nuclear fuel cycle (fuel manufacture and reprocessing).

In spite of the wide diversity which characterises these installations - and the resulting need to bear in mind the specific nature of each of them when considering risks and hazards - the principles of nuclear safety that apply to them and ASN's actions in that regard remain identical.

1 THE FRENCH ALTERNATIVE ENERGIES AND ATOMIC ENERGY COMMISSION'S INSTALLATIONS

The French centres belonging to the Alternative Energies and Atomic Energy Commission (CEA) include BNIs devoted to research (experimental reactors, laboratories, etc.) as well as supporting installations such as waste storage facilities and effluent treatment plants. Research at CEA focuses on areas such as the lifetime of operating power plants, future reactors, nuclear fuel performance and nuclear waste.

Point 1 | 1 below summarises the generic subjects that marked the year 2011. Point 1 | 2 describes topical events in the various CEA facilities currently in operation. The facilities undergoing clean-out or decommissioning are covered in chapter 15 and those devoted especially to storage or to waste treatment and spent fuel reprocessing are covered in chapter 16.

1 | 1 Generic subjects

ASN identifies generic subjects via inspection campaigns and analysis of lessons learned from operating experience, and consults CEA on these topics. This process can lead ASN to issue requests or to adopt a position after examination of the relevant file. Generic subjects on which ASN focused in 2011 were:
– the integration of the experience feedback from the Fukushima Daiichi accident;
– management of civil engineering works in installations under construction or being renovated;
– control of the criticality risk;
– the progress of the CEA's major commitments (see point 1 | 1 | 2).

On 6 September 2011, the ASN Commission gave a hearing to the CEA General Administrator, as in previous years. The ASN more particularly asked the CEA to provide information on:
– the actions conducted as part of the experience feedback from the Fukushima accident, and in particular the report on the complementary safety assessment for the CEA facilities;
– the tracking of the files relating to certain facilities with strong implications for nuclear safety and radiation protection;
– CEA's safety management, and notably the results of risk control for the year 2010.

In this respect, the CEA presented a more detailed account of the incident that occurred on 4 November 2010 at the Valduc site exit, for which the experience feedback led to the implementing of complementary measures on all the sites to reinforce the pre-exit checks on equipment.

1 | 1 | 1 Experience feedback from the Fukushima Daiichi accident

Further to the Fukushima Daiichi accident, ASN launched a complementary safety assessment (CSA) procedure for the civil nuclear facilities. The complementary safety assessments concern the power reactors in priority. They do nevertheless also concern the other nuclear facilities, for which an analysis was conducted beforehand to assess the risks with respect to the possible consequences associated with:
– the seismic risk;
– the risk of flooding;
– extreme climatic conditions;
– loss of the electrical power supplies;
– loss of cooling;
– the above two losses combined.

The "potential source term" (quantity of radioactive or hazardous products that can be implemented) was also taken into account. Given the diversity of the nuclear fleet, each facility must be examined individually.

Three categories of CEA facilities have thus been defined:
– the five highest priority facilities, assessed in 2011 on the same schedule as the power reactors: this concerned the OSIRIS, PHÉNIX and MASURCA reactors, the Jules Horowitz Reactor (JHR), and the plutonium technology facility (ATPu) currently being decommissioned;
– nine facilities and two sites (Cadarache and Marcoule) assessed in 2012;
– for the other facilities, the experience feedback will be taken into account according to the ongoing or future requests, particularly in the framework of the periodic safety reviews.

On 3 January 2012, ASN gave its opinion on all the complementary safety assessments carried out in 2011. ASN will notably require the licensees:
– to implement a "hard core" of material and organisational measures to control the fundamental safety functions in extreme situations;
– for the spent fuel pools in the different facilities, the implementation of reinforced measures to reduce the risks of fuel exposure.

Where the current baseline safety requirements are concerned, the CEA will address the deviations, particularly those found during the targeted post-Fukushima inspections. The in-depth experience feedback from the Fukushima accident will lead to the reinforcing of the baseline safety requirements of the nuclear facilities, particularly with regard to the "earthquake", "flood" and "risks associated with other industrial activities" aspects.

On completion of examination of the reports submitted by the CEA, ASN considers that the complementary safety assessment is satisfactory on the whole. The CEA has thus identified certain lines for improvement that it could follow. This approach will be supplemented in 2012 by the analysis of the common means of the Cadarache and Marcoule sites in particular, in accordance with the ASN decision of 5 May 2011.

1|1|2 Management of nuclear safety and radiation protection at CEA

ASN monitors management of safety at CEA at several levels:
– working with the General Administrator, ASN verifies CEA's compliance with its major commitments, in particular with regard to planned new installations, upgrading of older installations and waste management, especially in terms of compliance with the specified time-frames, and handling of safety and radiation protection issues in CEA's overall management;
– with respect to the Nuclear Safety and Protection Division (DPSN) and the General and Nuclear Inspection Division (IGN), ASN develops a national global approach to "generic" subjects concerning several installations or centres; ASN also examines how the DPSN develops CEA's safety and radiation protection policy and assesses internal supervision work performed by the IGN;
– within the CEA centres, and as appropriate, ASN reviews the safety analysis files specific to each of the CEA BNIs, paying particular attention to their integration into the more general framework of CEA's safety policy. In this respect, it examines the conditions in which safety management is carried out; the main contacts are the directors of the centre and the head of the installation concerned.

In 2011, ASN adopted a position with regard to the file concerning safety and radiation protection management at the CEA, which had been assessed by the Advisory committees of experts in 2010.

The examination showed that CEA had made considerable progress since the last examination on the same theme (1999), especially regarding the inclusion of human and organisational factors and the integration of safety and radiation protection into its projects. ASN noted actions under way to improve skills management and management of safety and radiation protection regarding services (setting up of an acceptance commission for companies involved in radioactive clean-up and a centralised base for supplier evaluation).

1|1|3 Monitoring of CEA's compliance with its main nuclear safety and radiation protection commitments

In 2006, ASN stated that it wanted to see effective monitoring of CEA's compliance with its safety and radiation protection commitments, by means of an efficient control tool that offered transparency for the ASN, in particular with regard to the decision-making process. CEA therefore presented ASN in 2007 with a list of nineteen major safety and radiation protection commitments.

Out of the thirteen commitments remaining in the updated list of July 2011, eight should be carried out within the planned times.

The most significant schedule delays concern the Cadarache site:
– the removal from storage of the waste drums and fuel from the PEGASE facility (BNI 22);
– the removal from storage of the radioactive waste from the Cadarache site storage yard (BNI 56);
– the commissioning of the AGATE effluent treatment station (BNI 171).

CEA reports to ASN on compliance with these commitments, on a formal basis during regular meetings. During the hearing of the CEA General Administrator, ASN restated that the major commitments approach is worth pursuing.

The results of the four years of application of this system show several positive points. The system allows targeted tracking of priority actions, which have a clearly set deadline. Any extension to the deadline must therefore firstly be duly justified, and secondly be discussed with ASN. This latter point could nevertheless be improved, as the CEA does not always provide ASN with all the information necessary to assess the situation. Thanks to the attention devoted to these major commitments, ASN notes that progress for the majority of them is generally satisfactory.

1|1|4 Periodic safety reviews

Many current CEA installations began operating in the early 1960s. The equipment in these installations, of older design, may now be timeworn. Furthermore, the installations have also undergone modifications on several occasions, sometimes without any overall review of their safety. In 2002, ASN informed licensees that it considered a review of the safety of the older installations to be necessary every 10 years. This provision is now written into the TSN act on "transparency and security in the nuclear field" of 13 June 2006 (now codified in books I and V of the environment code by order 2012-6 of 5 January 2012). The periodic safety reviews for CEA's installations have been scheduled according to a calendar approved by ASN. All of the installations are to be reviewed by 2017 at the latest, then every 10 years.

The periodic safety reviews often entail extensive upgrading work in areas where safety regulations and requirements have changed significantly, in particular regarding compliance with seismic loading requirements, fire protection and containment. ASN oversees all the work and requalification procedures, in accordance with principles and a schedule that it itself approves. Lastly, further to the periodic safety reviews, ASN can define requirements, as provided for by the TSN Act.

In 2011, ASN examined the conclusions of the periodic safety review of the EOLE, MINERVE and CHICADE installations. ASN also informed the ministers in charge of nuclear safety of its opinion concerning the continuation of operation of the OSIRIS and ORPHEE installations following their periodic safety reviews, which were analysed in 2010.

