

FRENCH REPUBLIC

**Report by France
pursuant to Directive 2009/71/Euratom
25 June 2009**

Contents

A – INTRODUCTION	6
1. General remarks	6
1.1 Purpose of the report	6
1.2 Authors of the report	6
1.3 Structure of the report	6
1.4 Publication of the report.....	7
2. Installations concerned.....	8
3. National policy and organisation in the field of nuclear safety	9
B – ACTION TAKEN ‘ARTICLE BY ARTICLE’	11
4. Article 4: Legislative, regulatory and organisational framework	11
4.1 The legislative and regulatory framework	11
4.1.1 The responsibilities of each stakeholder	12
4.1.2 Licensing procedures.....	12
4.1.2.1 Construction licences	13
4.1.2.2 The other facilities located within the perimeter of a BNI.....	15
4.1.2.3 Licences for the commissioning of a BNI.....	15
4.1.2.4 Modification of a BNI.....	16
4.1.2.5 Licences for the final shutdown and decommissioning of a BNI	16
4.1.3 The monitoring of nuclear activities	17
4.1.4 Coercive measures.....	18
4.2 The maintenance and improvement of the legislative and regulatory framework	19
5. Article 5: Competent regulatory authority	20
5.1 The legal basis and the regulatory authority	20
5.2 The independence of the regulatory authority	21
5.3 The resources of the regulatory authority and its activity.....	22
5.3.1 Operators’ compliance with safety requirements.....	24
5.3.2 Technical examination of the files supplied by the operator	25
5.3.3 Inspection	26
5.3.3.1 Objectives and principles	26
5.3.3.2 Inspection practices	26
5.3.3.3 The organisation of the regulatory authority in relation to the supervision of BNI	27
5.3.4 Coercive measures at the disposal of the regulatory authority.....	28
6. Article 6: Licence holders	29
6.1 The prime responsibility for nuclear safety	29
6.2 Safety assessments and verification.....	30
6.2.1 Requests and checks by the regulatory authority	30
6.2.1.1 Assessments prior to construction.....	30
6.2.1.2 Assessments prior to commissioning.....	30

6.2.1.3	Assessments and reviews during operation.....	31
6.2.1.3.1	The continuous improvement of safety	31
6.2.1.3.2	Periodic safety reviews.....	36
6.2.2	The measures adopted by licence holders	37
6.2.2.1	Measures adopted in respect of nuclear power plants.....	38
6.2.2.2	Measures adopted in respect of fuel cycle facilities.....	42
6.2.2.3	Measures adopted in respect of research reactor facilities.....	43
6.3	Design and construction of nuclear installations	47
6.3.1	Requests and checks by the regulatory authority	47
6.3.1.1	Requirements applicable to the arrangements to prevent accidents during the design and construction stage	48
6.3.1.2	Requirements applicable to the arrangements to prevent accidents during operation	49
6.3.1.3	Requirements applicable to the arrangements to mitigate the consequences of accidents	50
6.3.2	Measures adopted by the licence holders	51
6.3.2.1	Measures adopted in respect of nuclear power plants.....	51
6.3.2.1.1	Design and construction of nuclear power reactors	52
6.3.2.1.2	Operation of nuclear power reactors	54
6.3.2.2	Measures adopted in respect of fuel cycle facilities.....	56
6.3.2.3	Measures adopted in respect of research reactor facilities.....	57
6.4	Priority given to safety	61
6.4.1	Requests and checks by the regulatory authority	61
6.4.2	Measures adopted by the licence holders	63
6.4.2.1	Measures adopted in respect of nuclear power plants.....	63
6.4.2.2	Measures adopted in respect of fuel cycle facilities.....	66
6.4.2.3	Measures adopted in respect of research reactor facilities	67
6.5	Human and financial resources of licence holders	70
6.5.1	Human resources	70
6.5.1.1	Requests and checks by the regulatory authority	70
6.5.1.2	Measures adopted by the licence holders	70
6.5.1.2.1	Measures adopted in respect of nuclear power plants.....	70
6.5.1.2.2	Measures adopted in respect of fuel cycle facilities.....	71
6.5.1.2.3	Measures adopted in respect of research reactor facilities.....	71
6.5.2	Financial resources	74
6.5.2.1	Requests and checks by the regulatory authority	74
6.5.2.2	Measures adopted by the licence holders	75
6.5.2.2.1	Measures adopted in respect of nuclear power plants.....	75
6.5.2.2.2	Measures adopted in respect of fuel cycle facilities.....	76
6.5.2.2.3	Measures adopted in respect of research reactor facilities.....	76
7.	Article 7: Expertise and skills in nuclear safety.....	79
7.1	Expertise and skills of licence holders.....	79
7.1.1	Supervision by the regulatory authority	79
7.1.2	Measures adopted by the licence holders	80

7.1.2.1	Measures adopted in respect of nuclear power plants.....	80
7.1.2.2	Measures adopted in relation to fuel cycle facilities	81
7.1.2.3	Measures adopted in respect of research reactor facilities.....	82
	Measures adopted by the CEA.....	82
	The skills and the culture of safety of the various categories of people with a safety-related role are key to maintaining a good level of installation safety.	82
7.2	Expertise and skills of the regulatory authority	84
8.	Article 8: Information to the public	85
8.1	Measures adopted by the regulatory authority.....	85
8.2	Measures adopted by the licence holders.....	87
8.2.1	Measures adopted by the operators of nuclear power plants	87
8.2.2	Measures adopted by the operators of fuel cycle facilities	88
8.2.3	Measures adopted by the operators of research reactor facilities.....	88
8.3	The other parties involved in the provision of information to the public	90
8.3.1	The High Committee for Transparency and Information on Nuclear Safety (HCTISN)	90
8.3.2	The Local Information Committees (LIC).....	90
8.3.3	Measures adopted by the IRSN.....	91
	ANNEX 1 – LIST AND LOCATION OF NUCLEAR INSTALLATIONS IN FRANCE.....	93
1.1	Location of nuclear reactors.....	93
1.2	List of nuclear power reactors.....	94
1.3.	List of fuel cycle facilities.....	97
1.4	List of research nuclear reactor facilities	99
1.5	List of nuclear installations in the process of being decommissioned or being prepared for final shutdown.....	100
	ANNEX 2 – MAIN LEGISLATIVE AND REGULATORY PROVISIONS.....	101
2.1.	Codes, laws and regulations.....	101
2.2.	Regulatory decisions of the ASN.....	103
	Table 5: List of regulatory decisions of the ASN as at July 2014	103
	ANNEX 3 – BIBLIOGRAPHY	106
3.1.	Documents	106
3.2.	Websites.....	106
	ANNEX 4 – LIST OF MAIN ABBREVIATIONS	107

Contents

List of figures

Figure 1: Map of France indicating the locations of nuclear reactors in operation or under construction	91
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List of tables

Table 1: Nuclear power reactors in operation or under construction	92
Table 2: Fuel cycle facilities in operation	95
Table 3: Research reactor facilities in operation or under construction	97
Table 4: Nuclear installations in the process of being decommissioned or being prepared for final shutdown	98
Table 5: List of regulatory decisions of the ASN as at July 2014	101
Table 6: List of main abbreviations	105

A – INTRODUCTION

1. General remarks

1.1 Purpose of the report

Council Directive 2009/71/Euratom of 25 June 2009 seeks to establish a Community framework capable of ensuring nuclear safety within the European Atomic Energy Community and to encourage Member States to guarantee a high level of nuclear safety. As at 22 July 2011, relying on existing laws and decrees, France was complying with its obligations under the Directive.

Article 9(1) provides that Member States are to submit a first national report on the implementation of the Directive to the European Commission by 22 July 2014, and then a further report every three years thereafter.

1.2 Authors of the report

The preparation of this national report was entrusted to the *Autorité de sûreté nucléaire* [Nuclear Safety Authority] ('the ASN'). In addition to the ASN, the main French government departments concerned – *Ministère de l'écologie, du développement durable et de l'énergie* [Ministry of Ecology, Sustainable Development and Energy] ('the MEDDE'), *Mission sûreté nucléaire et radioprotection* [Nuclear Safety and Radiation Protection Mission] ('the MSNR'), *Direction Générale de l'énergie et du climat* [Directorate-General of Energy and Climate] ('the DGEC') and the *Comité Technique Euratom* [Euratom Technical Committee] ('the CTE') – were also involved in the report's preparation. The report also incorporates contributions from the operators of the nuclear facilities presented in Chapter 2, namely *Électricité de France* ('EDF'), AREVA, the *Commissariat à l'énergie atomique et aux énergies alternatives* [Atomic Energy and Alternative Energies Commission] ('the CEA'), the *Institut Laue-Langevin* [the Laue-Langevin Institute] ('the ILL') and the ITER International Organisation.

1.3 Structure of the report

This report is structured in line with the guidelines on national reports drawn up by the members of the European Nuclear Safety Regulators Group ('the ENSREG'). It is presented on an 'article-by-article' basis, with each article forming the subject of a separate chapter, at the beginning of which the corresponding text of the article of the Directive is reproduced in a box with a shaded background.

This is a stand-alone report which reflects the points of view of the French authorities together with the views of the operators. Accordingly, for every chapter in which the French

authorities are not the only entities to express their views, a two-part structure is adopted: firstly a description of the legislation by the French authorities, followed by a presentation by the operators of the actions taken to comply with the legislation.

1.4 Publication of the report

The Directive does not lay down any obligation relating to the public disclosure of the national reports produced. However, the French authorities, in a concerted effort to improve public information and transparency in the field of nuclear safety, have decided to make the French national report accessible to all interested parties. It is for this reason that the report will be available in French on the ASN's website (www.asn.fr).

2. Installations concerned

The *Loi relative à la transparence et à la sécurité en matière nucléaire* [Law on transparency and nuclear safety] ('the TNS Law') of 13 June 2006 (now codified in the *Code de l'environnement* [Environment Code], see Section 4.1) defines a basic nuclear installation (BNI) as an installation which, by its nature or on account of the quantity of or activity with the radioactive substances that it contains, is subject to a specific system of supervision. Such installations must be licensed by a decree adopted following a public inquiry and the opinion of the ASN. Installations under construction, in operation, which have been shut down or which are being decommissioned fall under the BNI system.

For technical or legal reasons, the BNI concept may cover a variety of physical scenarios: for instance, at a nuclear power plant (NPP), each reactor may be regarded as an individual BNI, or indeed one and the same BNI may be formed of two reactors. Similarly, a fuel cycle facility or a CEA centre may consist of several BNI. These different configurations in no way affect the supervisory conditions.

This report covers all BNI under construction, in operation or in the process of being decommissioned listed in Article 3(1) of the Directive (see the detailed list in Annex 1), namely:

- nuclear power plants: the current fleet, operated by Électricité de France ('EDF'), includes 58 pressurised water reactors (PWR), constructed over successive, standardised stages, which were connected to the network between 1977 and 1999 and are all in service. In addition, the construction of an EPR-type, third-generation reactor began at the Flamanville site in 2007;
- fuel cycle facilities (operated by AREVA): enrichment, nuclear fuel fabrication and reprocessing plants;
- research reactor facilities: in France, there are seven research reactor facilities in operation (commissioned between the 1960s and 1980s) or under construction. Of those seven, six are operated by the CEA. The high-flux reactor (HFR) is operated by the *Institut Laue-Langevin* ('the ILL'). The CEA, EDF and AREVA, together with European partners, began construction of the Jules Horowitz Reactor (JHR) in 2006; the CEA operates the reactor. This new pool-type irradiation reactor will contribute to meeting research and development needs until approximately 2050. In addition to those reactors, there is the ITER (International Thermonuclear Experimental Reactor) project, the purpose of which is to conduct nuclear fusion reaction experiments in magnetically confined tritium and deuterium plasmas, *inter alia* with a view to testing concepts and equipment for future power reactors harnessing that reaction;

- spent fuel storage facilities, as well as storage facilities for radioactive waste which are on the same site and directly connected to the nuclear facilities listed above; and
- finally, nuclear facilities falling within the scope of the Directive which are in the process of being decommissioned or being prepared for final shutdown.

3. National policy and organisation in the field of nuclear safety

Nuclear safety is an absolute priority for the French authorities and the following principles are of fundamental importance: the principle of the prime responsibility of the operator, the principle of the continuous improvement of safety, the principle of the independence of the regulatory authority, and the principle of transparency and public information.

This national policy is based on Law No 2006-686 of 13 June 2006 on transparency and nuclear safety ('the TNS Law'), now codified in the Environment Code, as well as its implementing legislation, which lay down the national framework for nuclear safety.

Thus, the Government determines, by decree or order, the general rules applicable to nuclear activities. It adopts the major individual decisions, of which there are a limited number, concerning nuclear installations, in particular the construction and decommissioning licences. Those measures are adopted on the advice of the ASN, which is made public at the same time as the measures to which it relates.

At ministerial level, the MSNR, a department operating under the joint authority of the Minister for Ecology and Sustainable Development and the Minister for Health, deals on their behalf with the matters falling within the Government's area of responsibility in the field of nuclear safety and radiation protection – with the exception of activities and facilities relevant to the defence sector – as well as that of the protection of workers from ionizing radiation. Those missions are defined in Article 8(1)(3) of the Order of 9 July 2008. Accordingly, the MSNR:

- steers and follows up on matters falling within the area of responsibility of the Ministers for Nuclear Safety and for Radiation Protection (steering of BNI procedures, preparation of legislation in conjunction with the ASN etc.);
- is involved in the drafting of national crisis organisational arrangements (accidents at a nuclear installation or in the transportation of radioactive materials, radiological emergencies, acts of terrorism etc.) in conjunction with the departments under the ministry with responsibility for civil security;
- contributes to the preparation of France's positions for the purposes of international and Community discussions;

- coordinates the action of the DREAL [*Directions Régionales de l'Environnement, de l'Aménagement et du Logement*, Regional Directorates for the Environment, Planning and Housing] vis-à-vis uranium mines and ICPE [*Installations classées pour la protection de l'environnement*, Installations Classified for the Protection of the Environment] which contain radioactive substances;
- steers and follows up on the management of the sites and land polluted by radioactive substances outside BNI (in coordination with the *Bureau du sol et du sous-sol* [Soil and Subsoil Office]);
- proposes priorities for the intervention of the State in relation to the rehabilitation of orphan polluted sites ('OPS') in conjunction with ANDRA [*Agence nationale pour la gestion des déchets radioactifs*, National Agency for the Management of Radioactive Waste] and the DGEC; and
- provides the secretariat of the *Haut Comité pour la Transparence et l'Information sur la Sécurité Nucléaire* [High Committee for Transparency and Information on Nuclear Safety] ('the HCTISN').

In turn, the ASN is responsible for monitoring nuclear safety and radiation protection on behalf of the State in order to protect workers, patients, the general public and the environment from the risks associated with civil nuclear activities. The ASN, an independent administrative authority, was established by the TNS Law of 13 June 2006. It is the successor of the *Direction Générale de la sûreté nucléaire et de la radioprotection* [Directorate-General of Nuclear Safety and Radiation Protection] ('the DGSNR') and its regional divisions, placed under the authority of the ministries responsible for industry, the environment and health. Amongst its missions, the ASN may clarify regulations by means of technical decisions and adopt individual decisions in relation to BNI which fall outside the Government's area of responsibility. Some of those decisions must be approved by the ministers with responsibility for nuclear safety (MEDDE). It takes enforcement actions and measures imposing administrative penalties against BNI operators and adopts all emergency measures. It reports on its activity, its missions and the state of nuclear safety and radiation protection in France by means of its annual report, which is communicated to the Parliament, the Government and the President of the Republic.

In order to carry out its missions, the ASN relies, in so far as necessary, on the *Institut de radioprotection et de sûreté nucléaire* [Institute of Radiation Protection and Nuclear Safety] ('the IRSN'), a State public body, which conducts its expert opinion and research missions *inter alia* in the field of nuclear safety.

B – ACTION TAKEN ‘ARTICLE BY ARTICLE’

4. Article 4: Legislative, regulatory and organisational framework

1. Member States shall establish and maintain a national legislative, regulatory and organisational framework (hereinafter referred to as the ‘national framework’) for nuclear safety of nuclear installations that allocates responsibilities and provides for coordination between relevant state bodies. The national framework shall establish responsibilities for:

(a) the adoption of national nuclear safety requirements. The determination on how they are adopted and through which instrument they are applied rests with the competence of the Member States;

(b) the provision of a system of licensing and prohibition of operation of nuclear installations without a licence;

(c) the provision of a system of nuclear safety supervision;

(d) enforcement actions, including suspension of operation and modification or revocation of a licence.

2. Member States shall ensure that the national framework is maintained and improved when appropriate, taking into account operating experience, insights gained from safety analyses for operating nuclear installations, development of technology and results of safety research, when available and relevant.

4.1 The legislative and regulatory framework

France has established and maintains in force a national legislative and regulatory framework for the nuclear safety of BNI.

The legal rules governing BNI were thoroughly overhauled by Law No 2006-686 of 13 June 2006 (‘the TNS Law’) and its implementing decrees, in particular Decrees Nos 2007-830 of 11 May 2007 (the ‘BNI Nomenclature’ Decree) and 2007-1557 of 2 November 2007 (the ‘BNI Procedures’ Decree); however, significant technical changes were also introduced by the *Arrêté du 7 février 2012 fixant les règles générales relatives aux INB* [Order of 7 February 2012 laying down the general rules applicable to BNI]. Since 2012, the provisions of the two main laws which relate specifically to BNI – the ‘TNS Law’ and the *Loi de programme No 2006-739 du 28 juin 2006 relative à la gestion durable des matières et déchets radioactifs* [Programme Law No 2006-739 of 28 June 2006 on the sustainable management of radioactive materials and waste] (‘the Waste Law’) have been codified in the Environment Code.

The provisions of the Environment Code are thus now based on the system of licensing and supervision which applies to all BNI.

The provisions of the Environment Code – which codify the TNS Law – its implementing decrees and the Order of 7 February 2012 enable France to comply with its obligations under Directive 2009/71/Euratom of 25 June 2009 establishing a Community framework for the nuclear safety of nuclear installations.

The legislative and regulatory framework provides for a division of roles between the Government and the ASN as well as effective coordination between those two bodies.

In the context of its international action, France signed the Convention on Nuclear Safety on 20 September 1994, the day on which that Convention was opened for signature at the IAEA General Conference, and approved it on 13 September 1995. The Convention on Nuclear Safety entered into force on 24 October 1996. On 22 February 2000, France approved the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management, which entered into force on 18 June 2001.

4.1.1 The responsibilities of each stakeholder

The Government is competent to draw up the relevant legislation (decrees and orders). It is required to obtain the opinion of the ASN on such draft legislation; that opinion is made public. In addition, the law grants the ASN the power to supplement the implementing rules of the decrees and orders adopted in the field of nuclear safety or radiation protection by means of technical regulatory decisions; those decisions are subject to the approval of the ministers with responsibility for nuclear safety.

Accordingly, several implementing decrees and an order have been adopted by the Government. For its part, the ASN has defined a programme of regulatory decisions intended to clarify Decree No 2007-1557 of 2 November 2007 and the Order of 7 February 2012 laying down the general rules applicable to BNI. As at July 2014, six regulatory decisions of the ASN have been adopted.

