Activities regulated by ASN

Chapter 13

Nuclear fuel cycle installations

1

THE FUEL CYCLE AND THE FACILITIES IN OPERATION

1.1 The uranium conversion, processing and enrichment plants in operation at Tricastin
1.1.1 AREVA NC TUS facility and W plant
1.1.2 The EURODIF gaseous diffusion enrichment plant
1.1.3 The GEORGES BESSE II gas centrifuge enrichment plant
1.2 Nuclear fuel fabrication plants in Romans-sur-Isère and Marcoule
1.2.1 The FBFC and CERCA uranium-based fuel fabrication plants
1.2.2 The MÉLOX uranium and plutonium-based fuel fabrication plant
1.3 AREVA NC reprocessing plants at La Hague
1.3.1 Presentation of the plant
1.3.2 Plant modifications

2

INSTALLATIONS IN CLOSURE PHASE

2.1 Older AREVA NC La Hague installations
2.1.1 Recovery of legacy waste
2.1.2 Final shutdown of the UP2 400 plants, the STE2 facility and the ELAN IIB unit
2.2 COMHUREX uranium hexafluoride preparation plant

3

REGULATING THE NUCLEAR FUEL CYCLE FACILITIES

3.1 Regulating the main steps in the life of nuclear facilities
3.2 Regulating the licensee’s organisation and management structure at fuel cycle nuclear installations
3.2.1 Taking account of social, organisational and human factors
3.3 Ensuring consistency across the cycle

4

INTERNATIONAL ACTION

5

LEARNING THE LESSONS FROM EXPERIENCE FEEDBACK CONCERNING THE FUKUSHIMA DAIICHI ACCIDENT

6

OUTLOOK
Conventionally, the fuel cycle begins with extraction of the uranium ore and ends with the disposal of a range of radioactive wastes arising from the spent fuel. In France, the fuel cycle chiefly comprises the fabrication of the fuel and its subsequent reprocessing after it has been used in nuclear reactors.

The fuel cycle plants are those facilities performing conversion, uranium enrichment, design and fabrication of nuclear fuels for nuclear reactors, as well as the reprocessing of spent fuel. These facilities utilise nuclear material, transformed into fuel, based on uranium oxide or a mixture of uranium and plutonium oxides, the plutonium having been generated by burn-up of the enriched natural uranium fuel in power reactors.

The main fuel cycle facilities, namely – COMURHEX, AREVA NC Pierrelatte (TU5/W), EURODIF GB II, FBFC, MELOX, AREVA NC La Hague – are owned by AREVA Group. ASN regulates each of these industrial facilities on an individual basis, and also considers that steps must be taken for fuel cycle facilities as a whole, so that safety and radiation protection are implemented coherently and in such a way as to promote best practice. ASN monitors the overall consistency of the industrial choices made with regard to fuel management, from both the safety and the regulatory viewpoints.

1 THE FUEL CYCLE AND THE FACILITIES IN OPERATION

The uranium ore is extracted, then purified and concentrated into “yellow cake” on the mining sites. The solid yellow cake is then converted into uranium hexafluoride gas (UF6). This raw material which will subsequently be enriched is made at the COMURHEX plants in Malvès (Aude département) and Pierrelatte (Drôme département). The facilities in question – which are not regulated under the legislation for basic nuclear installations (BNIs) but under that for installations classified on environmental protection grounds (ICPEs) – use natural uranium, which contains around 0.7% uranium-235.

Most of the world’s NPPs use uranium which is slightly enriched in uranium-235. For example, the fleet of pressurised water reactors (PWR) require uranium enriched to between 3 and 5% with the 235 isotope. The gas centrifuge process used by the GEORGES BESSE II plant, which is currently in commissioning, has replaced the gaseous diffusion process, employed by the EURODIF plant until June 2012.

The process used in the FBFC plant at Romans-sur-Isère transforms the enriched UF6 into uranium oxide powder. The fuel pellets manufactured with this oxide are clad to make fuel rods, which are then combined to form fuel assemblies. These assemblies are then placed in the reactor core where they release power by the fission of uranium-235 nuclei.

After about three to five years, the spent fuel is removed from the reactor and cooled in a pool, firstly on the reactor site and then in the AREVA NC reprocessing plant at La Hague.

At this plant, the uranium and plutonium from the spent fuels are separated from the fission products and other actinides. The uranium and plutonium are packaged and then stored for subsequent re-use. The radioactive waste produced by these operations is disposed of in a surface repository if it is low-level waste, otherwise it is placed in storage pending a final disposal solution.

The plutonium resulting from reprocessing is used either to manufacture fuel for fast neutron reactors (as was done in the ATPu facility in Cadarache), or to manufacture MOX fuel (a mixture of uranium and plutonium oxides) in the MELOX plant in Marcoule, used in some of the French 900 MWe PWR reactors.

The main material flows are presented in table 1.

The existence of nuclear facilities which exist to support the operation of the BNIs mentioned above must also be noted, such as SOCATRI which provides the maintenance and decommissioning of nuclear equipment, and the processing of nuclear and industrial effluent from the AREVA Group companies in Tricastin, or SOMANU in Maubeuge, which provides off-site servicing and repairs for certain nuclear components.

1 | 1 The uranium conversion, processing and enrichment plants in operation at Tricastin

To produce fuels that can be used in the reactors, the uranium ore must undergo a number of chemical transformations, from the preparation of the “yellow cake” through to conversion into uranium hexafluoride (UF6), the form required for enrichment. These operations take place primarily on the Tricastin site, in the Drôme and Vaucluse départements, also known as the Pierrelatte site.

All the BNIs on the site underwent a stress test in 2011 following the ASN resolution of 5th May 2011 and additional instructions contained in ASN resolutions of 26th June 2012, the contents of which are described in section 5. In June 2012, the site also underwent an in-depth inspection on the subject of safety culture and the stringency of operations. About ten ASN inspectors, accompanied by five engineers from the Institute of Radiation Protection and Nuclear Safety (IRSN), took part in this one-week inspection, which revealed differences between the practices observed and the operating requirements applicable to BNI licensees, as well as weaknesses in the safety measures adopted by the Tricastin management.

1 Administrative region headed by a Prefect.
The fuel cycle

Depleted uranium → Extraction of ore → Concentration → Conversion → Enrichment → Enriched uranium → Fuel manufacture → Electricity generating reactors → Spent UO₂ fuel

Spent MOX fuels → Reprocessing plant → Recycled uranium → Waste

Manufacturing rejects → Depleted uranium → Manufacturing rejects

Depleted uranium → Interim storage

Fuel manufacture → UO₂ Combustible → Spent MOX fuels

Map showing the location of the fuel cycle facilities
### Table 1: fuel cycle industry movements in 2012