1|1|5 Monitoring of sub-criticality

An incident notified on 6 October 2009 in the ATPu facility, currently being decommissioned (see chapter 15), indicated that CEA should further intensify its efforts on criticality risk prevention. In 2010, as part of the feedback procedure, ASN asked CEA to conduct investigations in all of the installations concerned by criticality risk.

From 11 to 13 July 2011, ASN conducted a "tightened" inspection on this theme on the Cadarache site as a whole, and about ten installations more particularly. More detailed information is provided in chapter 8.

1|1|6 Management of sealed sources of ionising radiation

At the request of ASN, CEA updated its ionising radiation source management rules in 2007. The new rules, which apply in all CEA facilities, incorporate the regulations in force, in particular the fact that, since 2002, CEA has no longer enjoyed exemption from the need to hold a licence for possession and utilisation of sources of ionising radiation.

In 2007, CEA also submitted several authorisation application files, to extend the sealed source utilisation period beyond the regulatory 10 years. In application of the order of 23 October 2009 approving the ASN decision defining the technical criteria for extending the sealed radioactive source utilisation time, ASN examined these applications and delivered an extension authorisation for some of the sources. For the other sources, the CEA submitted additional information to ASN at the end of 2011 so that it could pursue its examination. The administrative situation of all the sources requiring an extension of their utilisation time was in order by the end of 2011.

Furthermore, in 2010, CEA forwarded its used sealed source management strategy which will be considered by ASN within the more general framework of the strategy for management of radioactive wastes and effluents produced by CEA's civil nuclear installations.

1|1|7 Revision of water intake and discharge licences

The water intake and discharge licenses of the CEA Fontenay-aux-Roses centre are governed by ministerial orders dating from 1988. In view of the obsolescence of these texts, which do not include the changes in the status of the existing BNIs, in their activities and the changes in the induced discharges, ASN has asked the CEA to submit an intake and discharge requirements modification file by the fourth quarter of 2012.

With regard to the Marcoule site, the discharge license modification application file for the INBS (secret BNI) which currently treats all the liquid discharges from the site, was submitted at the beginning of 2009. The same applies for the ATALANTE facility. These files were supplemented in September 2010 by an overall impact study of the discharges from the CEA site, and from the CENTRACO and MÉLOX facilities, whose licenses will also change. These applications are being examined, and have been subject to a public information procedure (from 5 November to 5 December 2011). In the development of the decisions governing discharges, a revised study of the environmental and health impact induced by the chemical and radioactive discharges from the CEA Marcoule centre was sent to the two authorities (ASN and ASND, its defence counterpart) in January 2012 (see chapter 8, p. 238).

1|1|8 Assessment of seismic hazards

ASN devotes constant attention to the potential seismic risk. This risk is especially re-assessed during the periodic safety reviews conducted on each installation, in order to take account of scientific progress in characterising the risk, and changes in the design rules.

In response to an ASN request to supplement knowledge concerning the seismic risk at the Cadarache centre, the CEA proposed a method for taking particular site effects into account, developed under "CASHIMA", a study programme, conducted jointly with the ILL (Laue Langevin Institute) in Grenoble and involving several international partners and experts. ASN gave its conclusions on the CEA's approach in December 2011. This approach has brought progress, particularly in the geological knowledge of the Cadarache site environment, but it needs to be implemented in greater depth in order to be operational and allow the dimensioning of the facilities. ASN has encouraged the CEA to pursue the ongoing actions.

Alongside this, an overall assessment of integration of the seismic risk is continuing on the Marcoule site.

In addition, a study of the general resources of the Cadarache nuclear site that would be necessary in the event of an earthquake, established by CEA at ASN's request, has been under examination since the end of 2009.

1|1|9 Management of civil engineering projects

A number of projects for the construction of new installations or renovation of existing ones continued during the course of 2011, in particular at the Cadarache centre. To facilitate monitoring of progress on the construction of the installations in question, the CEA, at ASN's request, sends ASN a quarterly update of the works schedule, including a presentation of the planned annual progress of operations as well as details for the coming quarter. This document makes it possible to identify activities or particular points that ASN wishes to include in its spot checks during inspections.

The inspections carried out by ASN in 2011 particularly concerned the integration of the requests and remarks formulated further to previous inspections on the construction/civil engineering theme, or further to the examination of the design files relative to the pouring of certain concrete structures on the AGATE and JHR facilities. More specifically, two inspections were conducted on the JHR construction site to check the correction of anomalies detected on removal of the formwork of the upper raft on the reactor building side (see point 1|2|2 below).

1|1|10 Research reactor cores and experimental systems

The cores of some experimental reactors are regularly modified, owing to the experiments conducted in them. Others are fitted with specific experimental systems for carrying out certain types of experiments. One of the issues for ASN is to allow the regular performance of new experiments, while ensuring that they take place in appropriate conditions of safety.

In January 2007, the CEA drafted a technical guide defining the requirements relative to the conditions of design, production and radiation licensing for experimental systems. ASN plans analysing application of this guide, as much in the framework of the periodic safety reviews (application by the CEA to an experimental device of the OSIRIS reactor in Saclay) as in the context of the design of a new device (application to a device among those intended to be irradiated in the future Jules Horowitz reactor (JHR) in Cadarache); the corresponding safety files were received at the beginning of 2012.

ASN inspection of the reinforcing of the JHR containment – December 2011

1|2 Topical events in CEA research facilities

1|2|1 CEA centres

Cadarache Centre

The Cadarache Centre is located at Saint-Paul-lez-Durance, in the Bouches-du-Rhone *département*. It employs about 5,000 people (all contractors included) and occupies a surface area of 1,600 hectares. As part of CEA's strategy of specialising its centres as "centres of excellence", the Cadarache site deals mainly with nuclear energy. It comprises 20 BNIs, including two for the industrial operator AREVA (ATPu and LPC), while two others are used for IRSN research programmes (CABRI and PHEBUS). The purpose of these Cadarache centre installations is R&D to support and optimise existing reactors and to design new-generation systems. The Cadarache centre also plays a part in launching new projects, as it will house the future Jules Horowitz experimental reactor, for which the decree authorising its creation was published in 2009. The international ITER facility, whose commissioning is planned for 2018 subject to delivery of the authorisation decree, is under construction nearby.

ASN considers that the Cadarache centre's management maintained a good level of involvement in safety and radiation protection in 2011. Particular vigilance will be required with regard to supervision of service providers, given the increasing use being made of subcontracting. The renovation of the centre's electrical installations, scheduled from 2008 to 2015, must receive the necessary attention so as not to fall behind schedule. ASN will remain vigilant in this respect.

The construction of new facilities and the renovation of older ones, currently in progress at the centre, will also be a key issue for CEA in the coming years. ASN will continue to exercise close monitoring and control over this point.

Saclay Centre

The Saclay centre is located about 20 km from Paris in the Essonne *département*. It occupies an area of 223 hectares, including the Orme des Merisiers annex, and some 6,000 people work there. In 2006, the CEA head offices moved from their Paris premises and relocated at CEA Saclay.

This centre has been devoted to material sciences since 2005 and therefore plays an active role in the Saclay plateau development, as part of the Île-de-France master plan for regional development and land planning master plan.

The centre's activities range from fundamental research to applied research in a wide variety of fields and disciplines, such as physics, metallurgy, electronics, biology, climatology, simulation, chemistry and ecology. The purpose of applied nuclear research is to optimise the operation and safety of the French nuclear power plants and to develop future nuclear systems.

The centre also houses an office of the National Institute for Nuclear Science and Technology (INSTN), whose role is training, and two industrial companies: Technicatome, which designs nuclear reactors for naval propulsion systems; and CIS bio international, specialising in medical technologies, especially the radiolabelling of molecules, manufacturing of radio-pharmaceutical products used in nuclear medicine for therapy and imaging and in vitro medical diagnosis and molecular screening (see point 3⎪2).

ASN considers that the following points warrant particular attention at the Saclay centre:
– maintaining the nuclear safety performance of the BNIs in a centre focused primarily on non-nuclear activities;
– including nuclear safety in decisions concerning the development of future activities in the centre;
– control of urban development around the centre in a context of development of the Saclay plateau, in connection with the length of service life of BNIs envisaged by CEA.

ASN expects to see progress in safety management at the Saclay centre, which still houses a large number of different installations:
– research reactors (point 1⎪2⎪2): ULYSSE, ORPHÉE, OSIRIS;
– laboratories (point 1⎪2⎪3): LECI;
– irradiators (point 1⎪2⎪5): POSÉIDON;
– effluent and waste treatment facilities (chapter 16): liquid effluents management zone and STELLA project;
– waste storage facilities (chapter 16): solid waste management zone;
– one installation undergoing final shutdown or decommissioning (chapter 15): LHA.