4.1.2 Licensing procedures

French legislation and regulatory provisions prohibit the operation of a BNI without a licence. The BNI are currently governed by Title IX of Book V of the Environment Code. That title lays down a construction licensing procedure followed by a series of licenses issued

over the main stages in the lifetime of a BNI: construction, commissioning, potential modification of the installation, final shutdown and dismantling, decommissioning.

An operator which operates a BNI either without the necessary licences or in breach of those licences may be the subject of coercive measures and administrative sanctions provided for in the Environment Code.

The procedures are set out in detail in the ‘BNI Procedures’ Decree.

4.1.2.1 Construction licences

An application for a licence to construct a BNI is lodged by the industrial entity which plans to operate the installation, and thus acquires the status of operator, with the ministries with responsibility for nuclear safety. The application must be accompanied by a file consisting of several documents, which include a detailed plan of the installation, the impact study, the preliminary safety report, the risk management study and the decommissioning plan.

The licensing procedure is managed by the competent departments placed under the authority of the ministers with responsibility for nuclear safety (‘the MRNS’). The ministers may entrust the ASN with the technical investigation of the file accompanying the application and submit the impact study for the opinion of the Environmental Authority established within the MEDDE’s *Conseil général de l’environnement et du développement durable* [General Council for the Environment and Sustainable Development].

The public inquiry:

In addition to the possible organisation of a public debate, construction licences are issued following a public inquiry.

The purpose of that inquiry is to inform the public and to canvass opinions, suggestions and counter-proposals in order to provide the ministers with responsibility for nuclear safety with all the factors necessary for their own information purposes before taking any decision.

The *préfet* [Prefect] opens the public inquiry in at least each of the *communes* [municipalities] part of the territory of which is at a distance of less than five kilometres from the installation’s perimeter. The duration of the inquiry is at least one month and no longer than two months. The file submitted by the operator in support of its licence application is made available as part of the inquiry. The opinion given by the Environmental Authority is enclosed with the file.

Furthermore, the preliminary safety report may be consulted, subject to certain arrangements, throughout the duration of the public inquiry.

Since 1 June 2012, the Prefect has made the main documents making up the inquiry file available to the public electronically. One of the main reasons for so doing is to make it easier for the public to obtain information about the plans, in particular members of the public who do not reside in the locations in which the inquiry is organised. The purpose of using this method of making information available and providing the option to submit comments by electronic means is to facilitate and improve the ability of members of the public to express their views.

Consultation of the Commission locale d’information [Local Information Committee] (‘LIC’):

A Local Information Committee (‘CLI’ – see Section 8.3.2.) may be established as soon as an application for a licence to construct a BNI is lodged. In any event, it must be operational once the licence has been granted.

The acts relating to individual applications for BNI (decree granting a licence to construct or shut down and decommission a BNI, for example) form the subject-matter of a hearing procedure attended by the operator and the CLI before the ASN, as provided for in a decision of the ASN of 13 April 2010.

Consultation of the European Commission:

Under Article 37 of the Euratom Treaty, the French authorities are to provide the European Commission with general data relating to plans for the disposal of radioactive waste. The Commission delivers an opinion on the basis of the file communicated. That opinion accompanies the file submitted with the application for a licence to construct an installation required under the ‘BNI Procedures’ Decree.

Technical examination of the application:

In order to conduct the technical examination of the file, and in particular examination of the preliminary safety report which accompanies the application for a licence to construct a BNI, the ASN relies on the expertise of the *Institut de radioprotection et de sûreté nucléaire* [Institute of Radiation Protection and Nuclear Safety] (‘the IRSN’) (see Section 5.3).

In the light of the technical examination and the results of the consultations, the MSNR draws up a draft decree licensing construction of the installation.

The decree licensing construction (‘the DLC’):

The ministers with responsibility for nuclear safety send to the operator a preliminary draft of the decree licensing construction of the BNI. The operator has two months in which to submit its comments. The ministers also obtain the opinion of the ASN.

The licence to construct a BNI is issued by a Prime Ministerial decree adopted on the basis of the report produced by the ministers with responsibility for nuclear safety.

The decree licensing construction ('the DLC') determines the perimeter and features of the installation. It also specifies the term of the licence, where applicable, and the deadline for the commissioning of the installation. In addition, it lays down the essential criteria required in order to protect public security, health and hygiene, and for the protection of nature and the environment.

The requirements laid down by the ASN governing the implementation of the DLC:

In connection with the application of the DLC, the ASN lays down the requirements relating to the design, construction and operation of the BNI which it deems necessary for the purposes of nuclear safety.

The ASN lays down the requirements relating to the intake of water by and discharges from the BNI. The specific requirements laying down the limits on discharges from BNI into the environment are subject to the approval of the ministers with responsibility for nuclear safety.

4.1.2.2 The other facilities located within the perimeter of a BNI

The following are located within the perimeter of a BNI:

- the BNI;
- the equipment and facilities necessary for the operation of the BNI; technically, this equipment may, depending on its nature, be treated *inter alia* as installations classified for the protection of the environment (ICPE); and
- the classified equipment and facilities which are not necessarily linked to the BNI.

The TNS Law of 13 June 2006, codified in the Environment Code, provides that the equipment necessary for the operation of the BNI is subject in full to the system governing BNI laid down in the 'BNI Procedures' Decree. The other equipment located within the perimeter of the BNI, which by its nature is covered by a set of administrative rules (for water or ICPE), remains subject to those rules. Nevertheless, the power to adopt individual measures relating to such equipment and to guarantee the supervision of that equipment thus rests with the ASN.

4.1.2.3 Licences for the commissioning of a BNI

The TNS Law provides that the licence to commission a BNI is to be issued by the ASN.

Commissioning means the first use of radioactive materials in the installation. Pursuant to the 'BNI Procedures' Decree, the arrival of the nuclear fuel within the perimeter of the

installation and the start-up of that installation are subject to the grant of a licence by the ASN following the examination of a technical file, the content and submission deadline of which are specified in the ‘BNI Procedures’ Decree.

4.1.2.4 Modification of a BNI

The TNS Law provides that any significant modification of an installation must be subject to a procedure similar to that governing an application for a licence to construct a BNI.

A modification is deemed to be ‘significant’ in the situations mentioned in the ‘BNI Procedures’ Decree, namely:

- a change to the nature of the installation or an increase in its maximum capacity;
- a modification of the elements essential for the protection of the interests stated in the first paragraph of Article L. 593-1 of the Environment Code, which are listed in the decree granting the licence; and
- the addition, within the perimeter of the installation, of a new BNI, the operation of which is linked to that of the installation in question.

Furthermore, the ‘BNI Procedures’ Decree provides that, where a BNI operator plans changes to its operating arrangements or modifications to its installation which are not deemed to be significant on the basis of the abovementioned criteria, it must notify the ASN of those changes or modifications in advance. It cannot implement those modifications for a period of six months, a period which may be renewed, save where the ASN gives its express consent. If it considers it to be necessary, the ASN may lay down requirements intended to ensure that the changes or modifications planned are reviewed or that they are accompanied by supplementary arrangements so as to guarantee the protection of the interests stated in the first paragraph of Article L. 593-1 of the Environment Code.

4.1.2.5 Licences for the final shutdown and decommissioning of a BNI

The TNS Law provides that the final shutdown and the decommissioning of a BNI must be licensed by means of a decree. In such circumstances, the operator is required to send to the ministers with responsibility for nuclear safety a file including, *inter alia*, the updated decommissioning plan, an impact study, a preliminary version of the safety report, a risk management study covering the operations involved in the final shutdown and decommissioning of the installation, and the general monitoring and maintenance rules to be observed.

The examination procedure is identical to that followed when an application for a licence to construct the BNI is made (see Section 4.1.2.1). The licensing procedure is managed by the competent departments placed under the joint authority of the ministers with responsibility for nuclear safety (‘the MRNS’). The ministers may entrust the ASN with the technical investigation of the file accompanying the application and submit the impact study for the

opinion of the Environmental Authority established within the General Council for the Environment and Sustainable Development of the Ministry of Ecology, Sustainable Development and Energy. A public inquiry is organised by the Prefect and the opinion of the LIC is obtained. In the light of the technical examination and the results of the consultations, the MSNR draws up a draft decree licensing the final shutdown and decommissioning of the installation.

The ministers with responsibility for nuclear safety send to the operator a preliminary draft of the decree licensing the final shutdown and decommissioning of the BNI. The operator has two months in which to submit its comments. The ministers also obtain the opinion of the ASN.

The licence to shut down and decommission a BNI is issued by a Prime Ministerial decree adopted on the basis of the report produced by the ministers with responsibility for nuclear safety.

4.1.3 The monitoring of nuclear activities

Article L. 592-21 of the Environment Code provides that the ASN is to ensure the monitoring of compliance with the general rules and specific requirements in relation to safety and radiation protection to which the BNI operators and the persons responsible for nuclear activities are subject. In the case of BNI, the monitoring by the ASN of nuclear safety and radiation protection extends to the protection of the environment and, in the case of nuclear power plants (NPP), to labour inspections.

In addition, so that the BNI operators have to deal with a single authority only, Article 50 of *Loi n° 2009-526 du 12 mai 2009 relative à la simplification et la clarification du droit et d'allègement des procédures* [Law No 2009-526 of 12 May 2009 on the simplification and clarification of the law and the simplification of procedures] entrusts to the ASN the monitoring of the implementation of legislation in respect of all the pressurised equipment of a plant including a BNI.

The monitoring of nuclear activities is one of the ASN's fundamental missions (the implementation of which is presented in Section 5.3.3). This monitoring thus consists in verifying that each person and body responsible for nuclear activities fully assumes its responsibilities and observes the requirements of the legislation on nuclear safety and radiation protection. Historically focussed on the verification of the technical compliance of the installations and activities with legislation or standards, the monitoring today has a broader scope and also covers organisational and human factors.

The monitoring contributes to the performance assessment, in the areas of nuclear safety and radiation protection, of a person responsible for nuclear activities and makes it possible to estimate the implications associated with such activities. The operator has a duty to provide the ASN with the information necessary for the monitoring conducted by it. That information

must enable the technical demonstrations made by the operator to be analysed and inspections to be targeted. In addition, it must be possible on the basis of that information to identify and follow up on the significant events occurring in the operation of a BNI.

The ASN is supported, in so far as necessary, by the IRSN (see Section 5.3).

4.1.4 Coercive measures

If monitoring activities conducted by the ASN reveal non-compliance with safety requirements, coercive measures may be imposed on the BNI operators, possibly following a letter of formal notice which has failed to rectify the situation (see Section 5.3.4). Such measures may, *inter alia*, consist in prohibiting the re-start or suspending the operation of a nuclear installation until corrective measures have been taken.

In the event of an established breach, the Environment Code has provided for coercive measures and graduated administrative penalties, imposed following a letter of formal notice which has failed to rectify the situation and defined in Articles L. 596-14 to L. 596-22:

- the deposit of a sum equivalent to the cost of the work to be carried out with a public accountant;
- the *ex officio* performance of the work at the operator's expense, with any amounts deposited previously potentially being used to pay for that work; and
- the suspension of the installation's operation or the course of operations until the operator has taken steps to comply with the relevant provisions.

The operator may be called upon to submit its observations on those measures to the ASN College.

The law also provides for the adoption of protective measures in order to safeguard public security, health and hygiene or the protection of the environment. Accordingly, the ASN may:

- in the event of serious and imminent threats, order the temporary suspension of the operation of a BNI; it must inform the minister responsible for nuclear safety of this order immediately; or
- in the event of a threat to the interests set out above, require that assessments be carried out or that the necessary steps be taken at any time.

The *Code de la santé publique* [Public Health Code] likewise provides for coercive measures and administrative penalties where the provisions on radiation protection are found to have been infringed.

As far as administrative matters are concerned, the decision-making power rests with the ASN, which may order the following:

- temporary or definitive withdrawals of licences following a letter of formal notice;
- the suspension of a licensed activity, or an activity protected on an interim basis, in the event of an emergency relating to the security of individuals; and
- withdrawals or suspensions of the approvals it has issued.

The letters of formal notice associated with a licence withdrawal (letters issued on the basis of Article L. 1333-5 of the Public Health Code) relate to the application of all the provisions of the Chapter entitled '*Rayonnements ionisants*' ['Ionizing radiation'] of the legislative part of the Public Health Code (Articles L. 1333-1 to L. 1333-20), of regulatory provisions and of the requirements laid down in the licence. The temporary or definitive withdrawal of a licence by the ASN must be ordered by reasoned opinion, to be issued within a month of the service of the letter of formal notice.

4.2 The maintenance and improvement of the legislative and regulatory framework

The legislative framework underwent a major reform in 2006 with the adoption of the TNS Law. The drafting of the regulatory provisions applicable to BNI was largely initiated by the adoption of the 'BNI Procedures' Decree in 2007.

The BNI Order of 7 February 2012 is a key element in the context of the reform of the regulatory framework. Detailed provisions pertaining to that order will be laid down by some fifteen regulatory decisions, six of which have been adopted. The new French regulations are consistent with those of the other Member States since they incorporate the 'reference levels' of the Western European Nuclear Regulators Association ('WENRA'). The new regulatory provisions take into account the experience acquired as part of the operation of the installations.

Basic safety rules (BSR) incorporating experience acquired both nationally and internationally have been drawn up on a variety of technical subjects concerning all BNI. These rules are not strictly speaking regulatory acts. They are recommendations which clarify safety-related objectives and describe practices which the ASN deems satisfactory in order to comply with those objectives. The ASN ensures that operators are able to show that the measures that they propose to implement enable the safety-related objectives laid down in the BSR to be achieved. In the context of the current restructuring of the general technical regulations, the BSR are being amended or supplemented in form of ASN guides. There are at present around forty BSR as well as other technical rules drawn up by the ASN; all those rules can be consulted on the ASN's website.

5. Article 5: Competent regulatory authority

1. Member States shall establish and maintain a competent regulatory authority in the field of nuclear safety of nuclear installations.

2. Member States shall ensure that the competent regulatory authority is functionally separate from any other body or organisation concerned with the promotion or utilisation of nuclear energy, including electricity production, in order to ensure effective independence from undue influence in its regulatory decision making.

3. Member States shall ensure that the competent regulatory authority is given the legal powers and human and financial resources necessary to fulfil its obligations in connection with the national framework described in Article 4(1) with due priority to safety. This includes the powers and resources to:

(a) require the licence holder to comply with national nuclear safety requirements and the terms of the relevant licence;

(b) require demonstration of this compliance, including the requirements under paragraphs 2 to 5 of Article 6;

(c) verify this compliance through regulatory assessments and inspections; and

(d) carry out regulatory enforcement actions, including suspending the operation of [the] nuclear installation in accordance with conditions defined by the national framework referred to in Article 4(1).

5.1 *The legal basis and the regulatory authority*

Law No 2006-686 of 13 June 2006 (the TNS Law, codified in the Environment Code) created the Nuclear Safety Authority ('the ASN'), an independent administrative authority, responsible for supervising nuclear safety and radiation protection on behalf of the State in order to protect workers, patients, the general public and the environment from the risks associated with civil nuclear activities.

The law allows the ASN to adopt technical regulatory decisions to supplement the implementing rules of the decrees and orders adopted in the field of nuclear safety or radiation protection (with the exception of those relating to occupational health), which are subject to the approval of the minister with responsibility for nuclear safety or radiation protection. It also grants the ASN the power to impose requirements on the operator of a BNI throughout the lifetime of installation, including during its decommissioning, for example to request the correction of an anomaly or to avert a particular risk.

The ASN is consulted by the Government about general regulatory legislation within its areas of competence and about individual decisions. It fleshes out the legislation by means of technical decisions. The nuclear safety and radiation protection inspectors designated by the ASN guarantee the monitoring and supervision of nuclear activities and the BNI. Labour inspections at nuclear power plants are entrusted to the ASN's inspectors, who exercise the powers conferred upon them under the authority of the minister responsible for labour.

The ASN contributes to providing information to the public. Finally, the ASN provides support in connection with the management of radiological emergencies.

5.2 The independence of the regulatory authority

The ASN is managed by a college composed of five commissioners appointed by decree by virtue of their expertise in the fields of nuclear safety or radiation protection. Three of the commissioners, including the president, are appointed by the President of the Republic. The two other commissioners are appointed by the President of the National Assembly and the President of the Senate respectively.

The ASN commissioners perform their roles on a full-time basis.

As soon as they are nominated, the commissioners are required to produce a declaration setting out the interests they hold or have held over the past five years in the areas falling within the jurisdiction of the Authority. During his term of office, a member may not hold an interest capable of affecting his independence or his impartiality. For the duration of their functions, the commissioners are not to adopt, on a personal basis, any public position on matters falling within the jurisdiction of the Authority.

The term of office of the members is six years. It is non-renewable. A member may be removed from his functions only if he is prevented from performing his duties or resigns from his position, as determined by the college acting on the basis of the majority of commissioners. The President of the Republic may also remove a member of the college from his functions in the event of a serious breach of his duties.

The college defines the ASN's strategy. In this regard, it establishes a multiannual strategic plan and produces general policies, that is to say guidelines and policy principles adopted by the ASN in the context of its core missions, namely regulation, supervision, transparency, management of emergency situations, international relations etc.

Pursuant to the TNS Law, the college delivers opinions of the ASN to the Government and adopts the principal decisions of the ASN. The members of the college perform their duties completely impartially without receiving instructions from the Government or from any other person or institution.

It produces regular reports on its activities, in particular by submitting its annual activity report to the Parliament, the Government and the President of the Republic. In the case of the Parliament, every year the ASN presents its report on the state of nuclear safety and radiation protection in France to the *Office Parlementaire d'évaluation des choix scientifiques et technologiques* [Parliamentary Office for the Evaluation of Scientific and Technological Choices] ('the OPECST').

Established in July 1983, the role of the OPECST is to set out for the Parliament the consequences of choices of a scientific or technological nature in order, *inter alia*, to inform its decision making. The Parliamentary Office is assisted by a Scientific Council composed of members reflecting the diversity of scientific and technological disciplines. The task of the members of the OPECST is to study how safety and radiation protection is organised, both within the administration and at the operator, to compare the safety and radiation protection features with those of other countries, and to determine whether the authorities have the resources to carry out their responsibilities. The Office's reports are produced prior to the vote on a law as a means of preparing for the legislative decision, or thereafter with a view to following up on the application of the legislation adopted. The members of the OPECST also played a key role in the drafting of the TNS Law.

5.3 The resources of the regulatory authority and its activity

Human resources

As at 31 December 2013, the total number of ASN employees stands at 478, 257 of whom work in central services, 218 in the territorial divisions and three overseas.

As at 31 December 2013, the average age of ASN employees was 43 years and two months. This balanced age pyramid and the diversification of the people recruited, that is to say the diversification of experience, mean that the ASN has the qualified and complementary human resources necessary for the performance of its mission. Furthermore, the training available, the arrangements for the integration of younger members of staff and the transfer of knowledge contribute to guaranteeing the expertise and skills necessary for the Authority's activities.

Financial resources

Since 2000, all the personnel and operational resources contributing to the performance of the tasks entrusted to the ASN have come from the general State budget voted by Parliament. For 2013, the full-cost budget of the ASN stands at EUR 79 million.

Moreover, as provided for in the TNS Law, the ASN relies – in connection with certain decision making – on the IRSN, which provides it with technical expertise, supported where appropriate by research. The corresponding sum allocated to such activity amounts to EUR 84 million in 2013.