<table>
<thead>
<tr>
<th>Installation</th>
<th>Origins</th>
<th>Material processed</th>
<th>Tonnage (unless otherwise specified)</th>
<th>Product obtained</th>
<th>Tonnage (unless otherwise specified)</th>
<th>Destination</th>
<th>Tonnage (unless otherwise specified)</th>
</tr>
</thead>
<tbody>
<tr>
<td>COMURHEX Pierrelatte(1)</td>
<td>Marcoule INBS</td>
<td>Uranium nitrate</td>
<td>0 t</td>
<td>U$_2$O$_3$</td>
<td>0 t</td>
<td>Pierrelatte INBS</td>
<td>0 t</td>
</tr>
<tr>
<td>AREVA NC Pierrelatte</td>
<td>AREVA NC La Hague</td>
<td>Uranium nitrate based on reprocessed uranium</td>
<td>4,624 t</td>
<td>U$_2$O$_3$</td>
<td>1,385 t</td>
<td>Storage</td>
<td>1,385 t</td>
</tr>
<tr>
<td>AREVA NC Pierrelatte</td>
<td>AREVA NC La Hague</td>
<td>Depleted UF$_6$</td>
<td>11,688 t</td>
<td>U$_2$O$_3$</td>
<td>9,353 t</td>
<td>Storage</td>
<td>9,353 t</td>
</tr>
<tr>
<td>EURODIF Pierrelatte(2)</td>
<td>W facility</td>
<td>of natural origin</td>
<td>8,909 t</td>
<td>U$_2$O$_3$</td>
<td>7,090 t</td>
<td>Storage</td>
<td>7,090 t</td>
</tr>
<tr>
<td>EURODIF Pierrelatte(2)</td>
<td>Converters</td>
<td>UF$_6$ (derived from natural and depleted uranium)</td>
<td>3,056 t</td>
<td>U$_2$O$_3$</td>
<td>3,356 t</td>
<td>Defluorination and re-enrichment of tailings</td>
<td>7,178 t</td>
</tr>
<tr>
<td>GB II</td>
<td>Converters and EURODIF Production</td>
<td>UF$_6$ (natural)</td>
<td>3,074 t</td>
<td>U$_2$O$_3$</td>
<td>2,322 t</td>
<td>Defluorination</td>
<td>2,322 t</td>
</tr>
<tr>
<td>FBFC Romans</td>
<td>EURODIF, TEIX, URENCO</td>
<td>UF$_6$ (based on enriched uranium)</td>
<td>599.265 HM$^3$</td>
<td>UO$_2$ (powder)</td>
<td>5,973 HM</td>
<td>AREVA NC (France)</td>
<td>5,973 HM</td>
</tr>
<tr>
<td>AREVA NC</td>
<td>EURODIF, TEIX, URENCO</td>
<td>Fuel elements based on UNE</td>
<td>507.16 HM</td>
<td>EDF</td>
<td>77.249 HM</td>
<td>ELECTRABEL (Belgium)</td>
<td>77.249 HM</td>
</tr>
<tr>
<td>AREVA NC</td>
<td>UF$_6$ (based on enriched uranium)</td>
<td>25.571 HM</td>
<td>Fuel elements based on URE</td>
<td>44.227 HM</td>
<td>EDF</td>
<td>44.227 HM</td>
<td></td>
</tr>
<tr>
<td>MÉLOX Marcoule</td>
<td>AREVA NC Pierrelatte</td>
<td>UO$_2$ (based on depleted uranium)</td>
<td>136.1 HM</td>
<td>Fuel elements MOX(4)</td>
<td>150 HM</td>
<td>CNPE EDF</td>
<td>94.6 HM</td>
</tr>
<tr>
<td>AREVA NC La Hague</td>
<td>AREVA NC La Hague</td>
<td>PuO$_2$</td>
<td>12.5 HM</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AREVA NC La Hague</td>
<td>EDF reactors</td>
<td>Reprocessed spent fuel elements (U+Pu)_a on UP3-A</td>
<td>468.32 t</td>
<td>Vitreified waste</td>
<td>642 CSD-V</td>
<td>74 CSD-B</td>
<td>La Hague storage</td>
</tr>
<tr>
<td>BR2-MOL, ANSTO</td>
<td>Reprocessed spent fuel elements (U+Pu)_a on UP3-A</td>
<td>0.04 t</td>
<td>PuO$_2$</td>
<td>13.79 t</td>
<td>AREVA NC</td>
<td>13.90 t</td>
<td></td>
</tr>
<tr>
<td>EDF, BORSSELE reactors</td>
<td>Reprocessed spent fuel elements UOX/MOX (U+Pu)_a on UP2-800</td>
<td>555.35 t</td>
<td>Compacted waste</td>
<td>885 CSD-C</td>
<td>La Hague storage</td>
<td>635 CSD-C</td>
<td></td>
</tr>
<tr>
<td>EDF, TRINO, BORSSELE reactors</td>
<td>Spent fuel elements UOX/MOX (U+Pu)_a</td>
<td>1,129.67 t</td>
<td></td>
<td></td>
<td>La Hague pools</td>
<td>1,129.67 t</td>
<td></td>
</tr>
<tr>
<td>PHENIX</td>
<td>Reprocessed spent fuel elements RRN (U+Pu)_a</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CELESTINS, OSIRIS, ORPHEE and ILL</td>
<td>Reprocessed spent fuel elements RTR (U+Pu)_a</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(1) The facilities have been shut down since 2008. They did not receive, ship or convert any material in 2012.
(2) The facilities were shut down in May 2012 and have processed no material since that time.
(3) HM: ton equivalent heavy metal.
(4) The fuel elements are calculated according to the following bases:
- products manufactured in the plant and leaving as assemblies (HM in assemblies verified as conforming);
- products manufactured in the plant and leaving as rods (HM in rods verified as conforming).
In November 2011, AREVA NC sent ASN a creation authorisation application for a new BNI on the Tricastin site, called ATLAS. The purpose of this project is to bring together the activities currently performed by the industrial analysis laboratories specific to the various AREVA facilities on the Tricastin and Romans-sur-Isère sites. This application is currently being examined by the ASN services.

In 2012, AREVA NC also started the process to become the licensee in place of all its subsidiaries present on the Tricastin site, by submitting the dossier for the COMURHEX BNI as required by the provisions of Article 29 of decree 2007-1557 of 2nd November 2007.

Finally, the management of the Tricastin site submitted an authorisation application on 13th July 2012 for implementation of an internal authorisation process, similar to that already in place on AREVA’s La Hague site. This dossier is currently being examined.

111 AREVA NC TU5 facility and W plant

On the Pierrelatte site, AREVA NC operates:
- the TU5 facility (BNI) for conversion of uranyl nitrate (UO₂(NO₃)₂) produced by reprocessing spent fuel into uranium sesquioxide U₃O₈;
- the W plant (ICPE within the BNI perimeter) for conversion of depleted uranium hexafluoride (UF₆) into uranium sesquioxide (U₃O₈).

U₃O₈ is a stable solid compound, which makes storage of uranium safer than in liquid or gaseous form.

BNI 155, called TU5, has a capacity of up to 2,000 tonnes of uranium per year, enabling it to treat all the uranyl nitrate produced by the AREVA plant at La Hague, thus meeting one of the nuclear safety objectives. Once converted, the uranium from reprocessing is partly placed in storage on the AREVA NC Pierrelatte site and partly sent abroad for enrichment and re-use in the fuel cycle. In France, only the Cruas-Meysse NPP uses reprocessed uranium based fuel.

In 2012, the BNI 155 periodic safety review was initiated by submission of the orientation file. The submission of the periodic safety review report is scheduled for September 2014.

1111 The EURODIF gaseous diffusion enrichment plant

The isotope separation process used in the Georges Besse I (GB I) plant of EURODIF is based on gaseous diffusion. The plant comprises 1,400 cascaded enrichment modules, divided into 70 sets of 20 modules grouped in leak-tight rooms.

The principle of Gaseous diffusion enrichment operates by repeatedly diffusing the gaseous UF₆ through porous barriers. These barriers allow preferential passage to the uranium-235 isotope contained in the gas, thereby increasing the proportion of this fissile isotope in the UF₆ at each passage. The UF₆ is introduced in the middle of the cascade, with the enriched product drawn off at one end and the depleted residue at the other.

Industrial production at the plant ended on 7th June 2012 following an approval by ASN issued on 11th May 2012. The licensee is currently preparing its application for final shutdown and decommissioning of the facility. These operations should take about thirty years. They require planning (inventories, characteristics) to optimise treatment options, dismantling operations, transport and disposal routes, given the large quantities of materials to be recovered. For example, based on current estimates the diffusers represent 130,000 tonnes of steel.

In the first quarter of 2011, the licensee submitted an application for a modification to its facility corresponding to the PRISME operations (Project for intensive rinsing followed by EURODIF venting) which will consist in repeatedly rinsing the barriers with chlorine trifluoride (ClF₃) to recover virtually all the deposited uranium and enable the metal to be recycled in nuclear routes. This application gave rise to a public inquiry from 19th December 2011 to 20th January 2012. The PRISME operations require authorisation, which will be issued by modification of the creation decree. The application is currently being examined. These operations should begin in the first quarter of 2013.

To technically underpin its application for cascade rinsing and to optimise the operations as a whole, the licensee, with the agreement of ASN, conducted several air venting tests of various diffusion units in 2011 and 2012. The efficiency was improved.

On completion of the PRISME operations, the licensee will submit a final shutdown and decommissioning application (MAD-DEM) for the installation, a procedure that also entails a public inquiry.

A key point in 2012 was an ASN inspection, during which a deviation in the tension values of the diffuser columns supporting the tie-rods was detected. These deviations have the potential to compromise the seismic strength of the facilities. The licensee has proposed steps to restore the conformity of all the tie-rods in its facility and is committed to implementing them before proceeding with the PRISME operations.

112 The GEORGES BESSE II gas centrifuge enrichment plant

The GB II plant (BNI 168), operated by the Société d’enrichissement du Tricastin (SET), uses the gas centrifuge process to enrich uranium with the 235 isotope. The principle of this process involves injecting uranium hexafluoride (UF₆) into a cylindrical vessel rotating at very high speed. The centrifugal force
concentrates the heavier molecules (containing uranium-238) on the periphery, while the lighter ones (containing uranium-235) are recovered in the centre.

This process replaces the gaseous diffusion process which had been used at EURODIF until May 2012. It has two key advantages over the EURODIF process: it is safer and consumes far less electricity (75 MW as opposed to 3,000 MW for equivalent production). The quantities of nuclear material present in the centrifuge cascades are significantly reduced (3 t per unit in GB II instead of 3,000 t in EURODIF) and are in a low-pressure gas form.

The creation of the GEORGES BESSE II plant (GB II), which comprises two separate enrichment facilities (South and North) and a support facility (REC II), was authorised by a decree on 27th April 2007. The decree of 27th December 2011 modified this decree, authorising the use of uranium from reprocessing of spent fuel in the REC II support facility and adaptation of the perimeter of the installation.