Marcoule centre

The Marcoule centre is the CEA's centre of excellence for the back-end nuclear fuel cycle and in particular for radioactive waste. It plays a major role in the research being conducted pursuant to the Bataille Act of 1991 and the Programme Act of 28 June 2006 on the sustainable management of radioactive materials and waste. Civil and defence nuclear facilities are installed here, along with the CEA's two civil facilities in Marcoule, i.e. ATALANTE (research laboratory) and PHÉNIX (reactor).

The site moreover accommodates two other civil BNIs not operated by the CEA, namely MÉLOX (see chapter 13) and CENTRACO (see chapter 16). A third installation, the GAMMATEC irradiator, is under construction (see point 3⎪1).

The overall impact study for the Marcoule site is undergoing joint ASN-ASND examination. A public information meeting was organised on this subject in November 2011. In this context, the conditions of effluent discharge from the ATALANTE facility will be the subject of an ASN decision in 2012.

Further to the seismic risk conference of 7 December 2010 organised by ASN and ASND, an information meeting on this subject was held with the CLI (local information committee) on 20 May 2011.

Fontenay-aux-Roses centre

All the BNIs in this centre are currently being decommissioned (see chapter 15). Only the effluent and waste treatment facilities are still operating.

Grenoble centre

All the CEA's BNIs in this centre are currently being decommissioned (see chapter 15).

1⎪2⎪2 Research reactors

Experimental nuclear reactors make an essential contribution to scientific and technological research and to supporting operation of the country's nuclear power plants. Each reactor is a special case for which ASN has to adapt its monitoring while ensuring that safety practices and rules are applied. The last few years have seen the development of a more generic approach to the safety of these facilities, inspired by the rules applicable to power reactors, and more particularly the method of safety analysis by "postulated initiating events" and the safety classification of the associated equipment. This has led to significant progress in terms of safety. This approach is now used for the periodic safety reviews of existing installations as well as for the design of new reactors.

Despite the ageing of these installations, ASN is keen to ensure that they continue to operate with a high and constantly improving level of safety. Thus, all the installations in operation undergo periodic safety reviews intended not only to ensure that the installations are in conformity with the safety objectives initially set for them, but also to determine any improvements that could be made in order to keep pace with advances in knowledge and available technologies.

Critical mock-ups

• MASURCA reactor (Cadarache)

The MASURCA reactor, whose construction was authorised by a decree dated 14 December 1966, is intended for neutron studies, chiefly on the cores of the fast neutron reactor, and the development of neutron measurement techniques. This installation, for which the last periodic safety review was discussed at a meeting of the Advisory Committee of experts for nuclear reactors in March 2006, has been shut down for conformity work since 2007. The reactor core has been completely unloaded and the fuel has been stored since then in the fissile materials storage and handling building (BSM). In 2010 the licensee announced its decision to keep this reactor in operation and to build a new BSM.

The CEA's complementary safety assessment confirmed the need to build a new BSM and, in the meantime, to transfer the fissile material to the MAGENTA facility, which is built to earthquake design standards.

• ÉOLE and MINERVE reactors (Cadarache)

The ÉOLE reactor, whose construction was authorised by a decree of 23 June 1965, is intended for neutron studies of light water reactor cores. On a very small scale, it can be used to reproduce a high neutron flux using experimental cores representative of pressurised or boiling water power reactors. The MINERVE reactor, whose transfer from the Fontenay-aux-Roses research centre to the Cadarache research centre was authorised by decree 77-1072 of 21 September 1977, is situated in the same hall as the ÉOLE reactor. It is devoted to the measurement of the cross sections by sample oscillation, allowing the measurement of the variation in reactivity. According to the conclusions of CEA's strategic reflection on the long-term operation of its installations, CEA reportedly will stop the operation of these two reactors in 10 years at the most, and would keep certain items of equipment for reuse in the PHÉBUS installation (BNI 92) as part of the research into "Generation IV" reactors.

With these prospects in view, the periodic safety review has been carried out by the licensee and examined by the Advisory committee of experts. ASN will state its position in the near future. If it turns out that the reinforcement strategy defined by the licensee is not sufficient, ASN could demand final shutdown of these facilities in the nearer term.

Irradiation reactors

• The OSIRIS reactor and its ISIS critical mock-up (Saclay)

The OSIRIS pool-type reactor has an authorised power of 70 MWth. It is primarily intended for technological irradiation of structural and fuel materials for various power reactor technologies. It is also used for a few industrial applications, in particular the production of radionuclides for medical uses. Its critical mock-up, the ISIS reactor with a power of 700 kWth, is essentially used for training purposes today. These two reactors were authorised by a decree of 8 June 1965. Pursuant to ASN decision 2008-DC-0113 of 16 September 2008, the CEA will definitively stop operation of the OSIRIS reactor in 2015 at the latest.

In view of the periodic safety review file submitted in 2009 in accordance with the abovementioned ASN decision, and the renovation work finalised in 2010, such as the implementation of a backup ventilation system, ASN considered that the two reactors could continue operating (until 2015 in the case of the OSIRIS reactor). This was the subject of ASN opinion no. 2011-AV-0121 of 27 May 2011. In accordance with the decision of 16 September 2008, the CEA submitted a document in December 2011 presenting the measures it intended taking in preparation for shutdown of the OSIRIS reactor; these measures will be examined by ASN in the near future.

The complementary safety assessment report submitted by the CEA on 15 September 2011 in the framework of the actions following the Fukushima nuclear power plant accident, takes the OSIRIS reactor into consideration. The CEA has proposed improvements in this respect. Some of them, particularly as concerns defining a hard core of material and organisational provisions with regard to the seismic risk or the management of primary systems breaks, could give rise to ASN requirements in 2012. The complementary safety assessment of the ISIS reactor will be carried out during its next periodic safety review. This reactor also underwent a 2-day inspection on 5 and 6 July 2011 in the context of the experience feedback from the Japanese nuclear accident.

• The JHR (Jules Horowitz reactor) project (Cadarache)

The construction of a new reactor was deemed necessary by CEA, with the support of a number of foreign partners, in view of the ageing of the currently operating European irradiation reactors, which will be shut down in the medium or short-term.

The JHR will in particular be able to carry out activities similar to those performed today with the OSIRIS reactor. It will however comprise a number of significant changes with regard to both the possible experiments and the level of safety.

Further to the authorisation decree signed on 12 October 2009 (published in the Official Journal of 14 October 2009), ASN - by its decision 2011-DC-0226 of 27 May 2011 - set the technical specifications for the design and construction of the BNI. The aim is to freeze certain analytical elements used to draft the creation authorisation decree of 12 October 2009 and to establish stopping points for the performance of certain operations with potentially high consequences. Targeted provisions have also been made for the regular transmission of information to ASN.

Following the first excavation, preparation and concrete pouring work in 2009, embedding of the aseismic bearing pads, reinforcement and concreting of the upper raft of the nuclear unit (UN) in 2010, the civil engineering works continued in 2011 with the construction of the walls of the nuclear auxiliary building. The construction of the first walls of the reactor containment (reactor building), for which the concrete pouring was subject to prior ASN approval in application of the abovementioned decision of 27 May 2011, was authorised by ASN decision 2011-DC-0232 of 5 July 2011. Applying the same principle, the pouring of the first concrete for the reactor pool, which started in December, was approved by ASN by decision 2011-DC-0251 of 1 December 2011.

This construction site underwent 5 inspections in 2011. Two inspections were carried out after the CEA detected, early in the year, an anomaly on the underside of the upper raft on the reactor building side when removing the formwork of that structure. These two inspections did not reveal any differences with respect to the CEA's diagnosis, or anything that went against the CEA treating this anomaly in the planned manner. Treatment of the anomaly was completed in May 2011.

In addition, ASN is continuing its ongoing dialogue with CEA to facilitate monitoring of the measures requested following analysis of the preliminary safety report and in preparation for the review of the future commissioning authorisation application, currently scheduled for 2013.

Although the JHR is of a very recent design that integrates the operating experience feedback from the other experimental reactors, the CSA process has resulted in the CEA identifying possibilities for improvements that could be implemented relatively easily, as it is in the construction phase. ASN has thus considered that some of the proposals made by the CEA, which are likely to make the facility more robust, should be implemented. Moreover, making these improvements at the design/construction stage favours prevention, rather than mitigation, of the consequences of possible accident situations.