Technical support provided to the regulatory authority

The ASN benefits from expert technical support in the preparation of its decisions. The *Institut de radioprotection et de sûreté nucléaire* ('the IRSN', www.irsn.fr) is the main provider of such support.

The IRSN is an industrial and commercial public body of the State which performs its expert opinion and research responsibilities in particular in the fields of nuclear safety and radiation protection. The Institute conducts and implements research programmes with a view to establishing the national capacity of public expertise in the most advanced scientific knowledge available internationally and to contributing to the development of scientific knowledge in relation to nuclear and radiological risks. It is responsible for providing technical support to the public authorities with responsibilities in the fields of safety, radiation protection and security. Finally, it performs certain tasks in the public interest beyond the field of research, *inter alia* in connection with the monitoring of the environment and of the people exposed to ionizing radiation. A five-year agreement concluded between the ASN and the IRSN determines the arrangements for the provision of that technical support. Every year it is condensed into a protocol, thus making it possible to refine the priorities in line with the challenges in terms of nuclear safety and radiation protection.

In preparation for its decisions on the most important subjects, the ASN also relies on the opinions and recommendations of permanent groups of experts (PGE). Seven permanent groups of experts have been set up by the Director General of the ASN. The PGE are consulted by the ASN in relation to the nuclear safety and radiation protection of the installations and activities falling within their area of responsibility, that is to say nuclear reactors, laboratories and plants using radioactive materials, radiation protection in the medical sector, radiation protection in sectors other than medicine, waste, transportation and pressurised nuclear equipment.

The PGE are composed of experts appointed by virtue of their expertise, drawn from academic and associated backgrounds, as well as of the operators concerned by the subjects addressed. The involvement of foreign experts allows for the diversification of the methods of approaching problems and for greater benefits to be derived from the experience acquired internationally.

For each of the subjects addressed, the PGE study the reports produced by the IRSN or an alternative commissioned expert. They give an opinion together with related recommendations.

Monitoring by the regulatory authority

Nuclear safety and radiation protection are monitored in France at several levels:

- before an operator performs an activity subject to a licence, by examination and analysis of the files, documents and information provided by that operator to justify its actions. The purpose of this monitoring is to ensure that sufficient information is provided on a permanent basis;
- during the operation of a BNI, by visits, inspections of all or part of the installation, document checks and checks conducted on the ground in the case of interventions which have significant implications, such as scheduled shutdowns of nuclear reactors, and the analysis of significant events. This monitoring is carried out by means of sampling and by the analysis of the data provided by the operator to justify the performance of its activities.

The ASN endeavours to ensure compliance with the principle of the prime responsibility of the operator in matters relating to safety and radiation protection. It incorporates the idea of proportionality to guide its activities in order to tailor the scope and depth of the monitoring to the potential implications in terms of nuclear safety and health and environmental security.

Inspections are the preferred means of monitoring at the disposal of the ASN. Although not conducted systematically or exhaustively, inspections allow isolated anomalies to be detected, as well as any deviations which may point to a decline in the safety of the installations.

5.3.1 Operators' compliance with safety requirements

The operation of a BNI is subject to the grant of a licence pursuant to Article L. 593-1 of the Environment Code.

The file accompanying the licence application contains all the supporting evidence to enable the competent authority to decide whether to grant the licence or to refuse it. The operator must demonstrate that its proposed technical and organisational arrangements at the design, construction and operation stages, as well as the principles proposed by it for the decommissioning of the BNI, are capable of averting or sufficiently mitigating the risks or disadvantages presented by the installation to the interests protected by law, namely public security, health and hygiene as well as the protection of nature and of the environment.

The operator must also provide information to allow the competent authority to assess that it has the technical and financial capacities to enable it to implement its plans and to operate its installation in a manner consistent with the interests stated above, in particular in order to cover the costs of decommissioning.

In the course of the examination conducted by it, the ASN may request any additional information which it deems to be necessary for the MSNR. If the operator, at the request of the MSNR, fails to produce the information required, the MSNR may decide to suspend the examination of the application.

With regard to the application of the various licences, the ASN may lay down requirements for the protection of the abovementioned interests, requirements which must be observed by the operator in question.

In addition, throughout the lifetime of the BNI, the ASN monitors compliance with the regulations and the terms of the licence by means of inspections conducted at regular intervals by ASN's nuclear safety inspectors (see Section 5.3.3).

5.3.2 Technical examination of the files supplied by the operator

Examination of the supporting documents produced by the operators combined with technical meetings organised with the operators of BNI or the manufacturers of equipment used in the installations is one of the forms of monitoring conducted by the ASN. The purpose of the files supplied by the operator is to demonstrate compliance with the objectives laid down in the general technical regulations as well as those which it itself has laid down. The ASN is called upon to verify whether the file is sufficiently complete and to assess the quality of the demonstration made.

At the design and construction stage, the ASN checks the safety reports, which describe and provide justifications for the design principles, the calculations of the dimensions of the equipment, the rules governing the use and testing of that equipment, and the organisation of the quality system established by the prime contractor and its suppliers.

Once the BNI has entered into service, any modifications made by the operator which are important from the perspective of safety are to be declared to the ASN. In addition to the meetings necessitated by changes made to installations or to their method of operation, the ASN requires that the operators conduct regular safety reviews (see Section 6.2.1.3.2). The examination of the documents produced following those reviews may prompt the ASN to accept or to refuse the operator's proposals, or to require that supplementary information be provided, studies conducted or even compliance work carried out. The ASN lays down its requirements in the form of a licence or decision.

Whenever it considers it to be necessary, the ASN obtains the opinion of providers of technical support, the main provider of which is the IRSN. Safety assessments require the collaboration of a number of specialists and effective coordination in order to establish the key points relating to safety. The assessment conducted by the IRSN relies on studies and research and development programmes devoted to risk prevention and the improvement of knowledge on the subject of accidents. It is also based on in-depth technical exchanges with the operators' teams which design and operate the installations.

In the most serious cases, the ASN seeks the opinion of the competent PGE; in other cases, the safety analyses are the subject of opinions delivered directly to the ASN by the IRSN.

5.3.3 Inspection

5.3.3.1 Objectives and principles

In order to take account of the respective health and environmental implications and the performance of the operators in the areas of nuclear safety and radiation protection, the ASN identifies the activities and subjects which are most significant and upon which it focuses its inspections.

In order to assess those key activities and subjects, the ASN relies on the latest scientific and technical knowledge, the information obtained from external inspections, the examination of the files submitted by the operators and the results of the inspection activities which it has conducted. The ASN may at any time revise its assessment of the key activities and subjects in the light of their development and of significant events which have occurred in France or in the world.

Compliance with the safety standard by nuclear operators is subject to monitoring conducted at random in the form of inspections with a view to conducting specific checks on the implementation of the provisions on safety, radiation protection and related areas monitored by the ASN.

In the course of the inspections, findings are made and brought to the attention of the operator; those findings may relate to:

- anomalies in the installation or issues which require further justification in the view of the inspectors;
- discrepancies between the situation observed during the inspection and either the regulatory provisions or the documents drawn up by the operator in accordance with the regulations.

5.3.3.2 Inspection practices

Every year the ASN draws up a provisional inspection schedule. That schedule is not known to the operators of nuclear installations. It sets the priorities, priorities which are intended to entail increased monitoring of the issues or activities presenting the greatest implications. It also allows for an adequate distribution of ASN's resources in proportion to the relevant significance of the various installations.

Inspections are either announced to the operator a few weeks prior to the visit or are unannounced (approximately 25% of inspections). They take place primarily at the sites of nuclear activities. They may also be carried out at the offices of central services (or research services) of the major nuclear operators, the workshops or research offices of subcontractors, and the construction sites, plants or manufacturing workshops of the various components important from the perspective of safety.

The inspections are generally carried out by a team of two inspectors, one of whom is more specifically focussed on the management of the inspection, and may be supported by a IRSN representative with specialist knowledge either of the installation visited or of the technical subject-matter of the inspection. The ASN conducts different types of inspections:

- routine inspections;
- review inspections which take place over several days involving a whole team of inspectors and the purpose of which is to conduct in-depth examinations;
- inspections including the taking of samples and measurements which allow random monitoring independent from that conducted by the operator to be conducted;
- inspections conducted following a significant event; and
- site inspections connected with the shutdown of reactors or specific works, in particular during the decommissioning phase.

Within 21 days of each inspection, a follow-up letter must be issued; that letter is made public on the ASN's website.

5.3.3.3 The organisation of the regulatory authority in relation to the supervision of BNI

In order to carry out its supervisory function in relation to BNI, the ASN has teams of inspectors designated and authorised to act by the president of the ASN, in accordance with the arrangements laid down in Decree No 2007-831 of 11 May 2007, because they have acquired the legal and technical skills through their professional experience, 'buddying' or training. They carry out their supervisory duties under the authority of the Director General of the ASN and have at their disposal regularly updated practical tools to enable them to carry out their inspections. They take an oath and are bound by the rules of professional secrecy.

As at 31 December 2013, the number of nuclear safety inspectors in post stood at 162: 91 in the ASN's regional divisions and 71 in central services. Those inspectors lead the majority of the inspections at the BNI. Labour and radiation protection inspectors may also enter the installations to conduct inspections.

Indeed, the supervision of the application of all the provisions governing labour regulations (concerning, in particular, work safety or the social arrangements which seek to protect staff) falls to the officials in charge of labour inspections. Nevertheless, in the case of NPP, the labour inspectors are ASN inspectors appointed for that purpose by the president of the ASN. They act under the authority of the minister responsible for labour.

The three key tasks of labour inspections – supervision, information and advice – cover working conditions and the protection of workers. Their legitimacy stems not only from

international rules (in particular Convention No 81 of the International Labour Office) but also from national legislation governing inspection services.

In the NPP, the supervisory actions in relation to nuclear safety, radiation protection and labour inspection very often concern common themes, such as the organisation of sites or the conditions governing the use of subcontractors.

With a view to strengthening the credibility and quality of its activities, the ASN:

- has established a qualification system for its inspectors based on the recognition of their technical expertise;
- has adopted certain foreign practices identified through exchanges of inspectors between regulatory authorities; and
- encourages its inspectors to be open to alternative supervisory practices.

5.3.4 Coercive measures at the disposal of the regulatory authority

Any breaches observed are recorded in reports drawn up by the nuclear safety inspectors and sent to the State Prosecutor, who decides whether or not a prosecution may be brought. The Environment Code provides for criminal penalties, which are detailed in Articles L. 596-27 to L. 596-30; those penalties include fines ranging from EUR 7 500 to EUR 150 000 which may be accompanied by a term of imprisonment of between one and three years depending on the nature of the breach. In the case of legal persons found to be criminally liable, the amount of the fine may reach EUR 1 500 000.

Article 56 of *Décret n° 2007-1557 du 2 novembre 2007 relatif aux installations nucléaires de base et au contrôle, en matière nucléaire, du transport de substances radioactives* [Decree No 2007-1557 of 2 November 2007 on basic nuclear installations and the supervision, in nuclear matters, of the transportation of radioactive substances] also provides for 5th class offences for the breaches detailed therein.

Failure to comply with the *Code du travail* [Labour Code]

In the exercise of their responsibilities at NPP, the labour inspectors of the ASN have all the supervisory, decision-making and coercive measures at the disposal of inspectors in ordinary law. The observation of the infringement, the issue of the letter of formal notice, the production of the report, the initiation of summary proceedings (to bring risks to an end without delay) or even the shutdown of the site represent a range of incentive and coercive measures available to the labour inspectors of the ASN.

6. Article 6: Licence holders

1. Member States shall ensure that the prime responsibility for nuclear safety of a nuclear installation rests with the licence holder. This responsibility cannot be delegated.

2. Member States shall ensure that the national framework in place requires licence holders, under the supervision of the competent regulatory authority, to regularly assess and verify, and continuously improve, as far as reasonably achievable, the nuclear safety of their nuclear installations in a systematic and verifiable manner.

3. The assessments referred to in paragraph 2 shall include verification that measures are in place for prevention of accidents and mitigation of consequences of accidents, including verification of the physical barriers and licence holder's administrative procedures of protection that would have to fail before workers and the general public would be significantly affected by ionizing radiations.

4. Member States shall ensure that the national framework in place requires licence holders to establish and implement management systems which give due priority to nuclear safety and are regularly verified by the competent regulatory authority.

5. Member States shall ensure that the national framework in place requires licence holders to provide for and maintain adequate financial and human resources to fulfil their obligations with respect to nuclear safety of a nuclear installation, laid down in paragraphs 1 to 4.

6.1 The prime responsibility for nuclear safety

The organisational and regulatory system of nuclear safety in France is based on the prime responsibility of the operator. This principle of the prime responsibility of the operator is contained in Article L. 593-6 of the Environment Code.

The BNI Order also deals with the operator's integrated management system and provides that the operator is to define and implement a management system which enables it to guarantee that the requirements relating to the protection of the interests identified in the BNI rules are systematically taken into account every time a decision is taken regarding its installation.

The ASN, on behalf of the State, ensures that that responsibility is fully assumed in a manner consistent with the regulatory requirements. The breakdown of the respective roles between the ASN and the operator may be summarised as follows:

- the ASN defines the general objectives relating to safety and radiation protection;

- the operator proposes technical arrangements to achieve those objectives and provides related supporting evidence;
- the ASN verifies that those arrangements enable the objectives to be achieved;
- the operator implements the approved arrangements;
- the ASN monitors, in the course of inspections, the proper implementation of those arrangements and draws related conclusions.

6.2 *Safety assessments and verification*

6.2.1 Requests and checks by the regulatory authority

Safety assessments are conducted by the regulatory authority at all stages of the lifetime of a BNI.

The TNS Law provides for a licensing procedure for the construction of a BNI followed by licences marking stages in the operation of a BNI, from its entry into service to its decommissioning, including any modifications made to the installation. These points are covered in detail in Chapter 4 of this report.

6.2.1.1 Assessments prior to construction

The preliminary safety report (PSR), which forms part of the file accompanying the licence application, sets out and provides explanations to the ASN for the arrangements adopted at each stage of the lifetime of the installation in order to comply with the regulations and to guarantee safety. It brings together all the information on the basis of which it is possible to verify that account has indeed been taken of all the risks (of nuclear origin or not) and all the possibilities of attack (internal or external), and that, in the event of an accident, the protection of staff, the general public and the environment is properly ensured by the measures put in place. This report takes due account of the features specific to the site and its environment (meteorological, geological and hydrological conditions, industrial environment etc.).

Furthermore, in advance of the licence application procedure, a safety options file (SOF) may be sent by the future licence holder, who may thereby obtain the opinion of the ASN in relation to some or all of the safety options envisaged for the future installation prior to the grant of the construction licence.

6.2.1.2 Assessments prior to commissioning

Commissioning means the first use of radioactive materials in the installation or the first use of a particle beam. In order to secure the commissioning of a BNI, the operator must send to the ASN a file containing an update of the safety report of the installation ‘as constructed’ and of the impact study, the general operating rules (GOR), a waste management study, the

internal emergency plan and the decommissioning plan. Those documents are examined by the ASN, with the assistance of the IRSN and the PGE.

With regard to the Flamanville 3 EPR reactor, without waiting for the complete file accompanying the commissioning application announced by EDF for October 2014 to be sent, the ASN – together with the IRSN – initiated a preliminary examination (in preparation for the formal examination of the file accompanying the commissioning application) of:

- the technical standards necessary for safety demonstrations and the finalisation of the detailed design of the reactor;
- the detailed design of certain systems important from the perspective of safety, as presented in the safety report; and
- certain documents which make up or guide the compilation of the file accompanying the commissioning application.

6.2.1.3 Assessments and reviews during operation

The Order of 7 February 2012 requires operators to establish an integrated safety management system which enables safety to be maintained and continuously improved, in particular during the operation of nuclear installations. That management system is used to ensure, *inter alia*, that the nuclear-safety-related requirements are systematically taken into account every time a decision is taken regarding the installation.

In France, over the course of the operation of the BNI, safety assessments and checks are carried out continuously and periodically.

6.2.1.3.1 The continuous improvement of safety

Correction of faults

Faults are detected in the BNI thanks to the proactive approach adopted by the operator and to the systematic checks required by the ASN. The periodic testing and preventive maintenance programmes conducted on the equipment and systems, as well as the fault checking carried out continuously by the operator, play a major role in maintaining an acceptable level of safety.

The ASN requires that anomalies with an impact on safety are rectified within a period of time tailored to their degree of seriousness. The ASN therefore examines the arrangements and time-limits for ensuring compliance proposed by the operator.

Examination of events and operating experience acquired

All experience acquired represents a source of improvement in the fields of safety, radiation protection and the environment. Related legislation, and in particular the BNI Order, explicitly refers to that principle and requires operators to implement an integrated management system which includes the arrangements enabling them *inter alia* to identify and deal with faults and significant events.

The legislation requires operators to implement a reliable system for the detection of the anomalies which may occur, such as equipment failures or errors associated with the application of the operating rules. The notification of significant events must not be treated in the same way as radiological emergencies, for which different arrangements are in place, or a system intended to penalise the errors made by the operator or by an individual.

All significant events from the perspective of nuclear safety must be notified by the operators as soon as possible (within 48 hours) to the ASN, together with a proposal for classification on the INES scale (the ASN alone is responsible for the final classification decision). The ASN analyses that initial notification in order to verify that immediate corrective steps have been taken, to decide on whether to conduct an on-site inspection so as to conduct an in-depth assessment of the event, and, where appropriate, to prepare information for the public.

Within a period of two months, the notification is supplemented by a report setting out the conclusions that the operator draws from the analysis of the events and the steps that it is taking to improve safety or radiation protection. The ASN ensures that the operator has conducted a relevant analysis of the event, has made appropriate arrangements to rectify the situation and prevent it from happening again, and has disseminated the empirical knowledge acquired.

The ASN takes the view that the principle of the systematic notification of incidents is essential for the purposes of transparency and the sharing of experiences. Over the past number of years there has been a general upward trend in the number of significant events. Nevertheless, that trend must be qualified according to the areas of activity in question. In the case of the NPP, the number of significant events notified remains stable overall. Those data must, however, be treated with caution because on their own they are not an indicator of safety.

The ASN also endeavours to disseminate the empirical knowledge acquired from the operation of French nuclear installations in the course of bilateral and even multilateral exchanges with its counterparts or indeed other safety-related bodies. Nationally, the PGE periodically examine the empirical knowledge acquired at national and international level from the installations in operation. The ASN and the IRSN are likewise involved in various information exchange fora within the IAEA, the NEA and the European Union. For example, the ASN is a member of working groups within the Nuclear Energy Agency (NEA): the Working Group on Operating Experience (WGOE) is concerned with reactors in operation and the Working Group on the Regulation of New Reactors focuses *inter alia* on the sharing of experience acquired in connection with the construction of new reactors. The ASN also

asks operators to draw the necessary lessons from significant events which have occurred in other countries, in particular from reports based on IRS data produced by the IAEA and the NEA.

Modifications made to equipment and changes to the operating rules

In accordance with the principle of continuous improvement of the safety level of reactors, but also with a view to enhancing the industrial performance of their production facilities, operators periodically make modifications to the equipment and changes to the operating rules (see Section 6.3.1.2). Those modifications and changes are the result, for instance, of the handling of faults, safety reviews and even the account taken of experience acquired.