In early 2009, ASN authorised commissioning of the South enrichment facility, subject to compliance with the requirements surrounding the centrifuge plant start-up and operating conditions. In March 2010, ASN supplemented this framework with a resolution whereby it prescribed a set of conditions, relative to the safety tests prior to the first introduction of UF₆ (active commissioning) into the plant. The South facility commissioning process continued in 2011 with industrial start-up of the first cascade of centrifuges. Owing to the modular design of the facility, the licensee then successively started up the various cascades in modules 1 to 4. At the end of 2012, just over half the cascades in the South facility were in production.

The North facility is built along the same lines as the South facility but differs in that it can enrich the uranium resulting from reprocessing of spent fuel in the first pair of modules. The application for commissioning of the North enrichment facility is currently being examined by ASN, which has asked IRSN for its opinion. A partial commissioning authorisation to undertake active tests on the non-destructive isotopic inspection system for the UF₆ cylinders was issued to SET following an ASN resolution dated 18th October 2012.

The SET applied for commissioning of the REC II support facility separately from that of the North facility. This dossier is currently being examined.

### 1/2 Nuclear fuel fabrication plants in Romans-sur-Isère and Marcoule

On completion of the uranium enrichment stage, the nuclear fuel is fabricated in various installations, depending on the type of reactor for which it is intended. The fabrication of fuels for electricity generating reactors involves the transformation of UF₆ into uranium oxide powder. In the FBFC plant, this powder is used to fabricate pellets which are then made into fuel rods, which in turn are grouped to form fuel assemblies. Some experimental reactors, use highly enriched uranium in metal form. These specialist fuels are manufactured by FBFC in the CERCA plant at Romans-sur-Isère.

The MELOX plant in Marcoule specialises in the fabrication of MOX (mixed oxide) fuels.

The FBFC and MELOX plants underwent stress tests in 2011 following the ASN resolution of 5th May 2011, while the stress tests on the CERCA plant, considered to be lower priority, were presented in a report submitted on 15th September 2012. This report will be examined by the Advisory Committees in 2013.

### 1/2/1 The FBFC and CERCA uranium-based fuel fabrication plants

CERCA and FBFC, the two BNIs located on the Romans-sur-Isère site, are operated by FBFC, a company in the AREVA group. As far as the regulations are concerned, FBFC is the sole nuclear licensee for the site.

**FBFC nuclear fuel fabrication facility**

The output from the FBFC plant, consisting of uranium oxide powder or fuel assemblies, is intended solely for light water reactors (PWRs or BWRs).

Operation of this plant is regulated by a decree authorising its creation, dating from 1978 and modified in 2006 to allow an increase in production capacity.

The renewal of the facility's industrial equipment, which began in 2005, is now completed.

As in the previous year, 2012 was marked by incidents which called into question the facility's criticality safety rules. In particular, cylinders of wet material, not identified as such, were discovered on 17th and 24th September 2012. The repeated failure to abide by the packaging and internal transfer rules for fissile materials within the plant, is indicative of a lack of safety culture and insufficient integration of experience feedback and led ASN to rate this event level 2 on the INES scale. The root causes of these events are the inadequacy, at various levels, of the steps taken to prevent the criticality safety risk within the facility. Corrective measures were immediately applied, but the analysis of these root causes is still to be carried out. ASN thus issued a resolution instructing FBFC, firstly, to conduct a detailed inventory of fissile material management and an analysis of the criticality risk associated with the management of fissile materials produced by the grinding machines in the pellet forming unit and, secondly, to implement appropriate technical control of management of the fissile materials produced by the grinding machines in the pellet forming facility, in accordance with Article 8 of the order of 10th August 1984.

The CERCA plant comprises a series of facilities for the manufacture of highly enriched uranium based fuel for experimental reactors.

This plant, one of France's oldest nuclear installations, was put into service before the BNI regulations were introduced. The
Government was therefore simply notified of this installation in 1967.

In order to improve the regulatory control of the activities performed in the facility, ASN began work to draft the requirements provided for by Act 2006-686 of 13th June 2006 (now codified in the Environment Code). This process should lead to an ASN resolution being issued during the course of 2013.

The MÉLOX uranium and plutonium-based fuel fabrication plant

The MÉLOX plant located in Marcoule is currently the only industrial installation in the world producing MOX fuel, which consists of a mixture of uranium and plutonium oxides. It has been operated by the MÉLOX SA company since 2010.

In a decree of 20th March 2007, MÉLOX was authorised to raise the annual production level of its Marcoule plant to 195 tons of heavy metal. Since then, production has always been well below this regulatory limit. Nonetheless, ASN remains particularly attentive to ensuring that the organisation is compatible with the level of production and with the radiation protection optimisation measures taken.

In October 2010, the licensee submitted an application to modify the perimeter of its facility, in order to include new emergency electricity generator sets. After consultation with the Ministers and considering the remarks of the applicant, ASN returned a favourable opinion on the draft decree modifying the perimeter of BNI 151. The decree appeared in the Official Gazette on 15th April 2012.

The facility’s periodic safety review file was sent to ASN on 21st September 2011. ASN tasked IRSN with the technical examination of this document. The Advisory Committee for laboratories and plants (GPU) will meet in 2013 to issue an opinion on the MÉLOX periodic safety review file. The key issues of this review are to control worker exposure to ionising radiation and to adapt the facility and its organisation to changes in the composition of the MOX, as the plutonium content has been increased and further increases are foreseeable.

Further to several events related to insufficient management of the criticality risk, ASN tightened up the inspections on this subject. In 2012, ASN noted an improvement in the situation but nonetheless remained particularly vigilant on this point.

With regard to the repeated containment failure events which have occurred in the facility over the past 4 to 5 years, ASN noted that steps to improve the quality of static containment had been taken. This action plan will be assessed on the basis of the results obtained in 2013.

In 2012, MÉLOX also submitted an authorisation application to implement the internal authorisation process. The dossier is currently being examined by ASN.
AREVA NC reprocessing plants at La Hague

Presentation of the plant

The La Hague plant for reprocessing spent fuels from the power reactors is operated by AREVA NC.

The various facilities of the UP3-A and UP2 800 plants and of the effluent treatment station STE3 were put into service from 1986 (reception and storage of spent fuel) to 1994 (vitrification facility), with most of the process facilities entering service in 1989-1990.

The decrees of 10th January 2003 set the individual capacity of each of the two plants at 1,000 tons per year of metal before passage in the reactor (U or Pu), and limit the total capacity of the two plants to 1,700 tons per year.

The limits and conditions for discharge and for water intake were revised by the order of 8th January 2007.

The reprocessing of irradiated fuels in plant UP2 400 has been stopped since 1st January 2004 (see point 2).

The facilities of the AREVA NC La Hague site are amongst the installations examined in 2011 as part of the experience feedback from the Japanese nuclear accident at Fukushima Daiichi in March 2011 (see point 5).

Operations carried out in the plant

The main processing chain in these facilities comprises reception and storage installations for spent fuel, facilities for shearing and dissolving, chemical separation of fission products, uranium and plutonium, purification of the uranium and plutonium, treatment of effluents and conditioning of waste.

The first operations to take place in the plant are reception of the transport containers and storage of the spent fuel. Upon arrival at the reprocessing plant, the containers are unloaded, either underwater in a pool, or dry in a leak-tight shielded cell. The fuel is then stored in the pools.

After shearing the rods, the spent fuel is separated from its metal cladding by dissolution in nitric acid. The pieces of cladding, which are insoluble in nitric acid, are removed from the dissolver, rinsed in acid and then water, and transferred to a packaging unit.

The solution separation phase consists in separating the uranium and plutonium from the fission products and other transuranic elements, then separating the uranium from the plutonium.

After purification, the uranium, in the form of uranyl nitrate $\text{UO}_2(\text{NO}_3)_2$, is concentrated and stored. It is intended for conversion into a solid compound ($\text{U}_3\text{O}_8$) in the Pierrelatte TU5 installation.

After purification and concentration, the plutonium is precipitated by oxalic acid, dried, calcined into plutonium oxide, packaged in sealed containers and placed in storage. The plutonium can be used in the manufacturing of MOX fuel.

The production operations, from shearing through to the finished products, use chemical processes and generate gaseous and liquid effluents. These operations also generate the so-called “structure” waste.

The gaseous effluents are given off mainly during cladding shearing and during the boiling dissolving operation. These discharges are processed by scrubbing in a gas treatment unit. Residual radioactive gases, in particular krypton and tritium, are checked before being released into the atmosphere.

The liquid effluents are processed and generally recycled. Certain radionuclides, such as those of iodine and tritium, are checked and then directed to the off-shore marine discharge pipe. The others are sent to facilities for encapsulation in a solid matrix (glass or bitumen).