Neutron source reactors

• ORPHÉE reactor (Saclay)

The ORPHÉE reactor, with an authorised power of 14 MWth, is a pool-type research reactor using heavy water as the moderator. It is equipped with nine horizontal channels, tangential to the core, enabling 19 neutron beams to be used. These beams are used to conduct experiments in fields such as physics, biology and physical chemistry. The reactor also has ten vertical channels for the introduction of samples to be irradiated in order to produce radioisotopes or special materials and to carry out analysis by activation. The neutron radiography installation is used for non-destructive testing of certain components. The ORPHÉE reactor was authorised by a decree of 8 March 1978. Its first divergence was in 1980.

On completion of the second periodic safety review that was conducted in 2009-2010, the Advisory committee of experts in charge of reactors considered that operation of the reactor could continue subject to the application of recommendations and the licensee meeting its commitments. The CEA has committed itself to a major programme to replace the experimental devices that are subject to irradiation aging. Improvements are also expected with regard to the fire risk. In the near future, ASN will give its opinion to the ministers in charge of nuclear safety.

The complementary safety assessment of the ORPHÉE reactor, following the Fukushima NPP accident, is to be submitted in September 2012.

Test reactors

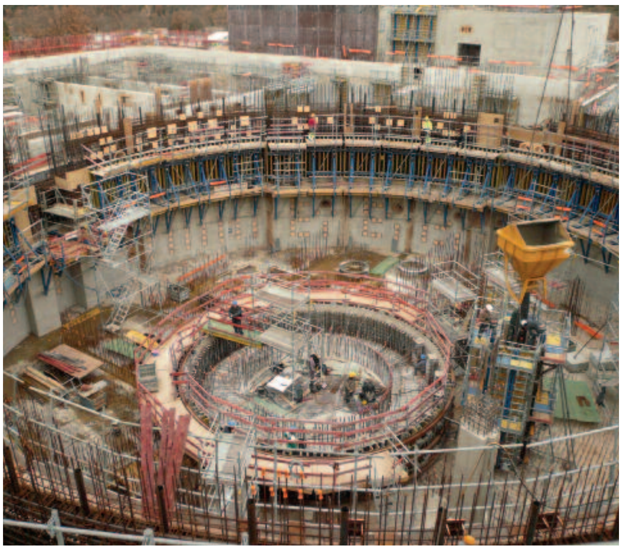
• CABRI reactor (Cadarache)

The CABRI reactor, created on 27 May 1964 is mainly used for experimental programmes aimed at better understanding nuclear fuel behaviour in the event of a reactivity accident. The reactor is operated by the CEA for the purposes of tests designed by IRSN and involving a number of French and foreign partners (nuclear licensees, safety authority technical support organisations, etc.).

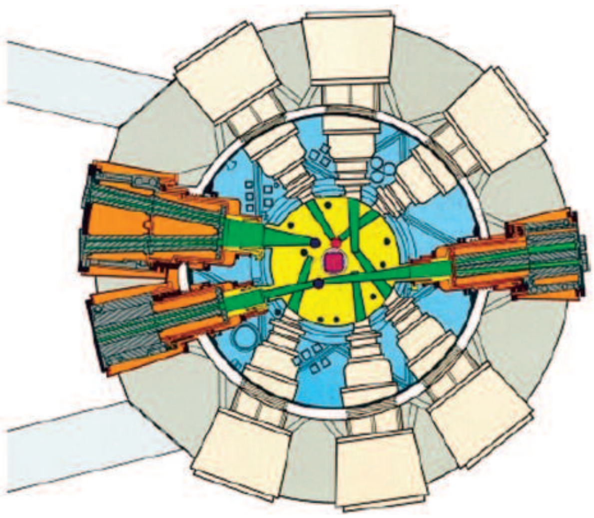
The facility was modified by decree 2006-320 of 20 March 2006 for the needs of new research programmes: the reactor's sodium loop was replaced by a water loop in order to study the behaviour of high combustion rate fuels in accident situations representative of those that could be encountered in a pressurised water reactor. The first criticality of the modified installation and performance of the first experimental test will be two steps that require ASN authorisation. Before doing so, ASN will examine the conditions in which the commissioning tests are to take place and will then ensure that their results confirm the installation's conformity with its safety demonstration file. This means that the licensee must have satisfactorily responded to the demands made of it for the modification of the facility. Over the last few years ASN has reminded the CEA several times that it must ensure that files are submitted in times compatible with their examination, given the scheduling targets. In 2011, ASN continued its examination of the CEA's application for authorisation to refuel the reactor core, which focused notably on the verification of the checks and any repairs, and reinforcements of the equipment required for these operations. With regard to the first criticality, examination of the corresponding file is continuing.

• PHÉBUS reactor (Cadarache)

The PHÉBUS reactor, whose creation was authorised by decree 77-801 of 5 July 1977, was one of the aids for studying the severe accidents that could affect pressurised water reactors (PWR), on the basis of tests devised and financed by the IRSN. CEA has announced that it wishes to stop conducting any new programmes with this reactor. Clean-out and decommissioning of the experimental systems used in the last experiment have been under way since 2004.



Concreting of the JHR containment and pool – December 2011



View of the reactor pile block and the irradiation channels of the ORPHÉE reactor

Further to the last event of 9 March 2011 relative to the unexpected presence of tritium in the gaseous effluents of the facility, the CEA identified the last campaign of experiments (PHÉBUS PF program), completed in 2004, as being the cause of the leak. ASN has asked the CEA to inform it of the measures it will adopt accordingly, the plan of action and the schedule for the associated operations.

ASN is still waiting for the CEA's strategy regarding the future of this BNI, so that it can start the appropriate regulatory procedures (decommissioning or modification of the installation).

Whatever the case, ASN remains attentive to the operations conducted in this installation, which the CEA has said could receive certain items of equipment from the Eole and Minerve installations as part of the research into the "Generation IV" reactors.

Teaching reactors

• ISIS reactor (Saclay)

The ISIS reactor, with the OSIRIS reactor, constitutes one of the two reactors of BNI 40 (see below).

• ULYSSE reactor (Saclay)

The ULYSSE reactor was mainly devoted to teaching and practical work. In February 2007, the installation entered the final shutdown preparation phase. The decommissioning authorisation application for the installation was submitted in summer 2009. The file, judged admissible, was sent to the prefecture of the Essonne département in October 2011, for the public inquiry to be launched.

Prototype reactors

• PHÉNIX reactor (Marcoule)

The PHÉNIX reactor, built and operated by CEA jointly with EDF, is a demonstration reactor of the sodium-cooled fast neutron type. Authorised by a decree of 31 December 1969, the reactor's first criticality took place in 1973. Its initial nominal power of 563 MWth was reduced to 350 MWth in 2002. The nuclear power plant definitively stopped power operation coupled to the electricity grid in early 2009. Tests corresponding to the end of operation, called end-of-life tests, were then carried out until the beginning of 2010. These tests were intended to supplement knowledge of sodium-cooled fast neutron reactors in view of the development of the "Generation IV" electricity production process, and also entered into the framework of the studies of the installation prototype mentioned in article 3 of act 2006-739 of 28 June 2006 on radioactive materials and waste management.

The decommissioning authorisation application file was submitted to ASN at the end of 2011. The decommissioning programme will include, in particular, the implementation of sodium treatment facilities. Preparatory work is currently under way, prior to the decommissioning authorisation decree.

The complementary safety assessment report submitted by the CEA on 15 September 2011, further to the Fukushima nuclear power plant accident, includes the PHÉNIX power plant. In this context, the CEA has taken several commitments concerning the risks related to flooding and a sodium fire. An inspection was also carried out in this context on 6 September 2011 (see chapter 8).

1|2|3 Laboratories

The irradiated materials and spent fuel assessment laboratories

These laboratories, also called "hot laboratories", are key experimental tools for the main nuclear licensees. There used to be a large number of these laboratories but they are now concentrated in two centres: one, in Saclay, devoted to irradiated materials and the other, in Cadarache, dealing with fuel. From the safety viewpoint, these installations must meet the standards and rules of the large fuel cycle nuclear installations, but this safety approach has to be proportionate to the specific risks.

• Active fuel examination laboratory (LECA) (Cadarache)

The LECA, which was commissioned in 1964, is a laboratory carrying out destructive and non-destructive testing on spent fuel taken from various types of nuclear power or experimental reactors and on irradiated structures and equipment from these technologies.

Further to the periodic safety review carried out in 2001, a major upgrading programme was undertaken. It included works to improve the seismic resistance of the civil engineering. This work will end with the dismantling of the building called "UO_2", initially scheduled for 2008 and postponed to 2012, thereby reducing the interactions between buildings in the event of an earthquake.