The ‘BNI Procedures’ Decree made it possible to clarify the requirements relating to the introduction of modifications and changes by the operators and to their examination by the ASN (see Section 4.1.2.3). In 2013, the primary purpose of the notifications of modifications to equipment received by the ASN was to improve the safety level of reactors, to tackle faults and to take actions following on from the supplementary safety assessments.

Supplementary safety assessments

In 2011, the ASN launched a BNI safety assessment initiative in the light of the accident which occurred at the Fukushima Daiichi power plant.

That initiative was adopted in response to the request made by the Prime Minister and to the conclusions of the European Council on the performance of stress tests in order to verify the robustness of nuclear power plants in the face of exceptional situations of the type which led to the accident at the Fukushima Daiichi power plant. The initiative was conducted in line with the specifications drawn up at European level by WENRA (approved by the ENSREG) with two extensions: firstly, the initiative conducted in France covered all BNI, including research and fuel cycle facilities; secondly, the specifications were supplemented by the addition of points relating to social, organisational and human factors as well as to the use of subcontractors.

The supplementary safety assessments (SSA)¹ consisted in a targeted re-assessment of the safety margins of the BNI in the light of the events which took place at Fukushima Daiichi, namely extreme natural phenomena (earthquakes, floods) and their combination, putting the safety functions of the installations to the test and resulting in a serious accident.

Following the SSA of the priority BNI, the ASN took the view that the installations examined are of a sufficient level of safety not to require the immediate shutdown of any of them. However, in order for certain installations to continue to operate, the robustness of those

¹ <http://www.asn.fr/index.php/Les-actions-de-l-ASN/Le-controle/Evaluations-complementaires-de-surete>

installations in the face of extreme situations must be increased beyond the current margins of safety.

On 26 June 2012, the ASN adopted 32 decisions² requiring operators to adopt supplementary arrangements. Those arrangements will improve the robustness of the BNI in the face of external threats, with the intention being to prevent accidents and, in the event that an accident should occur, to mitigate the effects of accidents. In November 2013 and January 2014, by means of decisions adopted by its college, the ASN clarified its requirements vis-à-vis the introduction of the core set of measures applicable to BNI.

Those new requirements cover subsequent work and investment, which began back in 2012 and will span several years:

- the introduction of a ‘core set’ of equipment-related and organisational measures at all installations requiring such measures in order to enable basic safety functions to be performed in extreme situations. The purpose of this is to prevent a serious accident, to limit mass radioactive discharges in the event of an accident which could not be managed and to allow the operator in question to guarantee – even in extreme situations – the performance of its duties in connection with the management of a crisis.³ The equipment which will form part of that core set of measures is to be designed to withstand major events (earthquakes, floods etc.), events on a scale significantly greater than those taken into account to determine the level of resistance of the installations, even if those events are not considered to be plausible. In addition, that equipment is to be protected from internal and external attacks triggered by such extreme situations. In the case of the EDF nuclear power plants, the ‘core set’ of measures is to include an additional ‘bunkerised’ emergency back-up diesel generator for each reactor, a diversified emergency water supply system for each reactor, as

²<http://www.asn.fr/index.php/Les-actions-de-l-ASN/Le-controle/Evaluations-complementaires-de-surete/Decisions-2012-de-l-ASN-Prescriptions-complementaires>

³ The operator must, in particular, lay down requirements relating to:

- the emergency management centres, so that they can offer a high level of resistance to attacks and remain accessible and habitable permanently and over the course of lengthy crisis situations, including in the case of radioactive discharges. Those centres are to enable crisis teams to diagnose the status of the installations and to assume control of the resources allocated under the core set of arrangements;
- the availability and operability of the mobile resources essential for crisis management purposes;
- the means of communication essential for crisis management purposes, including in particular the means of alerting and informing the members of the crisis teams and the authorities and, should they prove necessary, systems to alert the public in the event of the initiation of the specific intervention plan in the response stage acting on powers delegated by the Prefect;
- the availability of the parameters enabling the status of the installation to be diagnosed, as well as of meteorological and environmental measurements (radiological and chemical, inside and outside the emergency management centres) to enable the radiological impact on workers and on the general public to be assessed and forecast;
- operational dosimetric measures, tools to measure radiation protection levels and individual and collective protection measures. These resources are to be available in sufficient quantities.

well as a local crisis management centre for each site capable of withstanding the occurrence of a large-scale event affecting several installations;

- the gradual introduction, from 2012, of the '*Force d'action rapide nucléaire*' [Nuclear Rapid Response Force] ('the NRRF') proposed by EDF. This is a national response mechanism within EDF involving specialised teams and equipment,⁴ enabling teams at the site of an accident to be relieved and supplementary emergency response measures to be adopted in under 24 hours, with the launch of on-site operations within 12 hours of their deployment. This mechanism may be shared between several of the operator's nuclear sites;
- a new standard in the internal emergency plan (IEP) to take into account accidental situations simultaneously affecting several installations at the same site;
- where fuel storage pools are shared between different installations, the introduction of reinforced arrangements which seek to reduce the risks associated with fuel dewatering;
- in the case of the CEA's research reactor facilities, several types of arrangement were adopted: the boosting of the power supply to certain equipment deemed to be essential, the integration of additional robust instrumentation to manage extreme situations and the reinforcement of water management measures and the final water tank for the pools. Crisis management centres and accommodation for emergency response teams are also under construction.

Furthermore, in addition to the ordinary inspection schedule, the areas covered by the SSA were the subject of 38 targeted inspections in 2011 conducted at the nuclear sites deemed to be priorities. In 2012, the ASN carried out inspections to review the implementation of the corrective actions required following the inspections performed in 2011 across all nuclear installations.⁵

The ASN has published France's action plan for the implementation of the recommendations from the European stress tests conducted from 2011 and, more generally, for the implementation of all the actions decided upon following those assessments.⁶

⁴ These teams must be of an appropriate size to respond across all the reactors at a site and be equipped with measurement tools capable of being deployed on their arrival. The operator is to specify the organisation and size of those teams, and in particular the activation criteria, the duties of the teams, the material and human resources available to the teams, the individual protection equipment, the system put in place to guarantee the maintenance of those material resources as well as their permanent operability and availability, the training of the team personnel and the process to ensure that skills are maintained.

⁵<http://www.asn.fr/index.php/Les-actions-de-l-ASN/Le-controle/Evaluations-complementaires-de-surete/Inspections-ciblees>

⁶<http://www.asn.fr/index.php/Les-actions-de-l-ASN/Le-controle/Evaluations-complementaires-de-surete/Actualites-concernant-les-ECS/Stress-tests-europeens-l-ASN-publie-son-plan-d-action-national>

6.2.1.3.2 Periodic safety reviews

In addition to the abovementioned continuous procedures necessitated by modifications to installations and changes to their mode of operation, operators are required – pursuant to Article L. 593-18 of the Environment Code⁷ – to conduct periodic safety reviews every 10 years.

The safety review is an opportunity to conduct an in-depth examination of the condition of the installations in order to verify that they comply with the applicable safety standard. A further objective of the safety review is to improve the safety level of the installations. With that in mind, the requirements applicable to the current installations are compared to those which must be satisfied by the most recent installations, and the improvements which may reasonably be implemented are proposed by the operator. The findings of those reviews are submitted to the ASN, which may impose new requirements with a view to tightening up safety requirements.

After potentially consulting the PGE, depending on the installation concerned, the ASN decides on the list of areas chosen to form the subject of safety review studies during the ‘safety review orientation’ stage. On completion of those studies, a series of modifications to improve safety is defined. They will be rolled out during the ten-yearly inspection of the nuclear installation concerned.

Since the amendments to the regulations applicable to BNI, the BNI associated with research and fuel cycle facilities must be subject to a safety review no later than 2017. In the case of some of those BNI, this will be an initial review which may lead to major upgrade work in the areas of earthquake resistance, fire protection and containment.

⁷ This article is the result of the codification of Law No 2006-686 of 13 June 2006 on transparency and nuclear safety:

‘The operator of a basic nuclear installation shall periodically review the safety of its installation, taking into account the best international practices.

That review must enable the status of the installation in question to be assessed in the light of the rules applicable to it and allow the assessment of risks and disadvantages posed by the installation to the interests stated in Article L. 593-1 to be updated, by taking into account *inter alia* the condition of the installation, the experience acquired in the course of its operation, the advances in related knowledge and the rules applicable to similar installations.

The safety reviews shall take place every ten years. However, the decree licensing the construction of the installation in question may specify a different review cycle if this is justified by the particular features of the installation.

Where applicable, the operator may provide – in the form of a separate report – the information which in its view would, if disclosed, be prejudicial to one of the interests referred to in Article L. 124-4. Subject to that proviso, the safety review report shall be communicable to any person pursuant to Articles L. 125-10 and L. 125-11.’

In 2013, the ASN submitted the draft decision on the safety reviews of BNI for public consultation. That draft decision specifies the objectives, the scope and the three stages making up the reviews.⁸ In particular, the draft decision sets out the framework for the production of the review orientation file (ROF) and reproduces *inter alia* the ‘reference levels’ under Issue ‘P’ drawn up by WENRA regarding the safety reviews of reactors and relevant to all BNI.

The safety review is also an opportunity to conduct a detailed analysis of the effects of the ageing of the equipment. Thus, in the case of reactors undergoing their third ten-yearly inspection, an ageing analysis must be conducted covering all the degradation mechanisms capable of affecting the components important to safety and the non-classified components which may have an impact on the functioning of components important to safety. Management of the effects of ageing must be demonstrated by relying on the experience acquired from operation of the installation, the maintenance arrangements and the ability to repair or replace the components. On the third ten-yearly inspection of each nuclear installation, that analysis triggers the production of a ‘suitability for continued operation’ file.

6.2.2 The measures adopted by licence holders

The safety of installations is examined and implemented throughout the design, construction, operation, shutdown and decommissioning stages. That systematic analysis is integrated into all the processes contributing to the definition, construction, operation and decommissioning of installations, and the findings of that analysis are outlined in the installation documentation, in particular the BNI safety reports.

Any change to the operating conditions or to the works being carried out in BNI forms the subject of a prior analysis of the associated risks; that analysis is conducted and formalised in the context of defined procedures and in accordance with the licences provided for in the regulatory provisions. Depending on the significance of the changes, internal authorisation committees or internal start-up authorisation committees meet and issue an independent opinion to the nuclear operator.

This permanent safety inspection process is supported periodically by the safety review process. The safety reviews are a continuous and demanding process. The ten-yearly safety review process is an important milestone in terms of the safety of installations, and the value of the process is now broadly recognised internationally. It forms part of and makes explicit the ongoing maintenance actions and actions to improve the safety level of nuclear installations. This process is based on two major technical axes: the compliance check and the safety re-assessment.

⁸ <http://www.asn.fr/Reglementer/Consultations-du-public/Archives-des-consultations-du-public/Projet-de-decision-de-l-ASN-relative-au-reexamen-de-surete-des-INB>

Emphasis is placed first and foremost on the compliance check. That check involves verifying that the regulatory amendments, the modifications to the installation and the changes to its operation do not call into question the design-stage safety analyses and remain consistent with the licensed field of operation. This compliance check is based on the requirements applicable to the installation, requirements which are kept permanently up-to-date.

In addition to the permanent actions in this field, a schedule of physical checks of the installation is drawn up and implemented. The operator proposes amendments to its maintenance and monitoring programmes and the implementation of compensatory measures on the basis of studies of ageing phenomena and the knowledge which it acquires from its experiences. A plan to check the compliance of the operational practices with the documents pertaining to the applicable safety standard is also drawn up and put into practice. A plan to return the installation to a state of compliance is, where appropriate, defined and implemented.

The safety re-assessment is the opportunity to re-evaluate the safety of the installation in the light both of the current safety and radiation protection regulations and practices and of incidents that have occurred at similar installations in France and in other countries. It serves to identify axes for the improvement of the installations or of their operation.

6.2.2.1 Measures adopted in respect of nuclear power plants

Continuous safety assessments and checks

The continuous improvement of performance in terms of safety, but also in terms of radiation protection, the environment or even production, is based on a systematic approach making use of experience acquired. The use of experience acquired (EXA) involves drawing lessons from the past in order to improve the future. The operating experience acquired by EDF is based on a fleet of 58 reactors in operation of a relatively homogenous design.

The operating experience process includes the following stages:

1. *the detection, collection or situation selection stage (a fault, anomaly, a good or bad practice etc.)*

Detection is carried out on the basis of all the available information (periodic operational reviews, professional practices, observed faults, anomalies or events, including international events and events outside the nuclear field but which are taken into account at national level).

The purpose of the selection is to prioritise the issues to be addressed depending on their significance and to initiate the method of dealing with them. Selections are made at every level of the organisations. Selection contributes to the early detection of

recurring problems or of matters of national importance because they are potentially of a generic nature or are precursors.

2. *the analysis stage, including the definition of corrective and preventive actions where they prove necessary*

The purpose of the analysis is to define the issue to be dealt with, to specify the risks, potential implications and areas concerned, and to identify the existing EXA, the actions already initiated, and the objectives to be achieved. It culminates in the proposal of corrective, preventive or alternative solutions.

Analyses of events of a national scale using the same methods deployed at national fleet level can be used to identify generic causes and to define corrective actions with a more global reach.

3. *the corrective or preventive action implementation stage, incorporating the supervision of implementation and the verification of the efficiency of the actions*

The action implementation stage also includes compliance checks and monitoring to determine their efficiency as compared with the objectives pursued.

4. *the stage of exchanging experiences with the operational teams*

The purpose of this stage is to disseminate and share the lessons learnt from the analyses by providing information on the EXA to the operational teams at every level of the organisations.

The EXA project has clarified those principles and the associated organisational framework. In 2013, all the NPP will be involved in the deployment, with various degrees of progress.

Some specific examples:

Following the flooding of the Blayais site in 1999, EDF re-assessed the protection of its sites against the risks of external flooding. The following protective arrangements were adopted at all sites: the introduction of a protective system to seal the openings which potentially allowed water ingress, the implementation of adapted warning and handling procedures, the creation of a local and national crisis organisation. Immediate measures (such as volumetric protection) were quickly adopted. Between 2001 and 2007, a full re-assessment of the flood risk was conducted with a view to supplementing the work undertaken immediately after the Blayais flooding. The supplementary safety assessments prompted the ASN to require EDF to complete all the works identified in that re-assessment by the end of 2014.

High flood waters in December 2009 resulted in the blockage and partial loss of the heat sink at the Cruas and Fessenheim reactors. EDF launched a design review of all the heat sinks, the detailed findings of which were announced in 2012. The measures include the placement of a water-level measure downstream of the filtration unit, as well as improvements to the performance of the pre-filtration and filtration equipment so that they can cope with a

massive influx of substances which clog them. The supervisory and operational handling arrangements were also reviewed, as were the requirements applicable to the pumping station equipment.

Exceptionally high temperatures were recorded across the whole of France in the summers of 2003 and 2006. Those heatwave conditions were mirrored by increased temperatures of the heat sink and by low stream flow. Those parameters impact on the performance of the auxiliary safety equipment. In 2009, the ASN adopted an initial position on the management of such ‘extreme heat’ situations proposed by EDF for 900 MWe reactors. In 2012, the ASN approved the integration of the necessary material modifications. Those modifications include, *inter alia*, strengthening certain exchangers, strengthening the refrigeration systems, adding hydro-refrigerants to the oil system of certain pumps, improving the temperature stability of the diesel generators’ electrical cabinets and making changes to how accidents are handled.

Safety review

In the context of the safety reviews of nuclear power plants, and as required by the applicable regulations, every ten years EDF conducts a comprehensive inspection of the installation including, in particular, an inspection of the reactor vessel, a full reclassification of the main primary system and a pressure test of containment structure.

The inspection of the safety of reactors, performed by means of periodic reviews or conducted in relation to certain issues, in some cases triggers modifications to nuclear reactors with a view to improving safety, depending on their significance and industrial feasibility. Those modifications are grouped together and implemented across all the reactors of the series in question, with one initial reactor, the ‘lead’ reactor, acting as the prototype. The grouping together of the modifications ensures greater consistency and industrial implementation by making planning, documentation updating and operator training easier. Those grouped modifications are thus generally implemented in the course of the ten-yearly inspections (TYI) so as to guarantee quality and overall consistency. On completion of these works at each plant, a report is sent to the ASN so that the latter may give a ruling on the continuation of operations and the operating conditions for a new ten-year period.

The initial implementation of such a review was launched back in 1988 for the first PWR 900 MWe reactors at the Fessenheim and Bugey sites. This involved in particular carrying out an analysis of those installations by comparing them to the later installations of the same 900 MWe type (‘CP1-CP2 series’ or ‘CPY’) with a view to achieving an overall identical safety level for all the 900 MWe series.

This safety review process was continued for all 900 MW reactors, with the TYI2 review linked to the second ten-yearly inspection completed in 2010 (Chinon B4), followed by the TYI3 review linked to the third ten-yearly inspections which is ongoing. After each ten-yearly inspection, the safety requirements for each technical series are adapted, taking into

account the improvements to safety made. For example, the main changes adopted following the incorporation of TYI3 safety standard for 900 MWe reactors involve strengthening the installations' earthquake resistance, improving the way account is taken of the risk caused by explosive gases, improving the robustness of the sites in the face of external attacks of natural origin, strengthening the spent fuel storage pools and even improving the way in which serious incidents are managed.

For the 1300 MWe series, the first TYI2 1300 MWe shutdown was that of Paluel 2 in 2005; the last TYI2 1300 MWe shutdown is scheduled to take place in 2014 at Golfech 2. The first review of the N4 series began with Chooz B2 in 2009 and finished with the TYI1 at Civaux 2 in 2012.

In 2006, the ASN approved the continued operation of the 1300 MWe reactors beyond their second ten-yearly inspection, subject to the modifications decided upon in the context of that review actually being implemented. The improvements stemming from that safety review will be integrated by 2014 as part of the second ten-yearly inspections. The most notable modifications include the optimisation of the pressure outlet of the containment structure (sand filters) and the diversification of the mechanisms for the monitoring of the level of the water supply to the steam generators.

As at the end of 2013, eighteen (out of twenty) TYI2 of 1300 MWe reactors have been carried out; the inspections are scheduled to conclude at the end of 2014. In 2011, the ASN defined the focuses of the safety review linked to the third ten-yearly inspections of the 1300 MWe reactors. Those focuses fall within the scope of the continuation of the studies conducted in the context of the TYI3 of 900 MWe reactors and take account of international experience acquired and the lessons learnt from R&D.

Developments following the implementation of the post-Fukushima measures

Following the nuclear accident at the Fukushima power station, a supplementary safety assessment (SSA) procedure was initiated. In September 2011, EDF submitted to the ASN the supplementary safety assessments of the facilities in extreme situations for each site. This procedure has made it possible (i) to strengthen the existing margins of nuclear powers plants against the threats from external attack taken into account in the current standard, and (ii) to draw up an initial series of proposals for modifications to be implemented in the short and medium term in order to cope with extreme situations.