Solid waste is packaged on the site. Two methods are used: compacting and encapsulation in cement.

The solid radioactive waste from the reprocessing of spent fuel from French reactors is, depending on its composition, either sent to the low- and intermediate-level, short-lived waste repository at Soulaines (see chapter 16) or stored pending a final disposal solution.

In accordance with Article L. 542-2 of the Environment Code concerning radioactive waste management, radioactive waste from the reprocessing of spent fuels of foreign origin must be shipped back to its owners. In order to guarantee fair distribution of the waste among its various customers, the licensee proposed an accounting system for monitoring items entering and leaving the La Hague plant. This system was approved by order of the minister responsible for energy on 2nd October 2008. In 2012 the licensee therefore returned standard compacted waste containers (CSD-C) to Switzerland and Belgium and standard containers of vitrified waste to the Netherlands.

Plant modifications

The authorised operating framework of the plants

The creation authorisation decrees of 12th May 1981 for the nuclear installations on the La Hague site were revised in 2003, particularly to allow changes in installation activities to be made under satisfactory conditions of safety and environmental protection.
The installations at La Hague

- **BNI 80**: High activity fuel
  HAO/North: Facility for underwater unloading and spent fuel storage
  HAO/South: Facility for shearing and dissolving of spent fuel elements

- **BNI 33**: UP2 400 plant, the first reprocessing facility
  HA/DE: Facility for separation of uranium and plutonium from fission products
  HAPF/SPF (1 to 3): Facility for fission product concentration and storage
  MAU: Facility for uranium and plutonium separation, uranium purification and storage in the form of uranyl nitrate
  MAPu: Facility for purification, conversion to oxide and initial packaging of plutonium oxide
  LCC: Central product quality control laboratory
  ACR: Resins packaging facility

- **BNI 38**: STE2 facility: collection, treatment of effluents and storage of precipitation sludge, and ATI facility, prototype installation currently being decommissioned

- **BNI 47**: ELAN II B facility, CEA research installation currently being decommissioned

- **BNI 116**: UP3 plant
  T0: Facility for dry unloading of spent fuel elements
  D and E pools: Pools for storage of spent fuel elements
  T1: Facility for shearing of fuel elements, dissolving and clarification of solutions obtained
  T2: Facility for separation of uranium, plutonium and fission products, and concentration/storage of fission products solutions
  T3/T5: Facilities for purification and storage of uranyl nitrate
  T4: Facility for purification, conversion to oxide and packaging of plutonium
  T7: Facility for nitrification of fission products
  BSI: Facility for plutonium oxide storage
  BC: Plant control room, reagent distribution facility and process control laboratories
  ACC: Hull and end-piece compaction facilities
  AD2: Technological waste packaging facility
  ADT: Waste transit area
  EDS: Solid waste storage area
  D/E EDS: Storage/removal from storage of solid waste
  ECC: Storage and recovery facilities for technological waste and conditioned structures
  E/EV South-East: Vitrified residues storage facility (EEVLH extension)

- **BNI 117**: UP2 800 plant
  NPH: Facility for underwater unloading and storage of spent fuel elements in pool
  C pool: Pool for storage of spent fuel elements
  RI: Fuel elements shearing, dissolving and resulting solutions clarification facility (including the URP: plutonium re-dissolution facility)
  R2: Uranium, plutonium and fission product separation, and fission product solution concentration facility (including the UCD: alpha waste centralised processing unit)
  R4: Facility for purification, conversion to oxide and first packaging of plutonium oxide
  SPF (4, 5, 6): Facilities for storage of fission products
  BSTI: Facility for secondary packaging and storage of plutonium oxide
  R7: Facility for fission product vitrification
  AML – AMEC: Packaging reception and maintenance facilities

- **BNI 118**: STE3 facility: effluent recovery and treatment and storage of bituminised packages
  D/E EB: Storage of alpha waste
  MDS/b: Mineralisation of solvent waste
The cold crucible project

Between 1966 and 1985, the reprocessing of UNGG (Uranium Natural Graphite Gas) GCR (Gas Cooled Reactor) fuels of type UMo (alloy of uranium and molybdenum) and UMoSnAl (alloy of uranium, molybdenum, tin and aluminium) generated fission product concentrates with a high concentration of molybdenum and phosphorus, elements which are hard to incorporate into the aluminoborosilicate vitreous matrix usually employed in the plant’s vitrification facility. The concentrates were stored in tanks in the SPF2 unit, pending possible incorporation into a glass matrix. AREVA NC research into a packaging process led to the development of a vitroceramic type aluminosilicophosphate matrix which would be able to incorporate a large mass of molybdenum oxide (MoO$_3$) while offering good resistance to leaching. This glass is produced in a cold crucible. The glass poured into this crucible is induction heated, with the metal structure of the crucible being externally cooled, allowing the formation of a protective autocrucible with high temperatures being obtained at its centre.

By resolution of 22nd December 2009 and subject to compliance with its prescriptions, ASN authorised use of the cold crucible vitrification process on line B of the R7 unit. The line configured accordingly was put into operation on 17th June 2010. In its resolution of 14th June 2011, ASN authorised active commissioning, by supplying the cold crucible with fission product solutions containing molybdenum from legacy waste (see point 2 | 1 | 1).

Periodic safety reviews

Article L. 593-18 of the Environment Code stipulates that the licensee must perform a periodic safety review of its BNI every ten years, taking account of international best practice.

In 2008, ASN examined the conclusions of the periodic safety review for BNI 118, which includes the effluent treatment station (STE3), the solvent mineralisation facility (MDS-B) and the sea discharge outfall pipe. ASN is paying particularly close attention to the schedule for the licensee’s implementation of the commitments it undertook during this periodic safety review. ASN observes that, on the whole, the licensee has fallen behind in its initial undertakings regarding both the response times and their implementation, particularly in performing the installation conformity reviews and the treatment of legacy wastes.

In 2010, the licensee completed the periodic safety review of BNI 116 (UP3-A plant) and started that of BNI 117 (UP2 800 plant).

ASN has asked its technical support organisation, IRSN, to examine the relevance and quality of the licensee’s periodic safety review of the UP3-A plant. The result of IRSN’s appraisal will be presented to the Advisory Committee for laboratories and plants at five meetings scheduled from mid-2012 to 2014. The Advisory Committee’s first meeting took place on 27th June 2012. It examined the method and the data used by AREVA NC for the performance of this review, as well as the approach used to identify the important protection items (EIP) and how it was applied to BNI 116. On this basis, the next meetings of the Advisory Committee for laboratories and plants will focus on determining the current level of safety and that for the coming ten years in the UP3-A plant, by examining the following in turn:

- operating experience feedback, especially with regard to the incidents which have occurred;
- examination of the conformity of the EIP in the UP3-A plant’s facilities with the defined safety requirements, in particular with regard to any changes they may have undergone and to ageing,
- the safety of the internal transport packaging;
- the safety reassessment conducted by the licensee, in particular in the light of changing regulations and best practices in the field of safety and radiation protection, as well as the lessons learned from operating experience feedback from the facility;
- the programme of measures defined by the licensee to improve the safety of its facility.

The conclusions of the review will be presented in an ASN report to the ministers responsible for nuclear safety.

System of internal authorisations for minor modifications

The licensee requested the setting up of an internal authorisations system in 2008, as provided for by Article 27 of decree 2007-1557 of 2nd November 2007. ASN approved this system in its resolution of 14th December 2010, which is applicable as of 1st January 2011. This system provides for two internal authorisation levels, depending on the extent of the operations and the associated radiation protection and safety implications. Before a planned operation or modification is authorised, it is assessed – depending on its assigned level – by either a safety specialist independent of the requesting operating unit, or, for the most significant operations, an internal authorisations assessment committee (CEDIAI). ASN has verified the operation of this system during specially targeted inspections and examines the forward-looking programme of operations that are authorised by this system annually. The 2012 examination of this process revealed that the implementation of the internal authorisations system had progressed over that observed in 2011 but that it could nonetheless be further improved.

Construction of an extension to a vitrified waste package storage facility

In the light of the production programmes for standard containers of vitrified waste (CSD-V) and the end of the returns of CSD-V to AREVA NC’s foreign customers (contracts signed before 2001), the storage capacity for CSD-V on the La Hague site (R7, T7 and EEVSE) should reach saturation in the first half of 2013.

AREVA NC therefore decided to build an extension to the EEVSE storage facility called the “glass storage building extension on the La Hague site” (EEVLH), comprising two pits – pits 30 and 40 - in order to increase the storage capacity of the existing facility. The extension reuses the main design options of the EEVSE facility.