Acceptance of immersion heaters on the PHÉNIX installation

The CEA has moreover indicated its intention to extend the operating life of the LECA, whose shutdown was hitherto envisaged in 2015. For this, it will have to demonstrate the resistance of the buildings to a reference earthquake called the "safe shutdown earthquake" (SSE), at the next periodic safety review planned for 2013.

• LECA's treatment, clean-out and reconditioning station (STAR) (Cadarache)

The STAR facility is a high-activity laboratory comprising shielded cells. It was designed for the stabilisation and reconditioning of irradiated fuel rods with a view to storing them in the CASCAD facility. It also performs destructive and non-destructive examinations of irradiated fuel from various processes (PWR, research reactors, experimental reactors).

Its creation was authorised by a decree of 4 September 1989 and its definitive commissioning was declared in 1999.

On completion of the analysis of the periodic safety review file in June 2009, ASN indicated that it had no objection to the continuation of operation of the facility, and authorised the extension of its operating range, thereby enabling the CEA to recondition new types of fuel. ASN periodically checks that the licensee is meeting its commitments taken under the periodic safety review, and carried out two progress assessments in 2011.

Moreover, ASN authorised the commissioning of the VERDON laboratory within the STAR facility in 2011. This laboratory intends studying early releases and deposits of fission products from the new fuels.

In order to reduce the risks of items being dropped during handling operations, a new "truck loading chamber" is under construction. The licensee has undertaken to commission it in 2014.

Clean-out work in the "UO2 building" before dismantling

• Laboratory for research and experimental fabrication of advanced nuclear fuels (LEFCA) (Cadarache)

LEFCA is a laboratory responsible for performing basic engineering studies on plutonium, uranium, actinides and their compounds in all forms (alloys, ceramics or composites) with a view to application to nuclear reactors, the performance of ex-pile studies necessary for the interpretation and understanding of fuel behaviour in the reactor and at the various stages in the cycle, as well as the manufacture of irradiation test capsules or experimental assemblies.

This laboratory was commissioned in 1983.

In the framework of its last periodic safety review in 2003, the CEA undertook to carry out seismic reinforcement work on the building. This work was completed in 2010. However, with regard to the risk of liquefaction failure of the ground beneath the facility in the event of an earthquake, ASN took a decision introducing a technical requirement imposing the implementation of a system for preventing this risk before 29 June 2012 (decision 2010-DC-0186 of 29 June 2010). The corresponding work started at the beginning of 2011.

In addition to this, in 2011 ASN examined the programme for the next periodic safety review planned for 2013.

• Spent fuel testing laboratory (LECI) (Saclay)

The spent fuel testing laboratory (LECI – BNI 50) was the subject of a declaration on 8 January 1968, and a creation authorisation decree for the PELECI extension dated 30 May 2000. This facility comprises three buildings on the Saclay site, and groups shielded lines, one glove-box line and a shielded bunker, in which the various fuel constituents used in the nuclear reactors are analysed to determine how their properties evolve with irradiation. This facility also accommodates a shielded cell (Célimène, building 619) which has not been used since the end of 1993. Commissioning of the three lines of shielded cells was staggered between 1959 and 2005. The next periodic safety review is planned for 2013. In 2011, ASN gave its opinion on the initial note defining the programme for the periodic safety review.

Research and development laboratories

• Alpha facility and laboratory for transuranian elements analysis and reprocessing studies (ATALANTE) (Marcoule)

The main purpose of the ATALANTE facility, created in the 1980's, is to conduct research and development activities concerning:
– nuclear fuel recycling;
– ultimate waste management;
– exploration of new concepts for fourth-generation nuclear systems;
– studies, production and recycling of actinides.

The changes to the facility since its creation and its periodic safety review have been examined by the Advisory group of experts for plants in 2007. On this basis, ASN authorised the "definitive" commissioning of the facility in June 2007 (the various laboratories were commissioned as and when required since the creation of the facility). The licensee's commitments in this context are periodically monitored by ASN, particularly with regard to the prevention of fire risks. ASN carried out two progress assessments on this account in 2011. Despite a few postponements, the assessments show progress to be satisfactory.

In 2011, ASN examined the commissioning file for the hydrothermal oxidation (HTO) process in laboratory L21. This process is part of the DELOS facility, dedicated to the treatment of contaminated organic effluents. It corresponds to the last treatment stage of these effluents, the other stages having been authorised by ASN in 2009.

Lastly, ASN has examined the revision of the facility's discharge limits and requirements that will lead to an ASN decision in 2012.

• The CHICADE facility (Cadarache)

The CHICADE (waste chemistry and characterization) facility carries out research and development work on low level and intermediate level waste.

This work mainly concerns:
– the destructive and non-destructive characterisation of radioactive objects, waste sample packages and irradiating objects;
– the development and qualification of nuclear measurement systems;
– the development and implementation of chemical and radiochemical analysis methods;
– the assessment and monitoring of waste packaged by the waste producers.

Creation of the facility was authorised by a decree of 29 March 1993 and its definitive commissioning was authorised in 2003.

In 2011, ASN gave its opinion on the periodic safety review file, and formulated no objection to the continuation of operation of the facility. The licensee must nevertheless respond to ASN's demands and meet the commitments it gave further to the periodic safety review of the facility. They notably concern waste management and additional demonstrations of resistance to external hazards (aircraft crash, earthquake).

The licensee moreover wants to put the CADECOL cell into service as from 2012. It will be devoted to destructive testing of waste packages, enabling appraisals to be carried out for ANDRA, for example.

1|2|4 Fissile material stores

• The central fissile material warehouse (MCMF) (Cadarache)

Built in the 1960's, the MCMF is a storage warehouse for enriched uranium and plutonium. Its main duties are reception, storage and shipment of non-irradiated fissile materials (U, Pu) pending reprocessing, whether intended for use in the fuel cycle or to remain temporarily unused.

Given that the MCMF cannot guarantee fulfilling its safety functions in the event of an earthquake, the licensee has been asked to transfer the nuclear material from this facility to the MAGENTA facility. It is noteworthy that with regard to the mass of plutonium-containing materials stored in the MCMF, about 98% of the reference stock was removed at the end of 2011.

• The MAGENTA facility (Cadarache)

The MAGENTA facility, intended to replace the MCMF, is dedicated to the storage of non-irradiated fissile material and the non-destructive characterisation of received nuclear materials.

The MAGENTA creation authorisation decree was signed on 25 September 2008. ASN authorised the facility's commissioning by decision 2011-DC-0209 of 27 January 2011.

MAGENTA's licensee received the first package from the MCMF in February 2011.

However, commissioning of the glove-box lines for the physical characterisation of materials and the changing of primary conditioning is envisaged for a later date, subject to prior ASN agreement.

1|2|5 The POSEIDON irradiator

The POSÉIDON facility at Saclay, created by decree of 7 August 1972, is an irradiator consisting of a cobalt 60 source storage pool, surmounted over half its surface area by an irradiation bunker. The facility also features a submersible chamber called CALINE and a test cell called CESAR. The Poseidon facility is used for research and development activities relating to the behaviour of materials under radiation.

The main ongoing examination subject concerns the facility's waste zoning.

1|2|6 Waste and effluent storage and treatment facilities

The CEA has effluent and waste treatment and packaging facilities on its sites at Fontenay-aux-Roses, Grenoble, Cadarache and Saclay. They are generally equipped with characterisation facilities to enable measurement-based checks to be made on

View of the MAGENTA facility at Cadarache the declarations made by producers of waste and checking of compliance of packaged wastes with their acceptance specifications, prior to their streaming to the appropriate disposal route. The treatment and packaging facilities handle mainly liquid and solid wastes from the CEA centres in which they are located. They may occasionally process waste from other sites (CEA or others) depending on its specific characteristics.

The waste and effluent storage and treatment facilities are addressed in chapter 16.

1|2|7 Installations undergoing decommissioning

CEA has undertaken the final shutdown and decommissioning of some installations which have reached the end of their lives or whose continued operation is not desired and, more generally, when sites are located in the immediate vicinity of major urban centres (which is the case of the Fontenay-aux-Roses and Grenoble centres, for which the complete delicensing process is under way). These aspects are dealt with in chapter 15.