In the case of EDF's nuclear reactors, the requirements set out in Section 6.2.1.3.1 involve significant work and investment, which began as early as 2012, and will extend over several years:

- the 'core set' of measures: following a good many technical exchanges and studies conducted in 2013, in January 2014 the ASN laid down supplementary requirements applicable to nuclear power plants covering supplementary safety objectives relating to the functionality of the core set of measures as well as a number of design

assumptions which must be taken into account in order to guarantee the availability of the core set of measures in order to cope with extreme situations. Those objectives relate in particular to the discharges likely to occur on account of the increase in pressure in the containment structure in event of a serious incident. With regard to the power plants currently in operation, the draining-filtration device prevents the loss of containment by overpressure by triggering a voluntary discharge process via a filter outlet. Such a filtration system enables radioactive discharges to be significantly limited, in particular discharges of fission products with a longer half-life such as caesium; the performance of the system is more limited in the case of radioactive iodines (with a short half-life). In addition, the ASN requires *inter alia* that studies be conducted into the arrangements for the evacuation of residual power outside the containment structure without opening that structure's drainage-filtration device in those situations covered by the 'core set' of measures. These additional requirements also specify the level of earthquake risk to be taken into account when defining the 'core set' of measures. The other systems (including the ultimate heat sink and the local crisis centre) should be in place by the end of 2020;

- the 'Nuclear Rapid Response Force' ('NRRF') has been partly operational (for deployment at one reactor at any one site) since late 2012 and will be fully operational by the end of 2015 (Gravelines – for 6 plants).

6.2.2.2 Measures adopted in respect of fuel cycle facilities

Continuous assessment and verification of safety

The use of experience acquired is developed at several levels, and its dissemination for the benefit of all entities within the AREVA group is the responsibility of the network of specialists of the *Inspection Générale* (General Inspectorate).

For instance, the commissioning process for the Georges Besse 2 enrichment plant was accompanied in 2013 by 20 meetings of the *Commission d'autorisation interne de démarrage* (Internal Start-up Authorisation Committee, 'CAID'), set up to accompany that process.

Safety review

In the context of the safety reviews, a plan to verify the compliance of the operating practices is drawn up and implemented. Particular attention is paid to ergonomics and to the availability of the documentation at workstations as well as to the account taken of the changes to the operating rules and to the system of organisation. The operator's processes relating to fault management, change management and documentation management, all of which contribute to the updating of this safety standard, are described and analysed. Their effectiveness is also justified.

AREVA is required to initiate two reviews of nuclear installations each year; the full process for each installation extends over several years. The review process relates not only to installations in operation but also to installations in the final shutdown stage. The examination of the file pertaining to the review of the Melox installation is now closed. The files pertaining to the review of the UP3 plant at La Hague and the FBFC plant at Romans-sur-Isère have been submitted. The file pertaining to the compliance inspection of the Georges Besse plant has been sent.

Developments following the implementation of the post-Fukushima measures

Following the supplementary safety assessments, the Systems, Structures and Components (which form the core set of measures required to prevent serious accidents and mitigate their effects and of those necessary for the purposes of crisis management) were identified. The supplementary demonstrations of robustness required for the elements forming part of that core set of measures were initiated, and the definition and deployment of the new measures deemed essential were launched. Those actions are in response to the requirements laid down by the ASN following the meeting of the relevant permanent groups of experts to analyse the SSA files provided by the operators and examined by the IRSN.

6.2.2.3 Measures adopted in respect of research reactor facilities

Measures adopted by the CEA

Continuous assessment and verification of safety

At centre level, account is taken of experience acquired (EXA) in particular by organising and promoting exchanges between the installations and between the centres. To that end, an EXA facilitator is appointed from the unit which conducts checks on behalf of the director at each centre.

At Directorate-General level, the Protection and Nuclear Safety Division (DPSN) has the task of ensuring that the various units cooperate with one another, that account is taken of the EXA and that best practices are exchanged. The DPSN also produces a report on the significant events and defines the axes of progress. Its work in this regard also leads it to identify the situations in which recourse should be had to the expertise offered by the centres of excellence.

The EXA is also taken into account in internal documents (circulars and recommendations, directives, technical files) which the DPSN is responsible for producing.

The tools used are:

- the EXA forms, produced by the DPSN;
- the Central Experience File (CEF), which contains all the notified events that have occurred since 1990;

- the significant event analysis and handling guide;
- the significant event summary report, produced from the individual Significant Event Reports (SER); and
- the international bases of the IAEA.

The finding that human factors are a significant factor in events and incidents justifies the specific approach adopted by the CEA and the establishment of a dedicated network of people comprising:

- specialists in the safety support units at the CEA's centres;
- liaison officers at each BNI; and
- contact persons in the control units attached to the office of each centre director.

These people come together for a one-day meeting several times a year at each centre to discuss CEA internal and external practices.

The actions taken are based around a number of axes:

- the performance of targeted 'organisational and human factor' (OHF) studies at installations following the implementation of changes, the emergence of a problem or the occurrence of specific events;
- the conduct of systematic OHF interventions in the course of safety reviews, requests relating more specifically to all sensitive activities (certain operational stages, handling-related operations etc.).

The actions arising from this experience acquired on a day-to-day basis relate primarily to adjustments to procedures and compliance checks on certain elements following discoveries of anomalies at an installation, which may lead to the replacement of equipment.

Thus, for example, checks and improvements were made to the gripping devices for heavy loads and to the gas sampling devices in the installations' chimneys.

Safety reviews

The periodic safety review, which takes place at least every ten years, is the opportunity to conduct an in-depth examination of the state of installations to ensure that they comply with the applicable safety standard.

The safety reviews of the CEA's installations were scheduled in line with a timeline approved by the ASN. All the installations will undergo an initial review by 2017 at the latest. In the case of certain older installations to which modifications have been made during the course of their operation, sometimes without a review of the installation as a whole being conducted, the difficulty lies in the definition of improvements tailored to the challenges faced.

To date, all the CEA's research reactor facilities have been subject to a safety review. That initial review stage began in 2002 and was completed in 2010 with the review of the EOLE and MINERVE installations.

The safety review of the EOLE and MINERVE research reactor facilities was examined by the *Groupe permanent 'réacteur'* [Standing Group for Reactors] ('the GPR') in 2011.

The review of the Orphée reactor has previously formed the subject-matter of two meetings of the GPR, on 9 September and 7 October 2010. Following the second safety review, the CEA launched an action plan, which is being implemented. In particular, the CEA initiated the replacement of devices exposed to irradiation.

Although each research facility is different, a more generic approach to the safety of those installations, inspired by the rules applicable to power reactors – and in particular the safety analysis by 'operating conditions' (trigger events assumed) – and by the safety classification of the associated equipment, has been developed and applied in the context of safety reviews of the existing installations, as well as for the design of new installations. The result of the method of safety analysis deployed is that a safety classification is assigned to the components which are required to perform a safety-related function and which must be classified. This classification determines the level of requirements both during construction and in the course of operation and monitoring. This has led to the achievement of significant progress in terms of safety.

The main improvements made relate to improving civil engineering in relation to earthquake resistance and to improving protection against the risk of fire. Amendments to programmes for the maintenance and inspection of the main equipment may also be decided upon.

Supplementary safety assessments

The CEA's installations were subject to SSA following the nuclear accident at Fukushima Daiichi. The reports relating to the SSA of five installations were sent by the CEA to the ASN on 15 September 2011; those reports were examined at a joint meeting of the permanent groups of experts in November 2011 and in April 2013 in order to define the core set of measures for those installations. The reports relating to the other installations were sent to the ASN on 15 September 2012 and examined in July 2013 at a joint meeting of the permanent groups of experts. The associated supplementary requirements are in the process of being drawn up.

Generally speaking, those assessments revealed that the research reactor facilities offered a good level of robustness to such extreme attacks. In particular, the risk of flooding at the sites is minimal. The research reactor facilities, the power level of which is lower than that of power-generating reactors, are also able to withstand electricity supply and heat sink outages. A considerable amount of time must pass before an intervention is necessary.

On 26 June 2012, the ASN adopted decisions laying down supplementary requirements for each BNI. In addition to the general request to all BNI to define and implement a ‘core set’ of material and organisational arrangements to enable the performance of basic safety functions in extreme situations, the main requests related to:

- the evacuation, no later than 31 December 2014, of fissile materials from the MASURCA installation to an installation sufficiently sized to withstand earthquakes;
- the implementation of supplementary robust instrumentation for the management of extreme situations;
- improvements vis-à-vis the risk of a loss of cooling at the Osiris reactor;
- improvements vis-à-vis the risks of flooding and a loss of cooling at the Jules Horowitz reactor.

These new requirements involve significant work and huge investment, which began as early as 2012, and will extend over several years.

Although the JHR is of a recent design and the experience acquired at the other experimental reactors has been integrated, the SSA procedure led the CEA to identify possible further improvements which could be implemented, with relative ease, in view of the stage of construction.

Measures adopted by the ILL

Safety reviews

The last safety review took place in 2007 following the implementation of the measures defined following the 2002 safety review, a major focus of which was the earthquake resistance of the installation in the light of the 2001 Basic Safety Rule on the hazard posed by earthquakes.

Between 2009 and 2011, the HFR also substantially strengthened its defence-in-depth by adding a new backup system to prevent and mitigate the consequences of a core meltdown accident. This fallback re-flooding system seeks to guarantee control of the water inventory used to cool the core.

Supplementary safety assessments

Between 2012 and 2016, the ILL will continue to strengthen its defence-in-depth significantly by carrying out the work defined following the post-Fukushima supplementary safety assessment and thus establishing a ‘core set’ of backup equipment, including in particular:

- a seismic depressurisation system to prevent any direct leaks, and thus any unfiltered releases;
- a groundwater system to guarantee the long-term water inventory;

- an emergency command post will enable the facility to be monitored and the backup systems to be controlled even after rupture of all the dams located upstream and after an earthquake much stronger than earthquake taken as the design basis;
- the establishment of crisis management centres during the winter 2013-2014 shutdown and of several new systems to allow for fallback cooling and to limit radioactive discharges.

Measures adopted by the ITER International Organisation

Although, on account of its status as an international installation, ITER is covered by specific provisions, its safety is assessed in accordance with the French regulatory process. The preliminary safety report, drawn up in the context of the application for a licence to create the ITER basic nuclear installation, is based on the following general principles:

- to protect people and the environment from the nuclear threat;
- to provide protection against incidents and accidents by deploying the resources and taking the steps necessary to prevent them, and to limit the consequences of incidents and accidents which may occur at the installation; and
- to organise and adopt the necessary arrangements to manage radiological emergency situations.

This approach is based on French and international practices and experience in the field of nuclear safety.

Compliance with those principles is ensured *inter alia* by:

- applying the ‘defence-in-depth’ principle; and
- adopting the radiation protection approach based on the optimisation principle, known as the ALARA (As Low As Reasonably Achievable) approach.

The safety of the installation will be re-examined *inter alia* at the major key stages of the project: first plasma and commissioning of the installation.

ITER is currently at the design and structure and component manufacture stage. At this stage, the measures adopted to prevent accidents and to mitigate consequences are verified by monitoring the design and construction of the major structures and components important to the protection of the installation in order to ensure that the safety requirements applicable to those structures and components are being observed.

6.3 Design and construction of nuclear installations

6.3.1 Requests and checks by the regulatory authority

The safety principles, which are drawn from the regulations, apply to all BNI and are broken down according to the specific features of the various BNI in terms of risks and challenges.

In addition to the general technical regulations, the ASN lays down in basic safety rules (BSR) or guides the arrangements which it deems satisfactory in order to comply with the principles laid down in the regulations (see Section 4.2).

6.3.1.1 Requirements applicable to the arrangements to prevent accidents during the design and construction stage

The application to commission a reactor is subject to detailed examination and at the same time, with the support of the IRSN, the ASN also monitors the construction of the BNI.

Design of a BNI

Safety principles and procedures have been introduced gradually in France and incorporate the experience acquired from accidents.

The Order of 7 February 2012 lays down explicit regulatory requirements regarding the safety demonstration and, in particular, the defence-in-depth principle. That principle is an integral part of the safety demonstration and its implementation takes the form *inter alia* of:

- the choice of an appropriate site, taking particular account of the risks of natural or industrial origin to which the installation is subject;
- the identification of the functions necessary for the demonstration of nuclear safety;
- a prudent design approach, incorporating design margins and having recourse, where necessary, to the appropriate redundancy, diversification and physical separation of the components important from the perspective of safety which perform functions necessary for the demonstration of nuclear safety, with a view to achieving a high level of reliability and to guaranteeing the functions mentioned in the previous paragraph;
- the quality of the design, construction, operation, final shutdown, decommissioning, maintenance and monitoring of the installations; and
- the preparation for the management of any incidents or accidents.

The Order of 7 February 2007 specifies the requirements applicable to the components and activities identified as important to the protection of the installation in question. The classification of those elements must be proportionate to the potential implications, with a view *inter alia* to guaranteeing their capacity to perform their functions in the situations in which they are required. Appropriate study, construction, testing, inspection and maintenance arrangements must be put in place in order to ensure the permanency of that classification. Besides technical criteria, the ASN also focuses on the conditions which encourage or discourage the positive contribution of operators and workforces to the safety of nuclear installations. In this context, the ASN expects organisational and human factors to be integrated in an appropriate manner into the safety challenges for installations and security challenges for workers when a new installation is being designed or modifications are being made to an existing installation. That expectation is set out in the Order of 7 February 2012.

Furthermore, the ‘Technical Directives for the Design and Construction of the Next Generation of Pressurised Water Nuclear Reactors’, adopted by the ASN in 2004, lay down the safety approach and general safety requirements which the ASN deems appropriate to apply to the design and construction of new reactors.

Construction of a BNI

The ASN is responsible for monitoring the construction of BNI from as early as the initial work carried out once the file accompanying the application for a licence to construct a BNI has been lodged.

The monitoring of a BNI’s construction is important for several reasons since it involves:

- monitoring the quality of the activities involved in the construction of the installation in a manner proportionate to the implications for safety, radiation protection and environmental protection, in order to be able to give a ruling on the capability of the installation to meet the requirements defined; and
- capitalising on the experience acquired by each stakeholder in the course of the construction of new BNI.

On the basis of the detailed design study for the BNI, the ASN monitors the activities involved in the construction of the BNI, which cover the preparation of the site following the grant of the construction licence, and the manufacture, construction, classification, assembly and testing of structures, systems and components, either at the construction site or at the manufacturer’s premises in the case of nuclear power reactors.

The ASN specifically monitors the manufacture of nuclear pressurised equipment, in particular the primary and secondary nuclear steam supply systems. This compliance assessment concerns, *inter alia*, the equipment intended for new nuclear installations and replacement equipment intended for nuclear installations in operation (for example, replacement steam generators). The monitoring conducted by the ASN and approved bodies takes place at various stages of the design and manufacture of pressurised equipment. It takes the form of an examination of the technical documentation for each piece of equipment and inspections at the manufacturers’ workshops as well as those of their suppliers and subcontractors.

The ASN’s monitoring also covers the licence holder’s preparations to operate the BNI following its commissioning, the management of risks to neighbouring BNI triggered by the construction activities, radiation protection and the protection of the environment.

6.3.1.2 Requirements applicable to the arrangements to prevent accidents during operation

In accordance with the regulations, the start-up of an installation is subject to a licence issued by the ASN. In that context, the licence holder must send to the ASN a file including, *inter alia*, the installation's safety report and the general operating rules (GOR).

Those rules set out the operating conditions and translate initial hypotheses and the conclusions of safety studies drawn from the safety report into operating rules. This body of rules is approved by the ASN.

If licence holders deviate from the normal conduct required by the GOR, they must notify that deviation to the ASN.

Licence holders may be required to amend the GOR on a permanent basis in order to incorporate their experiences, improve the safety of the installations, enhance economic performance or integrate the consequences of modifications to equipment. The ASN also examines those modifications and may give its approval, possibly subject to the implementation of supplementary measures.

With technical support from the IRSN, the ASN analyses the maintenance methodologies devised by the licence holders, since maintenance is an essential line of defence to mitigate the emergence of faults and to ensure that an installation continues to comply with the relevant safety standard.

In the course of inspections, the ASN endeavours to check:

- compliance with the GOR and, where appropriate, the compensatory measures associated with temporary modifications;
- the quality of the standard operating documents, such as operating instructions and alert forms, and their consistency with the GOR;
- the incident and accident operating procedures and the management of specific equipment used during emergency operation;
- the performance of maintenance and periodic testing programmes in accordance with the defined rules; and
- the training of officials in the operation of the reactor.

Finally, the various works carried out in the context of the SSA have taken account of the scenarios which had not been considered in the past. On the basis of the conclusions of those SSA, changes are made to various documents relating to the management of serious accidents (internal emergency plan, operating procedure in the event of an accident, guide to intervention in the event of a serious accident).

6.3.1.3 Requirements applicable to the arrangements to mitigate the consequences of accidents

The operational area of the BNI is laid down by the GOR, which include the operating procedures in the event of an incident or accident, the purpose of which is to return the installation to a safe condition or to mitigate the consequences of the accident.

Furthermore, the application of the defence-in-depth principle involves taking account of the occurrence of serious accidents that are very unlikely when drawing up the emergency plans, so as to define the measures necessary to protect the site staff and the general public and to manage the accident at the site.

The operator of a BNI is required to prepare an internal emergency plan (IEP). The IEP clarifies the system of organisation and measures to be implemented at the site in the event of an accident. It also covers the arrangements for the prompt notification of the authorities. The implementation of the IEP is decided upon by the operator on the basis of pre-established criteria relating to the condition of the installation and its environmental status, or at the operator's initiative if it deems the situation requires it.

Both the incident and accident operating procedures and the emergency plans must be prepared in such a way that they provide an appropriate response to the accidents which may occur at a BNI. This requires the definition of technical bases, that is to say the recognition of one or more accident scenarios determining the envelope of possible consequences, with a view to determining the nature and scope of the measures to be provided. The approach is based primarily on a conservative theoretical approach involving the determination of source terms, then the calculation of their dispersal in the environment and finally the evaluation of the radiological impact.

6.3.2 Measures adopted by the licence holders

6.3.2.1 Measures adopted in respect of nuclear power plants

The safety of the nuclear power reactors in operation or under construction is based on a principle of defence-in-depth covering five levels:

- The first level is a combination of specific design margins, quality assurance margins and inspection activity margins in order to prevent the occurrence of abnormal or defective operating conditions;
- The second level consists in the implementation of protective arrangements to detect deviations from standard operating conditions and system failures. The purpose of this level of defence is to guarantee the integrity of both the fuel sheath and the primary cooling system in order to prevent accidents;
- The third level is provided by backup and protection systems and operating procedures which make it possible to manage the consequences of accidents that may occur by containing the radioactive substances in order to prevent a situation from developing into a serious accident;

- The fourth level includes the measures to preserve the integrity of the containment structure and to manage serious accidents;
- In the event that the abovementioned measures do not function correctly or prove ineffective, the fifth level includes all the measures to protect the general public in the case of significant discharges.

6.3.2.1.1 Design and construction of nuclear power reactors

Design criteria

The safety demonstration is based on a limited number of representative events and incident and accident scenarios to be taken into account at the reactor design stage, including those which may occur during the reactor's operation, and on the various physical conditions of the reactor. The events triggering the adoption of transitional arrangements are grouped into several categories according to estimates of their frequency of occurrence and their potential consequences for the environment.

The identification of those events and their classification into categories are used in the design of the primary and secondary systems and of the protection and backup systems to allow such situations to be managed, and thus to prevent the occurrence of consequences which are unacceptable for the installation and its environment.