Further to ASN’s resolution of 15th June 2010, AREVA NC sent ASN the safety report for the construction and commissioning of this storage facility. The file is currently being reviewed and will give rise to prescriptions from ASN. In this context, in a resolution dated 16th June 2011, ASN required the installation of thermocouples for monitoring the temperature of each well of the envisaged storage extension. The construction of the EEVLH facility is under way and commissioning of pit 30 is scheduled for some time in 2013.
AREVA NC also envisions fitting out pit 40 of the EEVLH and building a facility equivalent to the EEVLH, called “EEVLH 2”, comprising two new pits 50 and 60.

The new facilities planned

reprocesses non-irradiated plutonium-bearing materials existing as fuel assemblies, pellets or powder. As the reprocessing capacities of the units in service may not be compatible with the needs of the coming years, AREVA NC envisages putting into service a “plutonium-bearing material reprocessing” unit (TMP) in the T4 facility. The licensee submitted the corresponding safety options file to ASN in 2009, the examination of which was completed in 2010.

In late 2010, AREVA also submitted the safety file for the development project to enable the R4 facility to perform oxalic “co-conversion” of uranium and plutonium. This new process aims to directly produce a mixed uranium and plutonium oxide powder for use in the fabrication of MOX fuel. ASN resolution 2012-DC-0262 of 21st February 2012, requires prior ASN approval for certain operations relative to the implementation of a uranium and plutonium “co-conversion” process in the R4 facility of the UP2 800 plant (BNI 117) on the AREVA NC site in La Hague. The civil engineering modification works in the R4 facility began in 2011 and are still in progress. Commissioning of this new facility is scheduled for late 2015.

On 4th May 2012, AREVA NC submitted a modification authorisation application for BNI 118 to the Ministers responsible for nuclear safety. The purpose of this modification application is to allow processing and packaging of the sludges stored in the STE2 facility, by means of a new process to be utilised within an existing building of the STE3 facility, in place of one of the two bituminisation lines (line A). This process will consist of the following:

- drying of the STE2 treatment sludges;
- compacting of the powder resulting from drying, in the form of pellets;
- packaging of the pellets in a package filled with an inert material (C5 package);
- storage of the C5 packages, pending opening of a long-term management solution.

This dossier is currently being examined by ASN.

Finally, in July 2012, AREVA NC submitted a project to ASN for the complete renovation of the fleet of boilers that produce the energy necessary for operation of the La Hague plants. AREVA NC plans to replace them with one wood biomass boiler and two new oil-burning boilers. These installations are subject to licensing as individual ICPEs, and to notification as equipment items necessary for the operation of a BNI, respectively. AREVA effectively indicated in its file that the oil-burning boilers were sufficient to provide the energy necessary for safe operation of the plants, and that in the event of failure of the biomass boiler, the oil-burning boilers would immediately take over. This project, which requires an extension of the perimeter of BNI 117, is currently awaiting validation of the local urban planning scheme (PLU) for the communes around the La Hague site.
2 INSTALLATIONS IN CLOSURE PHASE

2.1 Older AREVA NC La Hague installations

The older plants of the AREVA NC La Hague site are among the installations examined in 2011 as part of the experience feedback from the Japanese nuclear accident of Fukushima Daiichi in March 2011 (see point 5).

2.1.1 Recovery of legacy waste

This point is also covered in chapter 16.

Unlike the on-line packaging of the waste generated by the new UP2 800 and UP3-A plants at Hague, most of the waste generated by the first UP2 400 was stored without any permanent packaging. The operations involved in recovering this waste are technically difficult and require the use of considerable resources. The difficulties associated with the age of the waste, in particular the need for characterisation prior to any recovery and conditioning, confirm ASN’s approach which, for any project, requires the licensees to assess the corresponding production of waste and plan for processing and packaging as and when the waste is produced. The recovery of the waste contained in the old storage facilities on the La Hague site is also a precondition for the decommissioning and clean-out of these storage facilities.

The recovery of legacy wastes from the La Hague site is thus monitored particularly closely by ASN, mainly because of the major safety and radiation protection implications associated with it. Furthermore, recovery of the site’s legacy waste is one of the AREVA group’s major commitments, made within the framework of the ministerial authorisations to start up new spent fuel reprocessing plants (UP3-A and UP2 800) in the 1990s.

The initial schedule for recovery of this waste has slipped. In spite of this, ASN considers that the deadlines must no longer be pushed back, because the buildings in which this legacy waste is stored are ageing and no longer comply with current safety standards. ASN specifically considers that AREVA NC must, as soon as possible, undertake recovery of the legacy waste generated by the operation of the UP2 400 plant, in particular, the sludges stored in the STE2 silos, the waste in the HAO silo and the waste in the building 130 silo, along with the drums of primarily alpha waste stored in building 119 in BNI 38, the level of safety of which is inadequate with respect to the current safety requirements.

Lastly, a final decision must be reached concerning the solutions for elimination routes or new intermediate storage facilities, because their implementation involves large-scale projects: further postponement would jeopardise compliance with the deadlines set by the “WASTE” Act of 28th June 2006, which states that the owners of intermediate level long-lived waste produced before 2015 must package it by 2030 at the latest.

AREVA NC was thus called before the ASN Commission on 7th June 2012 concerning the waste recovery and packaging programme (RCD). During this hearing, ASN asked AREVA NC to look at compensatory measures on the old silos (geotechnical barrier, temporary safe storage facilities pending the development of disposable packages) given the final RCD deadline set for 2030. ASN also concluded that AREVA NC would be called before the ASN Commission on an annual basis and would regularly keep the local information committee (CLI) informed of progress on this subject. Finally, ASN envisages issuing a resolution to control these RCD operations.

STE2 sludge

In recent years, processing of STE2 sludge has been the subject of research and development work, in particular with a view to determining the methods for recovery and transfer required prior to any packaging. The process initially chosen consisted in bituminisation of the sludge using a process employed in the STE3 facility.

Following on from experiments and the GPU’s review in December 2007 of the proposed packaging process, ASN issued a resolution on 2nd September 2008, prohibiting the bituminisation of STE2 sludges in the STE3 facility.

Pursuant to this decision, the licensee submitted a preliminary safety analysis report on 1st January 2010 corresponding to the modifications necessary for implementation of a new STE2 sludge packaging process, along with the characteristics of the corresponding waste package, called the C5 package. In June 2011, ASN gave its agreement on the dismantling of the unused bituminisation line so that the new process could subsequently be installed in its place. In 2012, AREVA NC also submitted to the Ministers responsible for nuclear safety an application for modification of the BNI 118 creation authorisation decree so that it could install the new envisaged STE sludge packaging process (see point 1|3|2). Pursuant to the provisions of the “Waste” Act of 28th June 2006, recovery of these sludges must be completed no later than 31st December 2030.

HAO silo

The HAO silo contains various wastes comprising hulls, end-pieces, fine dust coming mainly from the shearing, resins and technological waste resulting from operation of the HAO facility from 1976 to 1997. Recovery of the waste from this silo requires prior dismantling of the equipment installed on the silo slab, construction of the recovery cell and qualification of the equipment to be used. The initial dismantling work has already been done.

The preliminary decommissioning studies for the HAO silo were examined by ASN in 2007. In 2010, the licensee optimised its initial scenario: waste recovery from the optimised hull storage (SOC) should be carried out at the same time as waste recovery from the HAO silo. The hulls and end-pieces from the HAO silo will be packaged and compacted in the hulls and end-pieces compacting facility (ACC) and then stored in the compacted end-pieces storage facility (ECC). The fines and resins will be encapsulated in cement directly in the recovery cell to be built and then stored in the D/E EDS facility.

On 13th March 2012, ASN authorised AREVA NC to proceed with the preparations for the RCD operations in the HAO silo.
and the SOC. These operations specifically concern dismantling of the equipment installed on the silo slab.

The files required for approval of the packages for the fines and resins and the hulls and end-pieces, will be transmitted by AREVA NC at the end of 2013.

ASN remains attentive to the effective implementation times of the waste recovery and packaging operations which must be completed by 31st December 2022 at the latest, in accordance with the provision of decree 2009-961 concerning the final shutdown and decommissioning of the HAO facility.

SILO 130

Further to the licensee’s postponement of waste recovery from SILO 130 because of its outdated design and uncertainties as to the resistance of its civil engineering structure over time, ASN issued requirements on 29th June 2010 imposing compensatory safety measures on the licensee, to be implemented before mid-2012, along with the submittal of a file detailing the preparation and waste recovery operations.

This file was sent to ASN in December 2010 and is currently being examined. ASN has set 1st July 2016 as the deadline for starting the recovery and packaging operations for all the wastes, and the end of 2014 as the deadline for submitting the approval application file for the package for packaging waste containing graphite. The compensatory safety measures, notably the means of surveillance, were implemented in 2012 in accordance with the above-mentioned resolution.

Legacy fission product solutions stored in the SPF2 unit in the UP2 400 plant

To package fission products from reprocessing of GCR (gas-cooled reactor) fuel, in particular containing molybdenum, the licensee has opted for cold crucible vitrification (see point 1 | 3 | 2).