2 NON-CEA NUCLEAR RESEARCH INSTALLATIONS

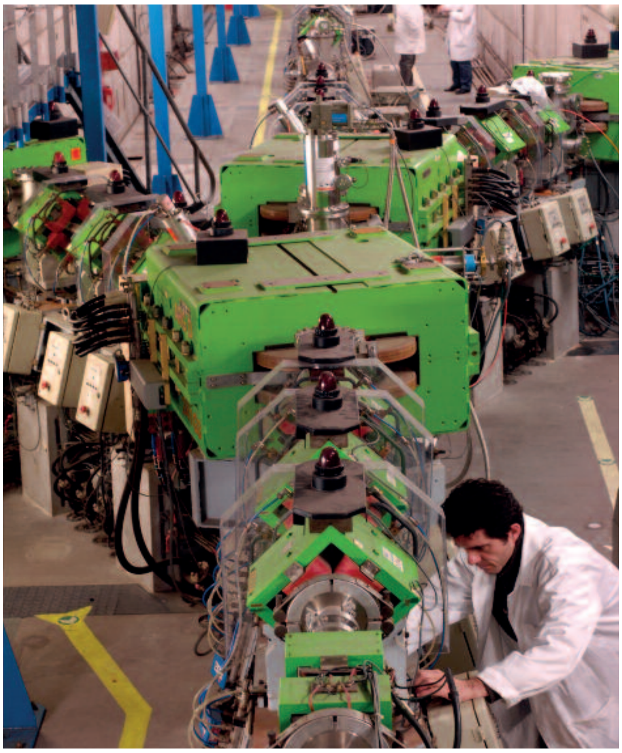
The main subjects of interest in 2011 concerned:
– the continuation of the examination of the modification of the GANIL facility decree;
– examination of the complementary safety assessment of the high-flux reactor (RHF), which was considered to be a priority on the same account as the nuclear power reactors and 5 of the CEA's installations;
– the entry into force of a new tripartite agreement concerning the CERN (European Organisation for Nuclear Research), between the French Government, the Swiss Federal Council and European Organisation for Nuclear Research, relating to protection against ionising radiation and the Safety of the Organisation's facilities;
– examination of the creation authorisation application for the ITER installation.

2|1 Large national heavy ion accelerator (GANIL)

The GANIL (large national heavy ion accelerator) GIE (economic interest grouping) situated in Caen (Calvados *département*), is a laboratory researching into the structure of the atom, which was authorised by a decree of 29 December 1980 to create an accelerator, and, by a decree of 6 June 2001, to operate an extension. The purpose of this research facility is to produce, accelerate and distribute beams of ions with different energy levels. The intense high-energy beams produce strong fields of ionising radiation when they circulate in the rooms, and even after the beams have stopped, which constitutes the main risk.

In order to be able to produce exotic heavy-ions, in July 2009 the GANIL applied for a modification to the authorisation decree for its facility so that it could set up the SPIRAL 2 project for the production of exotic ions in it (linear accelerator and building housing the associated experimental areas, exotic ion production buildings). This application, which comprises two phases, is currently being examined. The excavation work for construction of the phase 1 buildings began in January 2011, and the civil engineering work in August 2011.

The report submitted further to the public inquiry concludes with a favourable opinion for phase 1 and for the modification of the perimeter of BNI 113 to include the SPIRAL 2 project. ASN aims to give an opinion on a draft amending decree relative to phase 1 of the SPIRAL 2 project in the first quarter of 2012; the GANIL wants commissioning - which will be subject to prior ASN authorisation - to take place in mid-2013. ASN has also started examining the periodic safety review. Phase 2 of the SPIRAL 2 project will be examined later on, with commissioning desired for 2016.



The "fishbone" in the GANIL, which guides the beams in the experiment halls

2|2 Laue-Langevin Institute (ILL) high flux reactor

The high flux reactor (RHF) at the Laue-Langevin Institute (ILL) in Grenoble constitutes a neutron source mainly used for experiments in the field of solid-state physics, nuclear physics and molecular biology. The maximum power of the reactor, initially authorised by a decree of 19 June 1969 amended by decree no.94-1042 of 5 December 1994, is 58.3 MWth. The reactor core is cooled by heavy water contained in a reflective tank, which itself is immersed in a light water pool. 13 vertical channels and 4 sloping channels direct the neutrons to the experiment halls. Vertical tubes are also used to irradiate samples.

In 2002, ASN requested major seismic reinforcement work on the installation. The majority of this work ended in late 2007, although further improvements concerning more particularly the handling crane, the gaseous effluent management system, and the system for reflooding the reactor core in the event of a severe accident, are still in progress.

The RHF underwent a complementary safety assessment in 2011, in the framework of the actions following the Fukushima nuclear power plant accident. In this respect, the ILL endeavoured to deploy the entire margin evaluation procedure in depth, and has made many commitments to reinforce the robustness of the facility with respect to the seismic risk and the flood risk. An inspection was also carried out in this framework on 5, 6 and 7 September 2011 (see chapter 8).

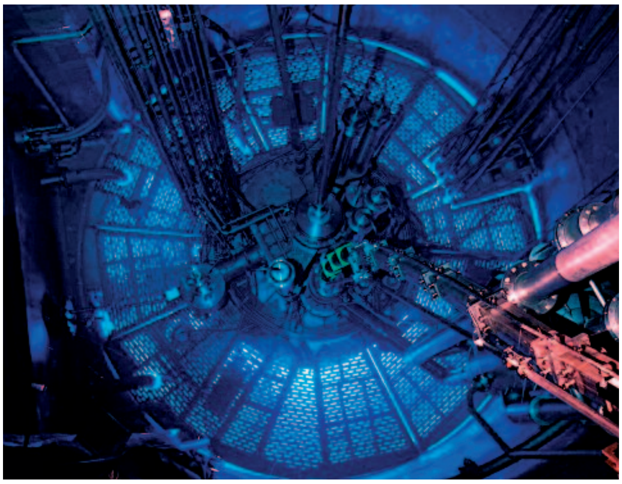
The update of the RHF safety report is expected in 2012. The licensee has implemented a new method of analysis by "postulated initiating events".

Lastly, in the context of the complete delicensing of the CEA centre in Grenoble, situated in the immediate vicinity of the RHF, ASN has asked the ILL to examine the shutdown of the RHF on the current site. ASN has reiterated its wish for a shutdown date to be defined. It underlines in this respect that by defining a shutdown date and studying a medium-term replacement strategy, the various actions required can be planned in advance.

2|3 European organization for nuclear research (CERN) installations

The European Organisation for Nuclear Research (CERN) is an international organisation whose role is to carry out purely scientific and fundamental research programmes concerning high-energy particles.

A tripartite agreement signed by France, Switzerland and CERN entered into effect on 16 September 2011. Prior to this, the safety and radiation protection of the facility were governed by bilateral agreements. ASN actively participated in the work leading to the signing of this tripartite agreement, which covers the fields of nuclear safety and radiation protection; for the first time, the agreement constitutes a legal basis common to the two host countries. It is now a question of publishing all the rules mentioned in this agreement.



RHF reactor pool

In 2011, ASN conducted surveillance visits focusing on periodic tests, maintenance and radioactive source management.

2|4 The ITER (international thermonuclear experimental reactor) project

The ITER project concerns an experimental installation, the purpose of which is scientific and technical demonstration of controlled thermonuclear energy obtained with a deuterium-tritium plasma magnetic confinement, during long-duration experiments with a significant power level (500 MW for 400 s). This international project benefits from financial support from China, South Korea, India, Japan, Russia, the European Union and the United States. The Headquarters Agreement between ITER and the French Government, signed on 7 November 2007, was published in the Official Journal of the French Republic by decree on 11 April 2008.

A first version of the creation authorisation application file for the ITER BNI was submitted at the end of January 2008. ASN had indicated to the ITER Organisation, however, that its file was not admissible such as it was submitted. The revised file was submitted to ASN in April 2010. This file was presented for public inquiry from 15 June to 4 August 2011, after which a favourable opinion, accompanied by recommendations, was issued on 9 September 2011. The CLI (local information committee) also gave its opinion on 21 July 2011. This includes a number of requests concerning the impact of chemical and radioactive discharges, environmental monitoring, the detritiation of effluents, and the management of waste during operation and decommissioning. With regard to decommissioning, the CLI wishes to be informed of the development of the costs of decommissioning.

The Advisory committees of experts met on 30 November and 7 December 2011. The Advisory committees of experts considered that, subject to implementation of the commitments (about 180) made by the licensee, and the 21 recommendations they proposed, the measures adopted by the licensee in the file supporting its creation authorisation application, are on the whole satisfactory. The Advisory committees of experts thus gave a favourable opinion for the creation of this facility. The licensee must nevertheless further reinforce the design of certain items of equipment and provide many additional elements within one to two years. ASN will give its opinion on a draft creation authorisation decree for ITER in 2012.

ITER Organisation aims to obtain the first hydrogen plasma in 2019 and the first deuterium-tritium plasma in 2026.