The management of the main operating conditions in the event of incidents and accidents is analysed in the safety report on the basis of the installation's design and the control principles.

At the same time as managing simple trigger events, an analysis of the situations involving multiple failures which may lead to the meltdown of the core is conducted on the basis of the findings of the probabilistic safety assessment of the design. On the basis of the defence-in-depth principle, supplementary lines of defence are put in place in order to prevent core meltdown situations and to mitigate the consequences of such situations.

Classification of the equipment

Generally speaking, the classification of each piece of equipment is determined by adhering to the relevant rules and requirements and depending on its 'safety classification', that is to say its importance from the perspective of safety and the type of demands which it must withstand:

- the seismic classification means that account is taken of the major constraints imposed by earthquakes in the design of equipment;
- the classification of the environmental conditions in the event of an accident (temperature, pressure, humidity, irradiation) is intended to prove, through testing or analyses, that the equipment is capable of performing its functions in the

environmental conditions and subject to the demands to which they are meant to be subject.

In the case of electrical safety equipment, three categories of classification representing 'envelope' conditions have been defined:

- category K1: equipment installed within the containment structure which must perform its function in the event of an accident;
- category K2: equipment installed within the containment structure which must perform its function under normal circumstances;
- category K3: equipment installed outside the containment structure.

The environmental conditions include normal conditions and conditions in the event of incidents and accidents as well as seismic demands, depending on the equipment in question and the classification category.

During operation, it is important to be able to ensure the permanency of those classifications over time. This is one of the important aspects taken into account in the compliance reports, which are produced at the time of the periodic safety reviews.

Measures adopted in respect of PWR under construction

The 'defence-in-depth' concept

The safety of a PWR reactor is based on the five levels set out above, implemented at the design stage, in particular vis-à-vis the account taken of serious accidents and external attacks (aircraft crashes).

The aim is to deliver a very high level of security for PWR reactors, firstly by facilitating the operation and maintenance of the reactors and secondly by reducing the potential immediate or deferred consequences of an accident. At the design stage, the approach which allows the compatibility of the design to be verified in the light of the various lines of defence-in-depth is presented in the preliminary safety report, which was sent to the Safety Authority to support the application for a licence to construct a third reactor at the Flamanville site.

Risk reduction and prevention of situations which may lead to core meltdown

The reduction of the risk of accident takes account of the combination of events which may lead to core meltdown scenarios on account of multiple faults.

From a technical perspective, supplementary backup systems are designed and installed in order to prevent core meltdown during those scenarios.

Risk reduction and control of core meltdown scenarios

Management of core meltdown scenarios is the second stage of risk reduction. It is based on the safety analysis of low-pressure core meltdown scenarios, since the other core meltdown scenarios are covered by specific provisions which make it possible to rule out or ‘eliminate in practice’ their occurrence.

That analysis makes it possible to define the measures which enable the function of the containment structure to be guaranteed and protected. It also makes it possible to define the tools required by the operator and the crisis team in order to manage this type of situation and to define the conditions governing the classification of the equipment necessary to demonstrate that the safety objectives are met.

6.3.2.1.2 Operation of nuclear power reactors

In the case of nuclear power plants, the GOR include several chapters, the most important of which from the perspective of safety are examined by the ASN:

- Chapter III, which sets out the Technical Operating Specifications (TOS);
- Chapter VI, which includes the operating procedures in the event of an incident or accident. It lays down the procedure to be adopted in such situations in order to maintain and restore the basic safety functions and to return the reactor to a safe condition;
- Chapter IX, which defines the inspection and periodic testing schedules for equipment and systems important from the perspective of safety implemented in order to check the availability of that equipment and those systems. If the results are unsatisfactory, the approach to be adopted is specified in the TOS;
- Chapter X, which defines the physical testing programme applicable to reactor cores which enables the core to be monitored during the re-start and operation of the reactor.

The TOS define the operating range which must be observed, that is to say the limits of the physical parameters with which reactors must comply as well as the safety functions which must be available. A piece of equipment or system is available if, and only if, it can be demonstrated that that equipment or system is capable of performing the functions assigned to it at the required performance levels (during the phase-in period in particular). A piece of equipment or system may be unavailable in the following scenarios:

- accidentally: chance discovery of a functional anomaly of the equipment/system concerned;
- scheduled: the period and cause of the non-availability are known and pre-determined (implementation of the preventive maintenance and periodic testing programme);
- other: neither accidental nor scheduled. This scenario arises where the non-availability of equipment/systems is occasioned by the introduction of a modification, for example.

The periodic tests described in Chapter IX of the GOR cover the basic systems classified as important to the safety of the nuclear installation. The satisfactory performance of the periodic testing schedules under the GOR is one of the conditions for a declaration that the equipment and systems are available.

A failure to comply with a rule under the TOS (exceeding a limit applicable to an operating range, non-availability of a required piece of equipment) constitutes an event. For each operating range, the TOS define the action to be taken following an event: fallback state, time (taken to enter) fallback state or repair time.

The operating parameters are permanently measured and, if the pre-defined criteria are exceeded, the automated equipment triggers an alarm in the control room so that the operators are able to analyse the situation and take the actions required *inter alia* under the TOS. Analysis of the alarms and of the physical values may lead the operator to conduct an entry-point diagnostic procedure as part of an incident procedure.

All the nuclear sites in the EDF fleet now follow the state-oriented approach (SOA). That approach covers all simple and multiple ‘thermo-hydraulic’ incidents and accidents, whether or not associated with system losses, electrical source outages or human error. Its primary objective is to prevent the risk of core meltdown.

In the hypothetical scenario of a core meltdown, the operation of the reactor must take account, firstly, of the new and complex phenomena which will occur as the accident develops and, secondly, of the difficulty of conducting a diagnosis of the state of the reactor in a significantly deteriorated situation. The protection of the containment structure becomes the primary objective. The operational strategy is set out in the GISA: the Guide to Intervention in the event of a Serious Accident.

The decision to adopt procedures under the GISA, which marks the abandonment of the SOA operational procedures, is taken on the basis of the temperature values recorded at the core exit and the dose rate values within the containment structure. The emergency backup diesel generator allows electrical support to be provided to the instrumentation, thus enabling the implementation of the serious accident operating procedure.

Finally, EDF implemented its amended emergency safety standard in 2012: streamlined and standardised IEP, development of new IEP (taking into account in particular the organisation and management of multi-plant accidents) and Support and Mobilisation Plans, the purpose of which is to ready, in a structured fashion, all or some of the crisis teams in anticipation of a foreseeable attack.

That amended safety standard accompanies the changes to the system of crisis management stemming from the experience acquired from the accident at the Fukushima Daiichi power plant; an initial deployment timeframe is scheduled for the end of 2014.

In order to deal with emergency situations, the system of crisis management adopted by EDF since the start of the operation of its nuclear power generation fleet is based on human and material resources which can be mobilised 24 hours a day and seven days a week at the request of a nuclear power plant to the national crisis manager.

The system of crisis management readied following a reactor trip has both a national dimension and a local dimension. The system is structured into teams (or command posts – CP) covering the four major areas essential to the management of a crisis (expertise, decision-making, action and communication).

6.3.2.2 Measures adopted in respect of fuel cycle facilities

The safety of the fuel cycle facilities operated by AREVA is based on the main safety principles: prime responsibility of the operator, defence-in-depth, proportionality to the potential implications, systematic analysis of all risks etc. The concept of defence-in-depth is the fundamental safety principle for nuclear installations. It is characterised by the establishment of levels of protection defined on the basis of prior risk analyses. Those levels are based on technical specificities, a system of organisation, procedures, operational methods and appropriate expertise. Any industrial project, change to operations or modification of an existing installation must undergo a prior analysis of the associated risks.

In this context, AREVA lays down general safety objectives which seek to minimise the potentially negative impact of its activities on the environment of each nuclear site throughout the lifetime of the installation in all conceivable situations. The safety analysis therefore considers, in a systematic fashion, the different situations which may arise over the lifetime of an installation, whether the result of current conditions, operating incidents or accidents.

With regard to the radiological exposure of its own employees and of all external persons present in its installations, AREVA has laid down identical objectives applicable to all sites in line with best practices. The radiological protection approach is based systematically on the fundamental principles of radiation protection and the implementation of an appropriate and relevant ALARA analysis having regard to the reality of each workplace situation. The efficiency of those practices is demonstrated by AREVA's annual results in terms of the dosimetry of staff and external persons with access to sites; those results are published every year in the report produced by the General Inspectorate.

Beyond the strict technical dimension of the installations to be designed and constructed, as early as the planning stage AREVA integrates organisational and human factors into its analyses and design principles. Documents laying down requirements at group level define the related internal requirements, not only in terms of ergonomic studies of the installations or workstation in question, but also in terms of operational methods (general operating rules, operating procedures and methods etc.).

Those principles were applied *inter alia* in the context of the renewal of the dedicated industrial installations upstream of the fuel cycle at the AREVA Tricastin site and led to a reduction of the potential dangers as well as to the strengthening of the lines of defence.

Following the accident at the Fukushima Daiichi nuclear power plant, AREVA reviewed the relevance of the architecture of its defence-in-depth approach vis-à-vis extreme natural phenomena, and specific actions to improve the fourth line of defence are at the study or deployment stages. Thus, supplementary mitigating measures intended to deal with serious accidents have been defined, by making the concept of serious accidents used in relation to reactors generally applicable to fuel cycle facilities. A strengthening of the crisis management arrangements, which contribute to the fifth line of defence, has been defined. Arrangements intended to be adopted within a short period of time in order to mobilise the resources of the whole of the group in emergency situations are being deployed through AREVA's National Response Force (ANRF).

6.3.2.3 Measures adopted in respect of research reactor facilities

Measures adopted by the CEA

The safety procedure and defence-in-depth

The design and dimensioning of nuclear installations is based on the implementation of successive barriers and the concept of 'defence-in-depth'. The CEA has established a safety procedure which integrates those elements across all its BNI.

That procedure thus entails defining operating conditions in the event of accidents, for which design arrangements are established at the installations. Internal and external attacks are also taken into account.

The concept of 'defence-in-depth' is subdivided into four successive levels of defence:

- Level 1: prevention of anomalies and failures (construction quality etc.);
- Level 2: monitoring and maintenance of the installation within the licensed area;
- Level 3: mitigation of the consequences of operating conditions adopted in the event of accidents with the implementation of backup and security mechanisms at the installation;
- Level 4: arrangements provided for in the Centre's IEP.

Within those levels, it is possible to divide up the successive and independent lines of defence established to provide protection against the failure of technical, human and organisational measures adopted to ensure the safety of the installation, as well as those established to detect and mitigate the consequences of such failures.

The operating conditions in the event of an accident studied in the safety standard are defined by a trigger event. The associated studies are conducted using conservative hypotheses. That conservative approach is applied both to the hypotheses linked to the initial state of the installation and to the rules governing studies of accident scenarios resulting from the trigger event considered.

The IEP is drawn up by identifying types of accidents likely to lead to dangerous discharges of radioactive materials in quantities necessitating the adoption of protective measures.

Measures adopted in respect of the JHR under construction

On the basis of the preliminary safety report and the files submitted to the public inquiry, the application for a licence to construct the JHR BNI was made to the national authorities in March 2006, accompanied by the effluent discharge and water intake licence applications, pursuant to Decree No 95-540 of 4 May 1995.

The public inquiry procedure initiated by the Prefect was held in eight municipalities surrounding the Cadarache site in November and December 2006.

In addition, the JHR preliminary safety report was examined by the Standing Group for Reactors (GPR) in the course of eight meetings held between June 2007 and June 2008.

The entire process culminated in the presentation of the draft reactor construction decree to the BNI Consultative Committee on 16 March 2009. The JHR construction decree was signed by the Prime Minister on 12 October 2009 (Decree No 2009-1219).

The civil engineering work is ongoing and the commissioning of the reactor is currently scheduled for 2016.

In France, the regulations applicable to research reactor facilities are the same as those which apply to other nuclear installations, in particular power reactors. The analysis of their safety demonstration and the steps taken to guarantee it are the result of a ‘graduated approach’ consisting in adapting the measures to be implemented to the various risks potentially presented by those facilities. Where appropriate, the ASN may rely on requirements which apply specifically to research reactor facilities or to certain types of operations performed at such facilities. These are simply amendments to regulatory requirements that exist elsewhere.

The design of the JHR, like that of the CEA’s other installations, is based on the concept of ‘defence-in-depth’, meaning that particular attention is paid to all equipment performing a safety-related function, in particular the containment structure, by establishing barriers between the radioactive materials and the external environment of the installation (see Section 6.2.2).

Although the JHR is of recent design, and the experience acquired at the other experimental reactors has been integrated, the SSA procedure led the CEA to identify possible further improvements which will be implemented, despite the advanced nature of the construction, in order to strengthen the robustness of the installation in the face of certain external attacks. In addition, such improvements at the design/construction stage enable priority to be given to the prevention of possible accidents over the mitigation of the consequences of such accidents. In this context, in its Decision No 2012-DC-0294 of 26 June 2012, the ASN published a certain number of supplementary requirements.

In order to facilitate the monitoring of the progress of this reactor's construction, in accordance with the Decision laying down the requirements governing the design and construction of the JHR (ASN Decision No 2011-DC-0226 of 27 May 2011), the CEA submits a quarterly progress report for the project.

In operation

A series of procedures and instructions, managed by the departments concerned, guarantees that the operations taking place within the BNI are conducted in accordance with the applicable rules, rules with which external service providers must also comply. The operator must ensure that the external service providers observe those rules.

Since 2002, the CEA has been authorised to implement an internal authorisation system. The framework of this system, which covered some fifteen facilities, reactors, laboratories and 'support' facilities, and the procedures for updating the safety standard have been the subject of two ASN guides.

The experience acquired from almost ten years of the implementation of this system has been fed into the criteria applicable to internal authorisations and made the process more robust. It has also enabled the effectiveness of that system to be confirmed and has not revealed any significant shortcomings.

In the same way, the experimental devices designed and operated in the research reactor facilities meet very strict safety requirements.

In order to verify the proper functioning of the elements important to the protection of each BNI and to guarantee their availability, periodic inspections and tests are conducted on that equipment and those systems. The frequency of those inspections and tests is precisely defined and may be calendar-based or event-based.

At each CEA centre, technical support units bring together the skills required for the different job roles involved in the operation of the facilities. These technical support units enter into contracts with external service providers, on whom the facilities rely for the maintenance of various pieces of equipment. The technical support units are different from the nuclear safety support units, whose expertise is called upon where necessary.

Subject to the satisfactory performance of those tests at the required frequency, the equipment concerned may be regarded as being available. The purpose of systematic maintenance is to prevent the failure of such equipment and to maintain that equipment in a state in which it is capable of performing its functions at the required levels of performance. Such preventive maintenance is carried out periodically in the same way as the periodic inspections and tests, in accordance with validated operational procedures and accompanied by a risk analysis if the maintenance work may affect safety.

Outside normal operating situations, the analysis of the alarms and operating parameters measured at the installation, and re-transmitted to the control room, may prompt operators to adopt incident or accident operating procedures.

Those procedures set out the actions to be taken in such situations, with the objective being to return the installation to, or maintain it in, a safe condition and to mitigate the consequences of the incident or accident.

The procedural rules to be adopted in the event of an incident or accident are described in the GOR. Deviations, and the handling of those deviations, are recorded in deviation reports at each CEA facility. The support services can also initiate deviation reports.

Measures adopted by the ILL

The safety procedure and defence-in-depth

As in the case of the CEA's reactors, the design and dimensioning of the HFR are based on the implementation of successive barriers and the concept of 'defence-in-depth'. Between 2009 and 2011, the HFR also strengthened its defence-in-depth by adding a new backup system to prevent and mitigate the consequences of a core meltdown accident. Between 2012 and 2016, the ILL will continue to reinforce its defence-in-depth by carrying out the work defined following the post-Fukushima supplementary safety assessment.

In operation

The system of organisation established by the ILL for the operation of the HFR is based on guiding principles which enable the level of quality required to be achieved and maintained and evidence of its achievement and maintenance to be provided:

- **Principle I:** the operator defines the scope of the system of quality assurance by identifying the safety-related activities and equipment and defining the necessary requirements for each of them. Those activities and that equipment are said to be 'quality-controlled' (QCA and QCE);
- **Principle II:** officials qualified to carry out a 'quality-controlled' activity are designated by the Head of Operations. Such officials are said to be 'authorised';

- **Principle III:** all ‘quality controlled activities’ are performed in accordance with written documents drawn up in advance, and their performance is recorded in written reports. These documents are said to be ‘quality-controlled’. In this connection, the documents are subject to either a technical inspection or an internal check as well as either a management inspection or an external check;
- **Principle IV:** the quality-controlled documents are updated and retained for a defined period of time depending on the document’s importance;
- **Principle V:** the results of a quality-controlled activity are verified both technically (quality check) and from a management perspective (quality monitoring). The findings of those verifications are recorded in a written report;
- **Principle VI:** the ‘performance’ and ‘verification’ functions are separate and assigned to different officials. The quality monitoring function is independent of the operational functions;
- **Principle VII:** a minimum of two supplier audits are scheduled each year.

Measures adopted by the ITER International Organisation

The principle of defence-in-depth is applied in connection with the design of the ITER installation in order to provide protection against or reduce the frequency of occurrence of incidents or accidents resulting from equipment failures and internal or external attacks.

Safety arrangements are made for each level of defence-in-depth in order to ensure the effective maintenance of the barriers established between radioactive materials and staff, the general public and the environment during the installation’s normal operating phases and operating phases implemented in the event of an incident or accident at the installation.

Although the ITER installation is the first nuclear fusion reactor, its design takes into account the international experience acquired in connection with the operation of other existing fusion installations (tokamak concept), installations using tritium and nuclear installations in relation to the aspects non-specific to fusion. The ITER’s design and manufacture are also based on ongoing and previously conducted and validated research and development studies initiated to support the safety analyses and to give weight to their demonstration.

In addition, the installation’s design likewise takes account of human factors *inter alia* through the implementation of a plan to integrate such factors.

6.4 *Priority given to safety*

6.4.1 Requests and checks by the regulatory authority

In accordance with the mission assigned to it, the ASN has from the outset required BNI operators to establish a system of organisation to ensure that top priority is given to nuclear safety.

The importance given to safety is made clear in the TNS Law and in the legislation adopted under that law, such as the Order of 7 February 2012. That legislation lays down the principles and objectives which the operator of any BNI must take into account when developing its safety policy. In accordance with the Order of 7 February 2012, that policy must explicitly confirm:

- the priority given to the protection of the interests stated in Article L. 593-1 of the Environment Code,⁹ first and foremost by preventing accidents and mitigating their consequences in relation to nuclear safety, over the economic or industrial advantages obtained by the operation of its installation or the progress of research activities linked to such operation; and
- the permanent research conducted into improving the arrangements made to protect those interests.

The breakdown of that policy into the integrated management system and its implementation at all stages of design, construction, operation and decommissioning of the installations contribute to the policy's continuous improvement. Safety management must be integrated into the undertaking's general management system in order to guarantee the protection of the interests stated in the Environment Code by giving priority to the prevention of accidents and the mitigation of their consequences.

The ASN expects nuclear operators to define and implement a system of management incorporating safety which is based around principles such as quality management, continuous improvement, management of experience acquired, rigorous intervention practices, consideration of organisational and human factors, the complementarity of checks and the commitment of individuals.