The cold crucible vitrification of these solutions was authorised by an ASN resolution of 20th June 2011. The production of the vitrified packages for packaging of intermediate-level effluents (CSD-B) via the cold crucible vitrification line, was unavailable in 2011 and early 2012 (loss of electrical power supply). Furthermore, technical problems with operation of the cold crucible during production of the vitrified packages containing fission product solutions with molybdenum (CSD-U) led to significant delays.

Removal from storage in Building 119 of BNI 38

The licensee has implemented an overall strategy for priority treatment of the drums of alpha waste that are still stored in building 119, a building that does not meet current safety requirements.

These drums are reconditioned before being transferred for treatment in the alpha waste conditioning unit (UCD) of the R2 facility. This treatment consists in mechanical sorting of the alpha waste to identify the waste fraction for which chemical leaching - another step in the treatment - is appropriate for recovery of the plutonium.

The rate of chemical treatment of the alpha drums has dropped considerably since 2009, due to an incident that affected the facility, and to operating difficulties. This being said, the transfers from building 119 to the alpha waste conditioning unit (UCD) of the R2 facility continued with the aim of treating and removing all the stored waste from building 119 by the end of 2015, in accordance with the commitment made by AREVA.

In October 2012, ASN authorised the recovery and packaging of the drums of alpha waste from the AT1 facility currently stored in building 119. These operations will begin in 2013.

Other legacy waste recovery and packaging projects

In 2012, very low level scrap was being recovered from the area adjoining the North-West zone of BNI 38. The resins from settling tank No 4 in the Cladding removal facility of BNI 33 are being recovered and packaged in the resins packaging facility (ACR).

2 | 1 | 2 Final shutdown of the UP2 400 plants, the STE2 facility and the ELAN IIB unit

On 1st January 1967, the UP2 400 plant for reprocessing the spent fuels from the GCRs entered into industrial operation jointly with effluent treatment station STE2 for treating the liquid effluents before their discharge into the sea. In 1974, UP2 400 was licensed to reprocess fuels from the light water reactors.

The Elan IIB facility dedicated to the fabrication of caesium-137 and strontium-90 sources between 1970 and 1973 has been shut down since 1973.

On 30th December 2003, the licensee notified its decision to stop reprocessing spent fuel in the UP2 400 facility as of 1st January 2004. This notification was accompanied by a file presenting the operations planned in the preparation for final
shutdown (MAD) phase for the various units in this plant, and the associated effluent treatment station.

The final shutdown and decommissioning decree No. 2009-961 for the HAO facility (high activity oxide: the former facility for fuel reception, shearing and dissolution of the UP2 400 plant), which corresponds to BNI 80, was published on 31st July 2009 (see chapter 15). The north section of the HAO facility will nevertheless, until 2015, continue to receive the fuels that cannot be received in the head workshops of the UP3 and UP2 800 plants.

2 I 2 COMURHEX uranium hexafluoride preparation plant

COMURHEX, a wholly-owned subsidiary of the AREVA Group, has been established on the Tricastin site since 1961, where it mainly produces the uranium hexafluoride (UF₆) for nuclear fuel fabrication needs. Alongside this main activity, COMURHEX produces various fluorinated products such as chlorine trifluoride (ClF₃). This production activity uses the excess fluorine resulting from the hydrolysis of hydrofluoric acid (HF).

UF₆ is produced from natural uranium in a part of the plant subject to ICPE regulations; the UF₆ was produced from reprocessed uranium in a part of the plant constituting a BNI, which was shut down in 2003. This latter part, BNI 105, chiefly comprises two facilities:

- the 2000 unit, which transformed reprocessed uranyl nitrate UO₂(NO₃)₂ into uranium tetrafluoride (UF₄) or uranium sesquioxide (U₃O₈)
- the 2450 unit, which transformed the UF₄ (whose uranium-235 content is between 1 and 2.5%) from the 2000 unit into UF₆. This UF₆ was used to enrich the reprocessed uranium for recycling in reactors.

On 13th October 2008, the licensee notified ASN of final shutdown of BNI 105 on 31st December 2008. An initial final shutdown and decommissioning application file was considered by ASN to be incomplete. It therefore requested a completed version of the file before the end of the first quarter of 2013 (see chapter 15).

Moreover, the coexistence on the same site of a BNI and various ICPEs housed in closely interconnected buildings, with associated risks and possessing a number of common equipment items, considerably complicates administrative oversight and regulation of the facilities, currently ensured by the DREAL (regional directorate for the environment, planning and housing) for the ICPEs, and by ASN for the BNI. In addition, this situation is not in conformity with the TSN Act, which in such situations provides for all the facilities to be included within the perimeter of the BNI and regulated by ASN. Consequently, ASN proposed in deliberation 2001-DL-0026 of 22nd November 2011, 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 modification of the perimeter has been effective since the publication of the decree on 26th April 2012.

ASN has also monitored the renovation of the 600 structure (subject to ICPE regulations), which will manufacture the chlorine trifluoride used for EURODIF’s PRISME operations. This renovation was in particular the subject of a third-party review by an independent expert.

Besides this, at the end of 2008 COMURHEX lodged an application file for a license to operate a new installation, COMURHEX II, regulated by the ICPE system. This project consists in replacing the existing conversion units, also classified as ICPEs, which will then be shut down and decommissioned. The file was the subject of a public inquiry and a joint review by ASN and the Rhône-Alpes DREAL, which led to order of the Prefect 10-3095 of 23rd July 2010 licensing the ICPEs currently in operation, which are to be shut down, and those in the course of construction.

The COMURHEX installations are included among those examined in 2011 as part of the experience feedback from the Japanese nuclear accident of Fukushima Daiichi in March 2011 (see point 5).

In order to simplify the organisation of the AREVA group, a process to merge the COMURHEX entity with the AREVA NC parent company has been launched. AREVA NC thus asked ASN for authorisation to take over operation of BNI 105 and the COMURHEX ICPEs on the Tricastin site. This application is currently being examined by the ASN services.

Finally, ASN examined new baseline safety requirements for the facility and approved the implementation of new general operating rules for the activities involved in the preparation for final shutdown and decommissioning of BNI 105.
3 REGULATING THE NUCLEAR FUEL CYCLE FACILITIES

ASN regulates the fuel cycle facilities at different levels. It regulates:
– the main steps in the life of nuclear facilities;
– the organisation of the licensees through inspections conducted on the ground;
– fuel cycle consistency;
– operating experience feedback within the fuel cycle BNIs.

This part specifies how the steps taken by ASN apply generally to the fuel cycle facilities.

3.1 Regulating the main steps in the life of nuclear facilities

Examining the licensing or modification applications for installations in operation

ASN works at several levels to regulate the AREVA group's nuclear facilities.

ASN is responsible for regulating the main steps in the life of these facilities when they are modified (in 2012, EURODIF PRISME project) and proposes the decrees accompanying these changes to the Government; ASN also draws up the provisions that establish the regulatory framework for these major steps.

These provisions specify the technical requirements relative to safety as well as those relative to the safety and radiation protection policy and management of the BNIs. These provisions, produced in particular for the commissioning of GB II, are ultimately to be extended to all the facilities of the AREVA Group. ASN has thus prepared draft prescriptions for the CERCA facility. The licensee has been consulted and can submit its comments before the decision is finalised.

ASN also reviews the safety files specific to each BNI, paying attention to their integration into the broader framework of laboratory and plant safety. In this respect, it ensures that the safety requirements are applied appropriately to all these facilities and that they are regularly updated, particularly on the occasion of the ten-year periodic safety reviews.

Examination of the periodic safety review files

In 2012, the orientation files (DOR) for the periodic safety reviews of the AREVA Group's facilities, and particularly those of the STE3 and LCC facilities at La Hague, TU5 for Tricastin and the inter-regional warehouses operated by EDF, were examined. The key subjects covered the organisation of the reviews, in order to give them their full weight as a means of improving safety, of taking account of the ageing of the facilities and of identifying and listing the elements important for protection.

The periodic safety review file for MÉLOX, prepared along these lines, was submitted in October 2011, while that for the UP3-A facility in La Hague underwent additions concerning the updates of the facility safety reports. The SOMANU orientation file (DOR) has been finalised and the licensee submitted the safety review file at the end of 2011. In 2010, the SOCATRI file had undergone an admissibility review by ASN and IRSN. The content of the safety review file had been considered insufficient; it was supplemented, particularly with regard to the facility's 10-year development prospects and its resistance to external hazards. The analyses of the civil engineering structural strength remain to be examined.

All these files shall be presented to the GPU between 2012 and 2014.

This first series of periodic safety reviews is a significant step for the AREVA facilities and complies with the provisions of the decree of 2nd November 2007. The group's facilities had never before been subject to such a procedure. ASN is keen that, on the submission of each new dossier, satisfactory account is taken of experience feedback from the previous ones, particularly that concerning UP3-A, for identification of the protection-related elements and the associated requirements defined.