The civil engineering work, particularly the tokamak foundations, began in 2011. The ASN inspection in July 2011 in this area showed that the licensee had a robust organisation that could ensure satisfactory management of the civil engineering operations inherent to the construction of the nuclear facility.

The complementary safety assessment of ITER, required as part of the experience feedback from the Fukushima NPP accident, is to be submitted in September 2012.

ASN inspection on the ITER construction site – July 2011

3 IONISERS, THE PRODUCTION OF RADIONUCLIDES FOR PHARMACEUTICAL USE, THE MAINTENANCE UNITS AND THE OTHER NUCLEAR FACILITIES

The main focus of ASN in 2011 concerned the continuation of examining the periodic safety review of the CIS bio international facility. The conclusions of this review will be known in 2012.

3|1 Industrial ionisation installations

The irradiators are intended primarily for the sterilisation of medical devices, foodstuffs, pharmaceutical raw materials, etc., by irradiating them with gamma rays emitted from sealed cobalt-60 sources. The irradiation cells are made from reinforced concrete, designed to protect the environment. The sources are stored in pools under a depth of water that guarantees the protection of the workers in the cells. The main risk in these facilities is irradiation of the personnel.

The IONISOS group, created in 1993, operates three industrial ionisation facilities (Dagneux BNI 68, Pouzauges BNI 146, Sablé-sur-Sarthe BNI 154). Further to an ASN demand, IONISOS has requested the implementation of an additional verification of pool tightness by acoustic emissions; this request is currently being examined. Furthermore, in agreement with the licensee, ASN has organised the scheduling of the periodic safety reviews for these three facilities, which must be carried out by November 2017 at the latest, as required by decree 2007-1557 of 2 November 2007. The first periodic review is planned for 2014, and will in principle concern the Sablé-sur-Sarthe site.

ISOTRON France operates the GAMMASTER irradiator (BNI 147). ISOTRON France wishes to relaunch its project to build a new irradiator: GAMMATEC (BNI 170) on the Marcoule site, for which the creation authorisation decree dates from 2008. This project had been provisionally suspended by the licensee, but it is now targeting commissioning by the end of 2012. In view of the two-year interruption in the project and a minor change in the construction permit, ASN will ensure that this new facility remains in compliance with its creation authorisation decree and that the Fukushima experience feedback has been integrated.

3|2 The radio-pharmaceutical production facility operated by CIS bio international

CIS bio international is a key player on the French market for radiopharmaceutical products used for both diagnosis and therapy. Most of these radionuclides are produced in BNI 29 at Saclay. The decree no.2008-1320 authorising CIS bio international to operate BNI 29 in place of the CEA was signed on 15 December 2008.

In July 2008, the CEA - the licensee at the time - submitted the periodic safety review file for BNI 29. This file was supplemented in 2009. This supplemented file was examined in 2010, and presented to the Advisory committee of experts for plants (GPU) on 7 July 2010. However, the documents provided in this file did not enable the sustainable nature of facility operation to be confirmed, particularly owing to the lack of a conclusive conformity analysis. This initial examination thus consisted in taking stock of knowledge on the safety of the facility and identifying the priority lines for improvement. It was therefore decided that the GPU would meet a second time to reach a conclusion on this periodic safety review file and the continuation of operation of the facility.

Production of artificial radionuclides for medical purposes

Radionuclides, or radioactive markers, are used for the diagnosis and treatment of many diseases. These radionuclides for medical uses are notably produced by irradiating sources in French BNIs, either in research reactors or using cyclotrons. They are then processed and conditioned in dedicated facilities. The BNIs concerned by these manufacturing processes are:
- *the OSIRIS research reactor operated by the CEA in Saclay, which produces molybdenum-99, iridium-192, yttrium-90, erbium-69, and rhenium-186;*
- *the ORPHÉE research reactor operated by the CEA in Saclay, which produces iridium-192, yttrium-90, erbium-69, and rhenium-186;*
- *the UPRA (artificial radionuclide production plant) operated by CIS bio international in Saclay, which has two cyclotrons and radionuclide processing and conditioning facilities. It essentially produces molybdenum/technetium generators, iodine-131, thallium-201, yttrium-90, and samarium-153.*

The JHR reactor will also contribute to the production of radionuclides. This reactor is currently under construction on the CEA Cadarache site.

The safety status of the abovementioned BNIs is presented in this chapter.

Metastable technetium-99 is the most commonly used radionuclide in medical imaging. It is produced by decay of molybdenum-99, which is itself obtained by reactor irradiation of enriched uranium targets. The world's production of molybdenum-99 is ensured by the following reactors:
- *NRU in Canada;*
- *HFR in the Netherlands;*
- *Safari in South Africa;*
- *BR2 in Belgium;*
- *OSIRIS in France (less than 10%).*

It should not be forgotten that the world production of molybdenum-99 dropped in 2007 and 2008 - due mainly to the outages of the NRU reactor in Canada, the HFR in the Netherlands, and the IRE facility in Belgium - leading to shortages in supplies of technetium-99m. As the research reactors involved in this production process are "old", and the OSIRIS reactor shutdown is set for the end of 2015 under the ASN decision of 16 September 2008, such difficulties could arise again. Given this context, the international nuclear safety authorities met in 2009. ASN then estimated, in its "position statement" of 16 September 2009, that the solution was not to extend the operation of the old reactors, which would jeopardise the safety of these facilities, but to concentrate on optimising the use of technetium-99m, particularly by seeking alternative production solutions and studying the use of alternative medical imaging methods.

It must be emphasised that, on completion of its analysis of the periodic safety review file for the OSIRIS reactor, ASN confirmed, through ASN opinion no. 2011-AV-0121 of 27 May 2011, its position - first mooted in 2004 - on the shutdown of this reactor in 2015.

New production line for radiopharmaceuticals at CIS bio

To this end, ASN decision 2011-DC-0207 of 27 January 2011 set the deadlines for sending the replies to the commitments made by CIS bio international and the demands formulated by ASN at the end of this first examination stage. However, further difficulties arose in 2011. Firstly, the content of some required additional information, notably concerning the fire risk, was still insufficient, and secondly, some information was sent late, in spite of several chase-ups by ASN. The conclusions of the periodic safety review file examination are expected at the beginning of 2012.

However, in view of the conclusions of the first stage of the examination, and to reduce the radiological consequences of a potential accident as quickly as possible, the iodine-131 inventory of the facility was progressively reduced in 2011 pursuant to the abovementioned ASN decision.

Lastly, ASN notes that difficulties also arise with the facility modification application files, which are often incomplete.

The complementary safety assessment of CIS bio international, required as part of the experience feedback from the Fukushima NPP accident, is to be submitted in September 2012.

3|3 Maintenance facilities

Three basic nuclear installations specifically handle nuclear maintenance activities in France. They are:

The SOMANU (nuclear maintenance company) facility in Maubeuge (Nord département*)*

Authorised by a decree of 18 October 1985, this facility is specialised in the repair and appraisal of material coming mainly from the primary cooling systems of pressurised water reactors and their auxiliaries, excluding fuel elements. This BNI belongs to the AREVA group. In compliance with the requirements of article 29 of the TSN Act, the licensee has engaged in a process that should lead, by the end of 2011, to providing ASN and the ministers responsible for nuclear safety with an initial report on the ten-year periodic safety review of the licensee's installation. The licensee proposed addressing the complementary safety assessments required on account of the experience feedback from the Fukushima Daiichi accident in the framework of this safety review, which was accepted.

*The SOCATRI (*Société auxiliaire du Tricastin*) clean-out and uranium recovery facility situated in Bollène (Vaucluse* département*)*

Its activities encompass the maintenance, storage and clean-out of material from the nuclear industry and waste storage on behalf of ANDRA. The operating company, SOCATRI, is part of the AREVA group and was licensed by a decree of 22 June 1984, amended. Its authorisations for water intake and liquid and gaseous discharges were modified for the last time by ministerial order of 16 August 2005. Further to an uncontrolled release that occurred on 7 July 2008, the facilities were satisfactorily reconditioned; ASN nevertheless underlined the persistence of shortcomings in operating rigour. On 30 September 2011, the appeal court of Nîmes requalified the offence of pollution as an "offence of discharging substances into the groundwater, surface water or the sea leading, even temporarily, to significant modifications to the normal water supply and to restrictions on the use of bathing waters", and reversed the initial judgement of 14 October 2010 to declare the company guilty of this charge. The court moreover confirmed the conviction for omission to give immediate notification of the incident that occurred on its premises, as required under articles 48 and 54 of the Act of 13 June 2006. SOCATRI was fined €300,000 for criminal liability and €250,000 for civil liability. AREVA has lodged an appeal with the supreme court of appeal. As for the consequences of the event on the environment, the extended monitoring put in place confirmed the absence to date of an environmental impact associated with the incident. SOCATRI nevertheless remains obliged to monitor the groundwater of the site and the river Lauzon with which it communicates.