With a view to explaining and putting into perspective certain requirements laid down in the BNI Order, the ASN has submitted for public consultation a draft decision on 'the policy of protecting the interests stated in Article L. 593-1 of the Environment Code and covered by the integrated management system'.¹⁰

In addition, the Environment Code requires every operator of a BNI to produce an annual report setting out the arrangements made in terms of nuclear safety and radiation protection. That report is made public and sent to the LIC and to the HCTISN.

⁹ Namely, public security, health and hygiene and the protection of nature and the environment.

¹⁰ <http://www.asn.fr/Reglementer/Consultations-du-public/Consultations-du-public-en-cours/Projet-de-decision-de-l-ASN-relative-a-la-politique-en-matiere-de-protection-des-interets>

Every year, the ASN monitors the safety policy and safety management system (at local and national level) of nuclear operators in several respects:

- it checks that the commitments made are being observed, in particular where those commitments involve the implementation of specific actions at the installations concerned;
- in the context of the reviews of generic subjects with major implications, it examines the systems of organisation put in place by the operator and how those systems function, including from a managerial perspective;
- it analyses the methods for assessing the efficiency of licence holders' safety management, the means of leveraging improvements that they identify and the gains achieved by the organisational modifications implemented.

The ASN's monitoring is also based on the assessments conducted at its request by the IRSN and the permanent groups of experts.

In this context, the ASN has launched the process of examining safety management within the AREVA group in relation to the BNI operated by the group. At the end of 2012, the ASN sent its findings to AREVA and has since been monitoring the implementation of actions on the basis of the data provided at regular intervals by AREVA. An inspection of AREVA's central services was conducted at the end of 2013 in order to verify the implementation of the actions and, in particular, the analysis of the deployment of its general process of incorporating experience acquired.

The opinion of the PGE was also sought in 2013 on the issue of safety and radiation protection management during reactor shutdowns.

The ASN publishes its opinion and its analysis of safety policy and safety management in the annual reports on the state of nuclear safety and radiation protection in France.¹¹

6.4.2 Measures adopted by the licence holders

6.4.2.1 Measures adopted in respect of nuclear power plants

Culture of safety

The responsibility as nuclear operator within EDF SA is assumed at four main levels: the Chairman and CEO, the Group Senior Executive Vice President responsible for Generation and Engineering, the Director of the Nuclear Generation Division (NGD), who is the officer responsible for the operation of all French NPPs, and every NPP manager. In the particular case of an installation in the process of being dismantled at an isolated site, the function of representative of the nuclear operator, EDF SA, is assumed by the Director of the Nuclear

¹¹ <http://www.asn.fr/index.php/S-informer/Publications/Rapport-annuel-de-l-ASN>

Engineering Division, who reports to the Group Senior Executive Vice President responsible for Generation and Engineering.

In view of the importance of all EDF's nuclear activities and its responsibilities and involvement in the reactor operations in France as well as in the UK and the USA, the EDF Group adopted a Nuclear Safety Policy in 2012, which applies to all its activities within each group company operating nuclear facilities (design and construction of new projects, operation of existing reactors, maintenance, waste management, dismantling, engineering). This policy, which is inspired by international guidelines and safety requirements (IAEA SF-1 and GRS-3, INSAG 4 for the safety culture, INSAG 13 for safety management, INSAG 18 for change management), aims to reaffirm the priority given to safety within the group and to help each manager to clearly demonstrate this, with the involvement of industrial partners. In the current context, this reflects the fact that the safety culture is an absolute requirement that must encourage all entities within the EDF Group to take greater and better account of the human and organisational aspects in order to enhance operational reliability and take account of the lessons learned from past events which affected safety, with a view to reinforcing the safety management system within the group. The responsibility for implementing this policy in each unit or company within the Group rests with the corresponding management team.

An independent safety assessment is carried out at each site, on each company and on the group. In the field of safety, the Quality and Safety Mission (QSM) for nuclear power plants, the Nuclear Inspectorate (NI) for the Nuclear Generation Division and the General Inspectorate for Nuclear Safety and Radiation Protection (GINSRP) at Board level are the independent entities reporting to the site director, the NGD director, the director of the Generation and Engineering Directorate (GED) and the Chairman and CEO of the EDF Group respectively.

Thus, on the basis of the system built up gradually since the beginning of the nuclear fleet, EDF has sought to further reinforce the safety culture throughout the Group by promoting the following main attitudes.

Emphasising the priority given to safety is the role of each manager

The Group's new safety policy, published in 2012, reaffirms the priority given to safety with a view to the sustainable use of nuclear energy, accompanied by a clear principle of responsibility and oversight at all levels of the company, strong commitments in terms of skills, safety attitudes and culture, a permanent effort to achieve further progress, openness to international best practices, preparedness for emergency situations, and transparency and dialogue. This policy is disseminated to each member of staff and to all external service providers.

With the same aim, a new version of the 2004 safety management guide takes account of the progress made in this field, and more specifically the creation of an integrated management

system at the sites and the deployment of the human performance project (intervention reliability enhancement practices, field visits by the managers, analysis of field visits).

The new version of the safety management guide details the background to the safety management system (which is particularly important when handing over to the new generation of staff), the key principles of safety management and, finally, the questions that the various management levels must ask themselves.

Incentives to develop a questioning and prudent attitude, where there is room for legitimate doubt

To help develop the safety culture in the field, EDF conducted a human performance project involving every member of staff and external service provider; one part of that project looked at the appropriation of intervention reliability enhancement practices: pre-job briefing, ‘stop and think’ approach, self-checks, cross-checks, secure communication and debriefing. These various practices are designed to reduce the occurrence of human errors, with some, such as the ‘stop and think’ approach, being there to give legitimacy to any interruption of the intervention if the individual has doubts about the conditions in which the work is being carried out, thus helping to manage the associated risks.

An attitude which encourages feedback about problems and difficulties

Being more in touch with realities at ground level and understanding and encouraging feedback about problems and difficulties were the main driving forces behind the development of the other two aspects of the human performance project. Firstly, acquiring experience on the ground is an opportunity to reinforce the expected attitudes in a positive way as well as to identify deviations and discuss difficulties. Analysis loops are then set up in order to deal within problems speedily and to identify trends and early-warning signals. This approach is supported by the EXA project currently being deployed.

A decision-making process designed to guarantee that priority is given to safety

EDF has continued to reinforce the decision-making process in order to guarantee that priority is given to safety. Since the early 2000s, the implementation of the OSRDE (*Observatoires Sûreté Radioprotection Disponibilité Environnement*, ‘Safety, Radiation Protection, Availability and Environment Observatories’) has been promoted in order to identify the conditions in which decisions are taken. In addition, work has been conducted in recent years, on the basis of the INPO ‘effective decision-making’ document, to ensure that conditions favourable to good decision-making are systematically set up.

Checks and verification

A system of checks and verification is in place within every entity. Checks must be carried out first of all by the relevant operational line management, which is responsible for

performing these checks. In addition, verification actions are performed by independent bodies.

All the units are also audited at various levels:

- by the GED's auditing service, which periodically carries out audits concerning implementation of the internal monitoring policy within the units and assessments of the unit's resources, be they technical, organisational or human;
- by the Nuclear Inspectorate, the NGD's auditing entity. These assessments, carried out every four years, involve evaluating the level of safety, radiation protection and environment by comparing the actual performance of the organisations and the baseline requirements established by the NGD management, and then issuing recommendations to the entire line management chain in order to further improve safety;
- by the World Association of Nuclear Operators (WANO) by means of peer reviews. These reviews consist in a plant assessment programme, covering technical and managerial aspects, performed by foreign operator peers. They are also an opportunity for productive discussions between the assessment team and the operators of the plant inspected. Since 2012, the frequency of the peer reviews has been gradually increased and will reach one inspection every four years at each plant in 2015. In 2013, the Blayais, Civaux and Paluel sites hosted the WANO review missions;
- by the IAEA, through OSART missions, with a special nuclear inspection preparatory audit carried out between 18 months and two years in advance (one OSART mission per year for the NGD). A 'Corporate OSART' mission devoted to examining the functioning of EDF's central services is scheduled for the end of 2014.

All of these assessments, the scope and detail of which have been expanded, help the NGD management to define its priorities with a view to achieving continuous improvements to safety, to conducting comparisons between plants, to reinforcing safety management and to improving the overall performance of the fleet. They are also a good opportunity for engineers and managers to take part in the WANO and IAEA assessments abroad and observe good practices. This is why the EDF Group encourages these assessments and is looking to increase the number of managers who take part in them.

6.4.2.2 Measures adopted in respect of fuel cycle facilities

AREVA has formalised its commitments in the field of nuclear safety and radiation protection in a Nuclear Safety Charter. The purpose of the charter is to meet the requirement of a high level of safety throughout the life of the facilities.

The prime responsibility of the operator is clearly indicated in the charter: each installation manager is responsible for safety and radiation protection within his installation. The levels of delegation of responsibility are established within each entity, in connection with the

operational line management and within the limits of the powers conferred. Where appropriate, they incorporate national specificities. The system of organisation in place allows legal and regulatory requirements to be satisfied, in particular in the fields of nuclear safety, radiation protection and transport security.

In addition to the technical ‘level zero’ controls, internal controls are conducted by staff independent from the operational teams:

- ‘first level’ controls are carried out on behalf of the unit manager and are intended, in essence, to ensure that the safety standard and the system of delegations are being correctly applied; and
- ‘second level’ controls are carried out by the corps of safety inspectors, appointed by the Board of Management.

All persons working in the installations, whether an employee of the group or of one of its subcontractors, are informed of the risks associated with their work and the arrangements made to prevent and manage those risks. They have a duty to report any blatant negligence or disregard for a legal requirement that they observe. They enjoy the same protection irrespective of their status. They also receive training and are involved in the implementation of actions to prevent risks and improve safety.

AREVA endeavours to provide reliable and relevant information to allow everyone to assess the safety status of its installations objectively. In accordance with the provisions of the TNS Law, nuclear sites draw up and distribute a report on nuclear safety every year. That report is submitted to the installation’s Hygiene, Security and Working Conditions Committee (HSWCC) prior to publication. In addition, pursuant to the provisions of the Nuclear Safety Charter, the General Inspectorate produces an annual report on the safety status of the group’s installations; that report is presented to the Executive Management Board (EMB) and to the Group Supervisory Board and is made public.

The principles laid down in AREVA’s Nuclear Safety Charter form part of an approach of continuous progress. In the more general context of its 2016 strategic action plan, objectives to improve nuclear safety have been determined by AREVA for achievement by 2016 in relation to the safety of installations, operational safety and safety management.

AREVA also acceded to WANO in 2012 as the operator of La Hague. This participation in the work of WANO will contribute to the processes for the continuous improvement of operations deployed by the group as a result of the sharing of international experience, the exchange of good practices and peer reviews. The peer reviews are highly detailed exercises (25 peers on site for three weeks) and are performed by professional operators in line with rigorous procedures. La Hague hosted its first peer review in June 2014.

6.4.2.3 Measures adopted in respect of research reactor facilities

Measures adopted by the CEA

In order to ensure nuclear safety, the CEA takes into account the wide variety of its installations, a variety which is the result of the broad range of research programmes conducted by the CEA, and the development of those programmes over time and, as a result, the diverse range of potential risks. Since 2006, the CEA has adopted a safety policy which is implemented on the basis of a three-year plan. This approach has led to contracts which, within the units and at various hierarchical levels, formally define precise safety and radiation protection objectives and the associated resources. The CEA has thus also committed to a self-assessment approach based on a certain number of indicators for the monitoring of safety and the proper functioning of the organisation.

Nuclear safety is the CEA's priority. The level of safety it achieves is based on meeting the following three conditions:

- a well-defined organisation in which every member of staff at every level is trained in, made aware of and given responsibility for the role which is clearly assigned to him or her (see the organisation chart below);
- a culture of safety that is taught, maintained and developed;
- staff that are professional, skilled and able to work as part of a team.

At a central level, the Chairman determines the broad safety focuses and adopts measures relating, on the one hand, to the implementation of the applicable legislative, regulatory and specific requirements and, on the other hand, to the system of nuclear safety at the CEA. The Chairman also makes strategic decisions.

With regard to nuclear safety, radiation protection and transport operations, the Chairman is assisted by the Protection and Nuclear Safety Division (PNSD). This directorate, which is part of the 'risk management' centre, defines CEA's safety policy, which is based on an approach of continuous progress.

The Nuclear Energy Director, assisted by the Quality and Environment Directorate, implements and monitors application of the CEA safety policy at all its nuclear installations.

Existing practices are detailed in the CEA nuclear safety manual. Those practices include:

- circulars taking the form of general management directives; and
- recommendations which seek to define CEA practices.

At local level, the centre directors and installation managers are responsible for implementing the necessary actions; they ensure that the safety policy defined is applied at each installation for which they are responsible.

The supervisory function is carried out by entities independent of those responsible for implementing the necessary actions. The supervisory function involves reviewing the efficiency and adequacy of the actions taken and of the internal technical inspections of such

actions. General nuclear safety support units provide the installations with assistance at centre level.

At Chairman level, the supervisory function falls under the responsibility of the General and Nuclear Inspectorate (GNI) of the CEA's 'risk management' centre. The GNI conducts scheduled inspections (about ten every year) and reactive inspections following significant events. The Director of the GNI may decide on the inspectorate's intervention on relevant topics.

The CEA has reinforced the organisational and radiation protection arrangements in the operations performed by external service providers.

The CEA is also continuing to reinforce certain axes of progress, including:

- the organisation of the technical support provided to the installations in certain areas of expertise, such as earthquakes, civil engineering, criticality and human factors;
- organisational arrangements concerning the management of external service providers.

Measures adopted by the ILL

Nuclear safety has always been and remains the ILL's priority. The level of safety reached by ILL is based on the following system of organisation:

- a radiation protection unit reporting directly to the Institute's director; and
- a reactor division, the head of which, on the authority delegated by the director, is responsible for the operation and safety of the reactor and its auxiliary buildings, as well as for operational quality assurance.

Some of these activities, as listed, are said to be 'quality controlled' (QCA) and must be the subject of a special procedure. QCA must in principle undergo two-level checks, as stipulated in the BNI Order:

- first-level check: this is primarily technical and intended to ensure that the QCA results objective is obtained. This is normally carried out within the functional group responsible for conducting the QCA;
- second-level check: within the reactor division, additional checks, which may take the form of spot checks, concerning the twofold technical and management aspects of QCA. These checks are carried out by the quality assurance team established within the reactor division.

Measures adopted by the ITER International Organisation

The founding acts establishing the ITER project emphasise the priority given to nuclear safety. The ITER is designed, constructed and will be operated with nuclear safety as an

essential requirement. The protection of workers, the general public and the environment is an overriding concern.

Amongst all the activities carried out within the ITER installation, some are deemed to be ‘important for the protection of the installation’. Those activities are identified and must be subject to a specific monitoring procedure. At this stage, they relate in essence to the installation’s design, research and development activities and the manufacture of structures and components important to safety.

6.5 *Human and financial resources of licence holders*

6.5.1 Human resources

6.5.1.1 Requests and checks by the regulatory authority

The Order of 7 February 2012 requires BNI operators to establish and implement a policy to protect the interests stated in Article L. 593-1 of the Environment Code.¹² This policy defines objectives and sets out the operator’s strategy to achieve them and the resources it commits to assign to them.

In addition, the operator must indicate the organisation of its technical capabilities, that is to say whether they are held internally, in subsidiaries or through third parties with whom formal agreements must be made; the most fundamental capabilities must be held by the operator or one of its subsidiaries.

Consequently, the ASN expects the licensees to possess the appropriate expertise and technical skills to ensure the operation of the facilities, the maintenance of the equipment and systems and the management of incidents and accidents.

The ASN’s monitoring of human resources is based on inspections and assessments conducted with the support of IRSN and the permanent groups of experts covering the subject areas of human and organisational factors and safety management. Human resources are also monitored in the course of specific inspections. The ASN endeavours in particular to monitor the system of organisation put in place to manage skills and jobs and, more specifically, the renewal of skills, recruitment and training.

6.5.1.2 Measures adopted by the licence holders

6.5.1.2.1 Measures adopted in respect of nuclear power plants

At the end of 2012, EDF’s Nuclear Generation Division (NGD), responsible for the operation of EDF’s nuclear reactors, employed some 21 000 people, divided amongst the 19 power

¹² Namely, public security, health and hygiene and the protection of nature and the environment.

plants in operation and the two national engineering units. Engineers and managers represented 35% of the workforce (7 400 members of staff), supervisors 62% (13 100 members of staff) and operatives 3% (700 members of staff).

To these 21 000 members of staff must be added EDF's human resources devoted to installation design, new construction, the engineering of the plants in operation, support functions and the dismantling of nuclear reactors:

- around 4 500 engineers and technicians in the Nuclear Engineering Division (NED) split 75% management and 25% supervisors;
- nearly 170 engineers and technicians in the Nuclear Fuel Division (NFD); and
- more than 600 engineers and technicians in EDF's Research and Development Division (R&DD).

As part of the development of a culture of safety, the accountability policy implemented within the company means that the vast majority of the personnel devote a significant percentage of their time and activities to nuclear safety and radiation protection.

If only those personnel whose role and duties are exclusively concerned with nuclear safety are considered, this still accounts for more than 450 members of staff.

The roles of some 950 people are devoted to security and radiation protection activities.

6.5.1.2.2 Measures adopted in respect of fuel cycle facilities

As at the end of 2013, the AREVA group had 45 340 employees, 40 000 of whom worked in the nuclear sector.

The unit line managers are responsible for deciding on the assignment of qualified staff to the performance of the tasks required, and therefore for assessing their skills. To that end, line managers refer to the initial training provided and experience acquired and identify any need for supplementary training or qualifications/authorisations to perform specific tasks. They are supported by the competent services of the Human Resources Division and its functional teams within the installations; those teams are responsible for providing training and retaining records of such training.

Actions relating to training, skills assessment and the provision of information are taken at all levels within the company. Those actions incorporate Safety – Security – Environment issues. Tools are used to assess the culture of safety within the group.

AREVA's staff is experienced and staff turnover is limited. This guarantees a high level of operational skill, which serves to ensure the safety of installations.

6.5.1.2.3 Measures adopted in respect of research reactor facilities

Measures adopted by the CEA

The CEA is a public research organisation established in 1945. In 2001, it adopted a system of organisation based on the establishment of four 'sectors' corresponding to its main areas of activity. Each operational sector is equipped with the resources necessary for it to develop, plan and control all its activities.

A safety engineer is on duty at each facility. This engineer is familiar with the facility and has experience of analysing and handling safety-related issues. The facility also has skills in the areas of criticality, the use of experience acquired and organisational and human factors.

In addition, safety-related issues are followed up, monitored and coordinated by various contributors, namely:

- the nuclear safety unit within each centre; and
- the Protection and Nuclear Safety Division.

The human resources required to perform such activities necessitates the deployment of between 10 and 20 engineers at each site.

Those engineers rely on specialists from the CEA and provide the installation and project managers with the assistance necessary to conduct complex safety studies successfully, to study topics of a generic nature, to ensure consistency between safety approaches and, ultimately, to allow the CEA to exercise its capacity of independent expertise. They are also responsible for capitalising on the experience acquired in the course of safety studies in order to ensure that their knowledge and technical independence are maintained and developed.