Regulating the conditions of final shutdown of the facilities

At shutdown of the AREVA Group's industrial facilities, ASN also ensures that each of them complies with the requirements of decree 2007-1557 of 2nd November 2007, with regard both to informing ASN about the dates of shutdown and to the quality of the files, particularly regarding the extent to which the risks due to the operating changes are taken into account. In 2009 and 2010, the shutdown files for EURODIF UP2 400, ELAN IIB, STE2 and COMURHEX Pierrelatte led ASN to clarify its expectations on this subject.

Examining the measures taken by the head office departments in terms of safety

ASN’s regulatory action also covers the AREVA head office departments, which are responsible for the group’s safety, radiation protection and environmental protection policy (D3SDD). ASN looks at how they draft and ensure the implementation of this policy in the various establishments within the group. In 2011 and 2012, the main subjects concerned the development of the stress test reports required by ASN resolution further to the Fukushima Daiichi accident.

Particular regulatory actions conducted in consultation with the Defence nuclear safety authority

With the prospect of ASN taking over responsibility for regulation and inspection of the entire Pierrelatte site in the medium term, ASN and the Defence Nuclear Safety Authority (ASND) are focusing on remaining as coherent as possible in the application of the safety and radiation protection requirements to facilities for which each of them is responsible on the Tricastin site. Most of the facilities under the responsibility of ASND have been shut down or are being decommissioned, and should shortly be considered to be civil facilities. The facilities that will not be decommissioned are those currently treating the effluents and wastes for the site as a...
whole, and all the uranium storage facilities. Some of these facilities are obsolete and must be replaced by new facilities which will then be placed under the authority of ASN. In a joint letter dated 29th September 2011, ASN and ASND asked the Chairman of the AREVA board of Directors to propose a substitute project for the Tricastin waste treatment station, currently situated on the secret basic nuclear installation (INBS), as an alternative to the planned relocation of its activities to a former civil facility that does not meet the safety requirements.

ASN and ASND have set up a working group to clarify the steps of ASN’s takeover of the regulation of the safety of activities on this site. It has been decided that the takeover would take place progressively, as and when the regulatory situation of each facility is clarified, after its periodic safety review. The working group reported its conclusions to the two regulatory bodies at the end of 2010. The delicensing process has been started for the first step. This process should end by the year 2018.

3.2 Regulating the licensee’s organisation and management structure at fuel cycle nuclear installations

The safety of nuclear installations is primarily the responsibility of the licensee. In this respect, for each installation, ASN verifies that the organisation and resources deployed by the licensee enable it to assume this responsibility.

It is not the role of ASN to impose a particular organisational model on the licensees. ASN can nevertheless express an opinion or give recommendations regarding the chosen organisation, and possibly issue directives on specific identified points if it considers that they present shortcomings in terms of internal inspection of safety and radiation protection, or that they are inappropriate.

ASN primarily observes the working of the organisations put into place by the licensees through inspections, including those devoted to safety management. The main points examined in this context concern, for example, the possible under-staffing of certain departments that play a key role in safety, or the balance between duties and available resources in other departments. These situations can make it difficult for employees to accomplish their duties, and can result in production requirements taking priority over other considerations, notably in terms of safety.

Given this context, ASN initiated a safety management review process within the AREVA Group, for the BNIs operated by the Group. AREVA submitted its review support file in January 2010. In December 2011, it was examined by the GPU which issued recommendations. ASN sent AREVA its conclusions on 21st September 2012. An initial check on AREVA’s compliance with its commitments and with the ASN requests was made during a head office inspection on 15th November 2012. The main conclusions are:

– the new organisations are not yet fully deployed;
– the new safety indicators will need to be substantiated;
– the prescriptive nature of the documents issued by D3SDD must be defined;
– a process to ensure the effective implementation on the sites of the group’s directives must be defined;
– the allocation of expert appraisal resources (in particular concerning social, organisational and human factors) must be justified.
3.2.1 Taking account of social, organisational and human factors

Formalisation of the way social, organisational and human factors (SOHF) are taken into account began in 2005-2006 for the fuel cycle installations, with the drafting of internal policies specific to each licensee. This approach began to be centralised within the AREVA Group as of 2008, which is when the Group's head office departments started employing SOHF specialists. Since then, a national policy has been developed and is being gradually deployed among the group’s licensees. ASN considers that this approach must be continued for it to fully bear fruit.

The various licensees within the AREVA Group are now staffed with persons competent in SOHF. Nevertheless, ASN is not yet convinced that all the licensees are devoting sufficient resources to this subject.

Furthermore, in particular through analysis of significant event reports or review of the technical files, it would appear that fuller integration of the SOHF approach is required. The specialists on the subject are not yet systematically consulted with regard to issues with strong implications in terms of human reliability or workstation ergonomics.

Following the Advisory Committee meeting which examined group safety management, AREVA made commitments regarding the consideration of SOHF in its activities and projects. With this in mind, a Directive should be drafted before the end of 2012, to guarantee the incorporation of SOHF into the design or modification projects. At the same time, the periodic safety reviews guide will be supplemented by a section concerning analysis of sensitive processes and how they interface with activities that are sensitive from the safety standpoint. With regard to the means devoted to this subject, the AREVA group increased the size of its teams of SOHF experts and coordinators in 2012. 2013 will be an opportunity to assess the effectiveness of these measures.

3.2.3 Ensuring consistency across the cycle

ASN monitors the overall consistency of the industrial choices made with regard to fuel management, from both the safety and the regulatory aspects. The issue of long-term management of spent fuel, mining residues and depleted uranium is examined taking account of the unforeseen variables and uncertainties attached to these industrial choices. In the short and medium terms, ASN intends to ensure that saturation of the spent fuel storage capacities in the NPPs or in the AREVA La Hague pools - as has been observed in other countries - is foreseen and prevented, so that the licensees do not use old facilities with lower safety standards as an interim solution. ASN is assisted in this approach by the Ministry in charge of Energy, which it consults in particular to obtain information relative to movements of materials or industrial constraints that could, for example, have consequences for safety.

EDF was asked to undertake a forward-looking study in cooperation with the fuel cycle companies, presenting elements demonstrating compatibility between changes in fuel characteristics and their management, and developments in fuel cycle installations. In order to maintain an overall and constantly appropriate view of the fuel cycle, these data must be periodically updated. For any new utilisation of the fuel, EDF must demonstrate that it has no unacceptable effect on the fuel cycle installations.

At the end of 2008, EDF reached an agreement with AREVA for managing reprocessing-recycling traffic and, allowing for unforeseen variables, for developing a long-term vision for forward-looking management of the fuel cycle plants, including end-of-life operations.

An overall revision of the “Impact Cycle” file was submitted in 2008. This file was examined on 30th June 2010 by the Advisory Committees for laboratories and plants and for waste, on the basis of a report presented by IRSN. The DGEC (General Directorate for Energy and Climate) and members of the Advisory Committees for nuclear reactors (GPR) and for transport (GPT) took part in this analysis.

On completion of this review, ASN tightened the monitoring of the coherence of the fuel cycle and its changes, by demanding biennial update reports and requiring EDF to submit an updated “cycle” file by 2016. ASN underlined four major points in its letter of 5th May 2011:

- the need to carry out a true sensitivity study, to take into account, among other things, the variability of electricity grid power demands;
- the need to assess the margins in terms of underwater spent fuel storage capacity, until the year 2020 and beyond;
- the development of EDF’s fuel management strategies, particularly after the virtually complete abandonment of “high burnup fraction” fuel management options;
- the change in the radiological content of the materials used, when they come from the reprocessing of spent fuel.

ASN also wanted the following to be put into perspective:

- the storage capacities for depleted uranium (due to the increase in the enrichment capacity) and for reprocessed uranium, as the saturation of available space cannot be totally ruled out in this latter case.
- the availability of the different packages proposed for the transport of radioactive substances.

During the course of 2012, EDF responded to most of the requests in this letter. More particularly:

- EDF drafted a note, which will be updated every two years, on the topic of monitoring the French PWR fuel cycle and its developments;
- a safety options file is to be submitted by AREVA NC in the first half of 2013 concerning the construction on the Tricastin site of a new depleted uranium and reprocessed uranium storage centre.

These responses, already transmitted, will be examined by ASN in 2013.

Furthermore, ASN considered that the first lessons needed to be drawn from the Fukushima Daiichi NPP accident of March 2011, and asked EDF to specify whether any factors were likely to confirm, or require changes to, its spent fuel management strategy.
In the field of fuel cycle facilities, ASN is involved in numerous international actions.

In 2011, it took part in the International Atomic Energy Agency (IAEA) working groups on safety standards for fuel cycle facilities and on the very long-term extension of spent fuel storage facilities.