In a sector bounded by the Donzère-Mondragon canal and the Gaffière, Lauzon and Rhone rivers, legacy contamination of the groundwater - unrelated to this incident - was identified; some thirty private boreholes have thus been monitored by AREVA NC.

The IRSN conducted a study of this contamination that identified more precisely the extent of the phenomenon. It was monitored by the CLIGEET (Tricastin major energy facility local information committee), the ARS (regional health agencies) of the Vaucluse, and AREVA NC.

The study gave rise to a public meeting on 22 September 2010 in which ASN participated. Further to this meeting, it was decided that monitoring of the private boreholes by AREVA NC would be taken over by the environmental monitoring network of the Tricastin site.

During 2009, SOCATRI started the periodic safety review of its facility, and submitted the corresponding files to ASN in 2010. After examining the file, ASN addressed the licensee a request for additional information. The technical examination of the file began at the end of 2011 after receiving the last files.

In addition, SOCATRI undertook major works to be able to handle the effluents generated by preparatory operations for the final shutdown of the EURODIF plant and the maintenance units of certain equipment items of GBII.

Lastly, the SOCATRI facility underwent a complementary safety assessment in 2011 further to the ASN decision of 5 May 2011.

Tricastin operational hot unit (BCOT)

The BCOT was licensed by a decree of 29 November 1993. Also situated in Bollène, it performs maintenance operations and storage of contaminated material from the PWRs, with the exception of fuel elements. This BNI is operated by EDF.

In 2011 the BCOT continued the shipment of the old reactor vessel heads to ANDRA; the last vessel head should be shipped in 2013. The BCOT has also started, with ASN authorisation, to install a unit for cutting up the end-of-life guide tubes from the EDF fleet.

During 2010, the BCOT licensee had initiated a periodic safety review of its installation. It completed it in 2011, for examination by ASN in 2012. The licensee should carry out the complementary safety assessments taking account of the experience feedback from the Fukushima Daiichi accident in the framework.

3|4 Chinon irradiated material facility (AMI)

This facility situated on the nuclear site of Chinon (Indre-et-Loire *département*) was declared and commissioned in 1964, and is operated by EDF. Its main purpose is to carry out examinations and appraisals of activated or contaminated materials from PWR reactors.

2006 was marked by a change in strategy on the part of the licensee with regard to the future of the installation. As ASN considered that the renovation project presented in 2004 did not enable long-term continued operation to be envisaged, EDF presented a new strategy, including final shutdown of the installation no later than 2015.

In 2008, EDF had indicated its aim of commissioning a new laboratory by 2011 also on the site of Chinon. Preparatory work began in 2009. If the schedule presented is met, the AMI's examination and appraisal work will wind down in 2012, and the preparatory operations for installation decommissioning will be able to begin.

Furthermore, the work to ensure the safety of the installation until its final shutdown was completed at the beginning of 2010.

The sorting and packaging operations for the legacy waste from the installation, currently stored in a pit, continued in a dedicated unit. Some of this waste was taken away to the disposal centres.

Lastly, in October 2010, EDF lodged a file applying for a modification of the limit values for liquid and gaseous radioactive discharges into the environment for the entire EDF Chinon site. In this framework, the modification application for the requirements setting the AMI discharge conditions is currently being examined. This modification project was submitted at the end of July 2011 to the CODERST (Departmental Council for the Environment and for Health and Technological Risks) of Indre-et-Loire, as provided for decree no.2007-1557 of 2 November 2007.

3|5 Inter-regional fuel warehouses (MIR)

EDF has two inter-regional fuel warehouses, on the Bugey site in the Ain *département* and at Chinon in the Indre-et-Loire département. These facilities were respectively authorised by decrees of 2 March 1978 amended, and 15 June 1978 amended. EDF uses them to store nuclear fuel assemblies (only those made of naturally occurring uranium oxide) pending loading into the reactor. Having reconsidered the organisation of its supply chain, EDF finally renounced on definitively shutting down the Chinon warehouse, and since April 2011 it is once again being used to store fresh fuel assemblies. ASN has asked the licensee to rapidly envisage the periodic safety review of these two facilities. These safety reviews will lead ASN to examine the conditions under which operation of these facilities can continue, considering the safety requirements currently applicable to BNIs, particularly those relative to containment. The complementary safety assessments must be carried out in 2012.

4 INTERNATIONAL ACTION

In 2010, as part of the exchanges within WENRA (Western European Nuclear Regulators' Association), ASN had transmitted questionnaires to the nuclear safety authorities concerned to gather information on the research reactors (type of reactor, date of commissioning, main operating problems, accidents studied in the safety analysis for the design of the facility, periodic safety review, production of radionuclides if applicable, etc.). After analysing the responses to these questionnaires, ASN organised a meeting in Paris on 2 March 2011. This meeting provided the opportunity firstly to present the specific way in which each nuclear authority regulates and monitors research reactors, and secondly to run through the main conclusions resulting from analysis of the questionnaires, particularly in view of the future meetings targeting some of these conclusions. With regard to this latter point, the future lines of work could thus focus on the following subjects:

– possible harmonisation of the safety documents required for these facilities;
– the licensing procedures for new facilities;
– the use of the "postulated initiating events" analysis method;
– the definition of the design-basis accidents and the beyond design-basis accidents;
– the external hazard risks to be considered in the safety analysis;
– plant aging;
– decommissioning.

The sharing of operating experience feedback from the research reactors could be organised in this context, notably by means of "cross" inspections.

These exchanges dedicated to research reactors have been presented on several occasions at the more general meetings of WENRA.

5 OUTLOOK

The research and other installations regulated by ASN differ widely, but are usually small in size. ASN will continue to concentrate on regulating the safety and radiation protection of these installations as a whole and on comparing practices per type of installation in order to choose the best ones and thus encourage operating experience feedback.

It is in this spirit that ASN as defined priorities for the submittal of the complementary safety assessments concerning the nuclear facilities other than the power reactors. A prior analysis was conducted to assess the risks in the light of the experience feedback from the Fukushima Daiichi accident and the "potential source term". In effect, given the diversity of the nuclear fleet, each facility must be studied individually.

In 2012, over and beyond the follow-ups that will be given to the complementary safety assessments received in 2011, ASN will examine those for:
- 9 other CEA facilities (PÉGASE, CABRI, RAPSODIE, MCMF, LECA, Cadarache storage yard, CHICADE, ORPHÉE, ATALANTE);
- support functions on the Cadarache and Marcoule sites;
- the inter-regional fuel warehouses;
- ITER;
- CIS bio international installation.

Moreover, ASN considers that the "major commitments" initiative implemented by the CEA over the last 4 years must be continued and regularly expanded to include new "major commitments". This system effectively allows targeted tracking of priority actions, which have a clearly set deadlines. Any extension to the deadline must therefore firstly be duly justified, and secondly be discussed with ASN. Even though the system can still be improved, and some deadlines have now been pushed back significantly with respect to the initial due dates, the results are globally positive. ASN will nevertheless remain particularly vigilant and could, if necessary, take decisions of a prescriptive nature.

In 2012 ASN will continue to pay particular attention to new projects such as the JHR, the GANIL extension, the ITER facility, and the restarting of the CABRI installation. It will also be attentive to meeting deadlines for transfer of nuclear materials stored in the MCMF, the EOLE and MINERVE reactors, and MASURCA, to the new MAGENTA facility.

ASN will examine the conclusions of the periodic safety review of the GANIL facility and of the CIS Bio International installation in order to decide on the acceptability of medium- to long-term continuation of their operation.

Moreover, in 2012, ASN will examine - via the examination of the ASTRID prototype project and work on fourth-generation "Generation IV" reactors (also see chapter 12) - the operating experience feedback from the fast neutron reactors (PHÉNIX, SUPERPHÉNIX and RAPSODIE, now shutdown), as well as the information requested from the CEA/EDF/AREVA consortium for comparison, in terms of safety, of the different systems. This will be part of the preparatory work to enable ASN to adopt a position at the end of 2012 on the interim report relative to the possibilities of transferring the long-lived waste, provided for by the "Waste act" of 28 June 2006.

Finally, in 2012 ASN will continue to promote international harmonisation on the safety of research reactors. It will also continue to be an active contributor to international reflection into the aging of installations and the safety of supply of radionuclides for medical use.