In September 2012, ASN took part in the annual meeting of the OECD's Nuclear Energy Agency (NEA) WGFCS (Working Group for Fuel Cycle Safety). It mainly dealt with integrating experience feedback from the accident which occurred on the Japanese nuclear site of Fukushima Daiichi, the latest news from each country concerning regulations and the organisation of a symposium in the near future on the safety of the long-term storage of spent fuel and high-level waste. ASN also took part in the meeting of the NEA’s FINAS (Fuel Incident Notification and Analysis System) group, which looked at various significant incidents in fuel cycle facilities in the member countries.

ASN also enjoys regular discussions with its foreign counterparts to share best practice for regulating the nuclear safety of fuel cycle facilities. ASN responded to foreign contacts concerning France’s approach to experience feedback from the Fukushima accident, which included subjecting the fuel cycle facilities to the stress tests process. ASN in particular received representatives from the Japanese nuclear safety agency (NISA) which reports to the Ministry for Economy, Trade and Industry, and from the Japan Nuclear Energy Safety Organization (JNES) for discussions about the stress tests on the fuel cycle facilities, but Japan implemented a similar approach in 2012 and initiated a review of their regulatory system.

Together with the British nuclear safety regulator, the ONR (Office for Nuclear Regulation), ASN organised a joint inspection of the La Hague site. The bilateral exchanges with the ONR continued in order to take advantage of the mutual appraisals of the French and British reprocessing plants at La Hague and Sellafield.
At the end of the prioritisation process for the nuclear facilities other than nuclear reactors, virtually all the sites and facilities operated by the AREVA group had provided the stress test reports by 15th September 2011: all the facilities on the La Hague and Tricastin sites, the MéLOX plant and the FBFC plant in Romans-sur-Isère.

On completion of the stress tests for the priority nuclear facilities, ASN considered that the level of safety of the facilities examined was sufficient for it not to demand the immediate shutdown of any one of them. At the same time, ASN considered that their continued operation does require that their robustness to extreme situations be increased beyond their existing safety margins, as rapidly as possible.

In its resolutions of 26th June 2012, ASN set additional instructions for the AREVA Group facilities assessed in 2011, in the light of the conclusions of the stress tests. These instructions in particular require the licensees to take the following steps:

– proposal by the licensee of a hardened safety core of material and organisational measures. In particular, emergency management rooms that are robust to an extreme hazard (beyond the current design basis requirements, with margins yet to be determined) shall be in place by 31st December 2016;

– implementation of reinforced measures to reduce the risk of the fuel stored in the La Hague pools becoming exposed by emptying of the pool;

– for the La Hague silos, feasibility studies with a view to setting up technical arrangements, such as geotechnical or equivalent effect containment, with the aim of protecting the underground and surface water in the event of a severe accident;

– for the Tricastin and Romans-sur-Isère sites, implementation of complementary means for mitigating the consequences of a toxic product leak (gaseous hydrogen fluoride, uranium hexafluoride, chlorine, chlorine trifluoride, etc.);

In the light of the MéLOX stress tests conclusions, ASN resolution 2012-DC-0303 of 26th June 2012 requires that MéLOX SA demonstrate its ability to manage the ageing of its facility and its ability to operate it in satisfactory safety conditions. It also asked it to provide additional information on how it takes account of the risk of a cliff-edge effect associated with the loss of the last level of filtration in the event of a fire in the powders facility at the same time as an earthquake, to justify its ability to cool the fissile material stores in the event of loss of the cooling function and to demonstrate the availability of emergency management means in the event of a hazard simultaneously affecting several BNIs on the Marcoule site.

The AREVA Group’s proposals for definition of the hardened safety core and the associated requirements for all its facilities will be examined by the Advisory Committees in April 2013.

The CERCA plant (Romans-sur-Isère) fabricating fuel for research reactors and operated by FBFC, submitted a stress tests report on 15th September 2012 pursuant to resolution 2012-DC-0220 of 5th May 2011. It is being examined by ASN.

Experience feedback from the Fukushima accident, concerning the other fuel cycle facilities – SOMANU, the Tricastin operational hot unit (BCOT) and the inter-regional fuel warehouses (MIR) – which are considered to be lower priority, will be integrated into the forthcoming periodic safety reviews. SOMANU thus included a stress tests report in its periodic safety review report received in December 2011.

Cross-disciplinary aspects

Today ASN asks AREVA to ensure high-quality management of safety and radiation protection in its facilities, rooted in the daily and on-the-ground activities of all the group’s players, commensurate with AREVA’s stated ambitions.

In 2013, ASN will continue the work started in 2012, in particular to examine the authorisation or major modification applications for the fuel cycle facilities, and to set the framework for these operations: application to modify the conditions of operation of the GB I plant with a view to its final shutdown, application to modify the conditions of operation of the AREVA La Hague installations (BNI 116 and 118). In addition, it will continue the analysis of the safety review files, particularly those concerning the La Hague facilities.

In September 2010, ASN also initiated the overall review of the safety and radiation protection management process within the AREVA Group. ASN sent AREVA its conclusions on 21st September 2012. ASN notes that efforts must be made to implement the group’s social, organisational and human factors policy in all the facilities, and to involve the outside contractors in this as a matter of course. ASN asked for monitoring of the development of subcontracting data and closer surveillance of outside contractors. It in particular demanded improvements in the monitoring of project management, including when this is entrusted to a subsidiary of the group.
National long-term management of all activities relating to safety and radiation protection proved to be an essential factor in safety management. In addition, ASN considers that new and more representative “safety” indicators must be developed and implemented within the AREVA group. Lastly, AREVA must present an assessment of the use of the new aids for processing events and experience feedback.

Continuing in line with the actions taken in 2012, ASN will pay particular attention to the integration of experience feedback by the AREVA group licensees, and to the implementation of the internal authorisation systems.

Finally, ASN will specifically monitor the measures necessary for implementation of the additional safety measures requested following the stress tests: in 2013, ASN will make a decision on the AREVA proposals concerning the definition of systems, structures and components robust to off-site hazards and the management of emergency situations.

**Tricastin site**

In 2013, the site will continue with its reorganisation, with the aim of the licensee AREVA NC taking over operation of all the facilities. ASN will examine the modification notifications relating to this project. Furthermore, within the framework of the stress tests performed further to the Fukushima Daiichi accident, ASN will continue to monitor closely the implementation of measures to reinforce the safety of the site facilities that handle large quantities of UF₆ and hydrofluoric acid, particularly by reinforcing the earthquake resistance of certain ICPEs and by integrating the chemical risk into the on-site emergency plans of the Tricastin site licensees. Finally, ASN will continue to examine the authorisation application for operation of the North facility and the REC at GB II.

**Romans-sur-Isère site**

On the Romans-sur-Isère site, the industrial equipment renewal programme of the AREVA FBFC nuclear fuel fabrication unit is now complete. In 2013, ASN will be vigilant with respect to improving the nuclear safety performance of AREVA FBFC. Specifically, ASN asks AREVA for improved application of the safety-criticality rules in the FBFC plant and an improvement in the quality of the studies performed. It will be attentive to compliance with the deadlines for the actions taken following the safety reassessment of the units within the site facilities. It will also be attentive to ensuring the implementation of the improvements planned under the stress tests.

**MÉLOX plant**

ASN will be vigilant as to the means adopted to accompany the changes in materials used with regard to requirements in terms of nuclear safety and radiation protection. In this context, management of dosimetry, the incorporation of SOHF and prevention of criticality risks will remain regulation and inspection priorities.

The periodic safety review file for the MÉLOX plant, which will be examined in 2013, is a key step in the operation of the facility. This step will enable the conformity of the facility with the applicable regulations and its baseline safety standard to be verified in depth, while at the same time setting a safety improvement programme for the next ten years in the light of the best available practices.

Finally, ASN will monitor the implementation of the measures adopted further to post-Fukushima experience feedback.

**La Hague site**

For the La Hague plants, ASN considers that efforts must be continued, particularly for the recovery and packaging of legacy waste on the site and for the integration of operating experience feedback and the notification of significant events. Within the framework of the periodic safety reviews of the facilities, 2013 should see the continued process to implement the safety and elements important for protection identification procedure and improvement of the general operating rules of these plants. With regard to the periodic safety review of the UP3-A plant, ASN asked IRSN to closely examine operating experience feedback and to check the conformity of the elements important for protection of the UP3 with the safety requirements defined, in the light of any changes they may have undergone and their ageing.

As for the recovery of legacy waste, ASN will focus on ensuring that U-turns in industrial strategy do not significantly delay the recovery and disposal of the waste from SILO 130 or the sludge from STE2 and HAO. ASN already issued instructions to this end in 2010 for SILO 130 and will issue a resolution concerning the entire RCD programme in 2013.

Finally, ASN will continue to monitor the internal authorisations system in place since 2011 in the La Hague facility.