The system of organisation in place at the CEA for many years has contributed to improving the understanding of the units' responsibilities and missions, in particular in relation to the continuity of the action plan, the independence of the supervisory function and the identification of a function of providing support to the facilities.

With regard to the forward-looking jobs and skills management system, the arrangements in place are based primarily on staff reviews and job plans, which involve establishing the future needs in terms of positions and the prospective movements of employees, thus enabling staff recruitment and mobility to be managed in line with those needs.

Two complementary approaches are followed in that management system:

- a collective approach for prospective employment management in line with the CEA's programmes. The aim is to anticipate needs from both a qualitative and a quantitative perspective and to tailor human resources to the changes in needs linked to programmes and activities;

- an individual approach focussed on the development of skills and career paths. This approach is based on a system of annual meetings between the employee and his line manager, as well as on the organisation of staff reviews with a view to matching the professional development ambitions expressed by employees and the needs of programmes and activities.

The skills necessary for the conduct of programmes and the operation of installations are updated annually and a forecast is made for the years ahead. That forecast is based *inter alia* on the estimated rates of departure and recruitment.

Measures adopted by the ILL

In order to meet safety requirements, the ILL has since 2008 employed a second safety engineer, who also reports directly to the head of the Reactor Division.

In order to ensure the monitoring of the facility and the radiological monitoring of staff, the Radiation Protection Unit comprises nine members of staff led by a radiation protection engineer.

In order to ensure environmental monitoring, the ILL set up a new laboratory in 2010 employing seven technicians led by an engineer. This monitoring was previously the responsibility of CEA Grenoble, prior to the transfer of its equipment to the ILL. The CEA provided training to staff over the course of the year preceding this transfer of activity to ILL.

In order to implement the post-Fukushima actions, the ILL set up a project structure which utilises both the services of the ILL and personnel from outside contractors. An additional safety engineer was hired for the duration of this project, covering the period 2012-2016.

Measures adopted by the ITER International Organisation

The technical capacity of the ITER project team is based on the skills of scientists and technicians drawn from fusion research institutes associated with the project from around the world, fusion installations and nuclear installations with features similar to those of the ITER.

The recruitment process endeavours to factor in two elements which are essential to ensuring that the project team has the necessary skills and that those skills are permanently retained:

- firstly, the recruitment of engineers, scientists and technicians with considerable expertise in fusion, nuclear sciences, operations or project management; and
- secondly, the recruitment of young graduates who will be able to acquire and ensure the continued existence of those skills throughout the construction and then operation of ITER.

Consideration must also be given to two further factors:

- the choice to site the ITER near a research centre involved in fusion research and operating some twenty nuclear installations; and
- the capitalisation on knowledge acquired through exchanges of experience between all partners.

6.5.2 Financial resources

6.5.2.1 Requests and checks by the regulatory authority

Article L. 593-7 of the Environment Code provides that the licence to construct a BNI is to ‘take account of the technical and financial capacities of the operator’. Those capacities must enable the operator to carry out its plans whilst protecting the interests stated in Article L. 593-1 of the Environment Code, ‘in particular to cover the costs of decommissioning the installation and of the rehabilitation, monitoring and maintenance of its site or, in the case of radioactive waste storage facilities, to cover the costs of final shutdown, upkeep and surveillance’.

In accordance with the Order of 7 February 2012, the nuclear operator must have sufficient resources – specifically financial resources – to define, implement, maintain, evaluate and improve an integrated management system. That order also states that the policy relating to public security, health and hygiene and to the protection of nature and of the environment must indicate the resources that the nuclear operator undertakes to commit to that policy.

Like the system of monitoring in place in relation to human resources, the monitoring by the ASN in relation to financial resources is based on inspections and assessments conducted with the support of the IRSN and the permanent groups of experts; those inspections and assessments focus on the issue of safety management.

In the particular case of public research organisations, resources are sensitive to the context of the State Budget. Although the source of funding, i.e. the State, provides certain guarantees, it does also sometimes come to decisions which may compromise the future of certain facilities. The amendments and upgrades to current safety requirements, following safety reviews, often entail extensive work and remain difficult and lengthy. The ASN ensures that budgetary constraints have no impact on safety and radiation protection in connection with the operation of those facilities.

Furthermore, Law No 2006-739 of 28 June 2006 establishes a scheme for the ring-fencing of funds to meet the costs of decommissioning BNI and managing spent fuel and radioactive waste.

The legal scheme seeks to secure the funding of nuclear-related costs in compliance with the ‘polluter pays’ principle. It is therefore up to the nuclear operator to cover the cost of this funding by creating a portfolio of dedicated assets able to cover the anticipated costs. This is done under the direct supervision of the State, which analyses the licence holder’s situation

and may require the adoption of necessary measures if the provisions made are deemed to be insufficient or inadequate. In any event, the operators remain responsible for the appropriate financing of their long-term costs.

The legal arrangements require nuclear operators to make a prudent assessment of the cost of decommissioning their facilities or, in the case of radioactive waste storage facilities, their final shutdown, upkeep and surveillance costs. They must also estimate the costs of managing their spent fuel and their radioactive waste. In this context, nuclear operators submit three-yearly reports and annual updates to the State; those reports and updates are subject to joint examination by the MEDDE and the ASN.

6.5.2.2 Measures adopted by the licence holders

6.5.2.2.1 Measures adopted in respect of nuclear power plants

In 2013, the EDF Group achieved a consolidated turnover of EUR 75.6 billion, a gross operating surplus of EUR 16.8 billion and net income of EUR 4.1 billion.

In France, the net production of electricity by EDF in 2013 was 462 TWh, of which 403.7 TWh was from nuclear sources (63.13 GWe), 42.6 TWh from hydraulic sources (20 GWe) and 15.6 TWh from fossil fuels (14.7 GWe), out of a total of 550.9 TWh from all producers taken together.

With regard to nuclear power production in France, operational investments for nuclear maintenance amounted to nearly EUR 3.1 billion in 2012. The group will be increasing its investment in the nuclear fleet between now and 2015 in order to increase safety and allow efficient operation of the fleet whilst increasing production. Particular emphasis will thus be placed on maintenance with the ramp-up of the programme to replace major components such as alternators, transformers and steam generators (EUR 3.4 to EUR 3.6 billion between now and 2015), the aim of which is to extend the operating life of the plants beyond 40 years in optimum conditions of safety and operation. In 2011, for example, this led to the signing of contracts for the refurbishment of the safety control/command systems for the 1300 MWe reactors and the ordering of 44 steam generators. This is the focus of the Generation 2020 'Grand Carénage' (major overhaul) programme planned for the plants in operation. Finally, the group will take account of the lessons learned from the accident at the Fukushima Daiichi plant, as required by ASN, and intends to invest a total of about EUR 10 billion in order to meet the ASN requirements.

Furthermore, in order to secure the financing of its long-term nuclear commitments, EDF has in the past few years set up a portfolio of assets exclusively devoted to meeting provisions linked to dismantling of the power plants and back-end fuel cycle facilities. As at 31 December 2013, its market value is EUR 21.7 billion, with a EUR 21 billion updated cost of the long-term nuclear obligations (part of the provisions are to be covered by dedicated assets), thus enabling the achievement of the objective of covering all long-term nuclear

commitments pursuant to the Law of 28 June 2006 by means of the dedicated portfolio of assets.

EDF considers that all of the above shows that adequate financial resources are available to ensure the safety of each nuclear facility over its lifetime.

6.5.2.2.2 Measures adopted in respect of fuel cycle facilities

The AREVA Group's turnover for 2013 is EUR 9 240 million. The nuclear operator activities are performed primarily by the Front End and Back End business groups (fuel cycle activities), which account for 42.5% of the turnover and 82.4% of the gross operating surplus. The group's financial resources cover the needs associated with managing the activities carried out.

Furthermore, those resources contribute to providing financial coverage for the long-term obligations inherent in nuclear activities.

As at 31 December 2013, the provisions for risks relating to the environment – including the decommissioning and redevelopment of installations and mine sites, the decommissioning of nuclear installations, the recovery and conditioning of radioactive waste, final waste disposal, ongoing sanitation work and the depollution and rehabilitation of industrial sites and mines – stand at EUR 6 857 million. The proportion of the provisions allocated to the decommissioning of nuclear installations and the recovery and conditioning of waste amounts to EUR 6 437 million, EUR 6 238 million of which is covered by AREVA. Since 28 June 2011, the Law of 28 June 2006 on the sustainable management of radioactive materials and waste has required that the coverage rate of provisions for end-of-cycle operations by means of dedicated assets is 100%. As at 31 December 2013, the coverage ratio stood at 102%.

AREVA provides a reprocessing service to electricity providers, who retain ownership of their waste: AREVA therefore has very little waste of its own.

6.5.2.2.3 Measures adopted in respect of research reactor facilities

Measures adopted by the CEA

The CEA is funded by three different main sources:

- State subsidy;
- external revenues (sale of patents, cooperation agreements etc.); and
- the dedicated fund for sanitation and decommissioning.

The resources of the research facilities operated by the CEA, like those of all large public research bodies, may be affected by the context of the State Budget. Although the source of funding, i.e. the State, provides certain guarantees (subsidies), it does also sometimes entail

some difficult decisions. The amendments and upgrades to current safety requirements, following safety reviews, may entail extensive work at certain older installations. That work can thus take several years to be completed. The CEA ensures that budgetary constraints have no impact on safety and radiation protection in connection with the operation of research facilities. A CEA-State ‘objectives and performance agreement’ sets out the organisation of the CEA’s activities over a four-year period in order to comply with the strategic focuses determined by the State.

In 2006, the CEA implemented an approach designed to ensure efficient monitoring of all major projects (major commitments to safety and radiation protection) and produced related reports for the ASN using an effective control tool that was transparent to ASN, especially with regard to the decision-making process. This tool must thus allow improved management of complex programmes with major nuclear safety and radiation protection implications, and protect these projects, which are few in number, from any budgetary threats.

The ‘major commitments’ approach adopted by the CEA is a constantly available tool and is regularly expanded to include new ‘major commitments’. Any delay must therefore firstly be duly justified, and secondly be discussed beforehand with the ASN.

For instance, more than EUR 25 million is devoted to the safety and radiation protection of the CEA’s research reactor facilities. That calculation does not include the works to be carried out in the context of the SSA.

Furthermore, provisions linked to the decommissioning of nuclear installations and to the total cost of the operation in the event that the CEA is the nuclear operator of the installation, or failing that to the share attributable to it on account of its past involvement in a programme or of the joint operation of an installation, are established as early as the commissioning of the installation.

The provisions are offset on the assets side of the balance sheet in the form of fixed assets held in an ‘Assets for decommissioning’ account, under which there are several items depending on the financing expected.

On 27 June 2001, the Board of Directors of the CEA decide to establish a dedicated fund to cover the decommissioning and sanitation costs of the CEA’s civil installations, the initial contributions to which took the form of the transfer of an exceptional dividend payment and the allocation of a percentage of shares held by the CEA.

A framework convention signed in 2010 between the CEA and the State guarantees the long-term equilibrium of the balance sheet of that dedicated fund.

Measures adopted by the ILL

The ILL is the world leader in neutron research. Its annual budget is around EUR 90 million, 20% of which is devoted to investment both in major maintenance work, upgrades or new work on the reactor, and in the continuous modernisation of scientific instruments.

Measures adopted by the ITER International Organisation

ITER's funding is guaranteed by an international agreement which provides for contributions from each of its seven partners. The agreement identifies four project stages: design, construction, operation and decommissioning.

The decommissioning of the ITER will be the responsibility of the host country, i.e. France. In accordance with Law No 2006-739 of 28 June 2006 on the sustainable management of radioactive materials and waste and with the obligations of the ITER organisation, a financial fund will be established and contributions will be made to that fund during the operation stage in order to cover the costs of the decommissioning operations, the management of waste and the surveillance of the installation once testing has ceased. This provision, a total amount of EUR 530 million (EUR value in the year 2000 exclusive of tax), will be established by contributions from ITER partners throughout the 20 years' operation of the installation (EUR 26.5 million per year for 20 years). That value will be updated over the course of the operation stage.

7. Article 7: Expertise and skills in nuclear safety

Member States shall ensure that the national framework in place requires arrangements for education and training to be made by all parties for their staff having responsibilities relating to the nuclear safety of nuclear installations in order to maintain and to further develop expertise and skills in nuclear safety.

7.1 Expertise and skills of licence holders

7.1.1 Supervision by the regulatory authority

The ASN defines social, organisational and human factors (SOHF) as all work-related and organisational factors which will have an impact on the activity of the operators. The SOHF are factors which are of crucial significance to safety and must be taken into account throughout the lifetime of a BNI.

The factors considered are determined by the individuals concerned and the working arrangements to which they are subject, by the technical arrangements and, in more general terms, by the working environment with which those individuals interact.

The monitoring of SOHF by the ASN is based primarily on the inspections conducted of the actions adopted by the operator to improve the integration of SOHF into all stages of the lifecycle of a BNI. The inspections performed by the ASN focus on the activity of the operators, but also on the operating conditions and the resources made available in order to carry out that work. More specifically, the quality and implementation of the system of managing jobs, skills, training and authorisations are monitored. The same monitoring takes place in relation to the resources, skills and methods employed by the licence holders to implement SOHF actions.

During its inspections, the ASN attaches great importance to the system of organisation in place to manage skills and staff, and in particular the renewal of skills, recruitment and training.

For instance, in the course of inspections carried out in 2012, the ASN noted that the CEA Cadarache site had not sufficiently assessed the consequences of the significant and rapid cutbacks of AREVA NC staff at the respective installations. Those cutbacks did, however, impact on the skills existing within the CEA and necessitated a re-assessment of its needs. The ASN issued a letter of formal notice to the CEA Cadarache site, requiring it to establish an AREVA NC monitoring system and to strengthen the management of skills linked to the safe decommissioning of certain BNI. The measures adopted by the CEA were deemed satisfactory by the ASN.

In addition to inspections, the monitoring by the ASN in relation to SOHF is based on assessments made at its request by the IRSN and the PGE.

Finally, the ASN monitors the safety management systems of licence holders, who are required to provide a framework and support for decisions and actions which have either direct or indirect safety implications (see Section 6.5).

The ASN heads the *Comité d'orientation sur les facteurs sociaux, organisationnels et humains* [Social, Organisation and Human Factors Steering Committee] ('CoFSOH'), a forum for the multidisciplinary exchange of information established to drive forward ideas based around three priority axes, namely the renewal of the staff and skills of operators, the organisation of subcontracting arrangements and research into these topics.

7.1.2 Measures adopted by the licence holders

7.1.2.1 Measures adopted in respect of nuclear power plants

Since 2006, EDF has been carrying out in-depth work to secure the skills and career paths of staff by the adoption of a forward-looking jobs and skills management approach, based on identical principles applicable to all nuclear power plants and drawn up on the basis of the reality on the ground in successive iterations. These elements are subject to follow-up, steering and specific monitoring.

Staff numbers are currently increasing to accompany the renewal of skills currently in process, to implement the plans relating to the nuclear fleet in operation and to bolster skills in relation to the management of a serious accident (with, for example, the creation of the NRRF – Nuclear Rapid Response Force). A significant number of people have been recruited in the past few years: in five years, almost 5 500 new employees have joined the NGD (25% of staff). There are currently some 2 700 trainees (almost 13% of staff).

The amount of training undertaken has also seen a marked increase over a five-year period: the number of training hours has doubled, passing from 1.2 million hours in 2007 to 2.7 million hours in 2012. The content of initial training courses has been enriched and adapted to this new context with the creation of 'Nuclear Common Knowledge Academy' courses and reviewed courses for each specific job role. In addition, reactive training sessions are rolled out on the basis of experience acquired by other international operators.

Similarly, with regard to engineering, since 2006 the Nuclear Engineering Division (NED) has been driving forward a 'plan to develop key nuclear engineering skills', involving teams from the NED and other teams in the GED and the R&D divisions. This approach seeks to ensure the successful development of engineering-related job roles and, through its transverse and prospective vision, can feed into the units' ideas about choices relating to forward-looking jobs and skills management.

New recruits to the NED undergo a five-week training course covering the common knowledge of engineer ‘studies’ (operation, culture of safety and quality, security and radiation protection etc.).

7.1.2.2 Measures adopted in relation to fuel cycle facilities

The operation of such facilities is guaranteed in a manner consistent with the requirements applicable to the facilities, as described in the safety standard.

The provision of support to operators and regular checks on the application or knowledge of any new procedure is the responsibility of the local operational management team, in order *inter alia* to guarantee the management of situations specific to certain work stations, under the responsibility of the installation manager.

This approach of providing support is just as important in the case of installations which are being decommissioned; the environment and the operating conditions at such sites are in constant flux over the course of the work to dismantle the equipment. Indeed, it is quite common for the management of risks associated with such work to be based in part on operating rules, which must minimise the potential risk of human error. It is thus important that the operating constraints and justifications for those constraints are properly understood by those responsible for implementing the constraints. In the case of installations in continuous operation, the operation and maintenance teams are assisted by operational safety engineers.

At the top operational level, ‘buddying’ arrangements are in place, thus allowing for a transfer of past knowledge acquired and a gradual upskilling of the new arrivals.

With the adoption of the Safety Excellence programme, created in 2012 and headed by the Safety – Health – Security and Sustainable Development Divisions, AREVA is also reinforcing its awareness-raising efforts and training in the areas of safety, security and environment amongst its operational managers.

In particular, a dedicated course of continuous training has been established for site directors and installation managers.

For site directors, that course includes a module specifically devoted to safety-health-security-environment management (M3SE). Forty site directors and deputy directors together with an operational delegation completed this module in 2013 in order to refresh their knowledge of the permanent developments occurring within the field and to facilitate the sharing of their operational experiences.

For future installation managers, a pre-appointment mandatory training course has been created. This course includes in particular two modules and an individual project specifically

devoted to safety-health-security-environment management. To date, 60 installation managers have undertaken this training; 40 more are scheduled to do so in 2014.

In addition to training courses focussing on regulatory matters and on risks and the safety-security culture offered at operator and site level, the group has defined and provides training courses relating specifically to nuclear safety, organisational and human factors (OHF) and security at work for key personnel: a generalist nuclear safety engineer (GNSE) module for safety engineers, event analysis and OHF awareness training modules for local managers, and a crisis situation organisational and management awareness module for members of the Steering Committees. More than 300 people undertook this training in 2013.

In 2014, further training modules will be added to the multitude of continuous training tools which exist within AREVA. Those modules will be intended for the professional risk prevention experts required as a result of the changes to the applicable regulations in the areas of security at work, and for the persons responsible for monitoring from external bodies. Some 500 people will be involved in such training.

7.1.2.3 Measures adopted in respect of research reactor facilities

Measures adopted by the CEA

The skills and the culture of safety of the various categories of people with a safety-related role are key to maintaining a good level of installation safety.

The PNSD is responsible for the management of safety-related training. In that context, it is responsible for drawing up training programmes, with the support of the centres of excellence.

The main training courses developed thus far cover the following areas:

- preparation for the role of BNI Manager;
- nuclear safety;
- criticality;
- human and organisational factors; and
- the culture of safety.

The rate of attendance of such training courses makes it possible to ensure that one safety engineer is on duty at each installation. This engineer is familiar with the facility and is experienced in the analysis and handling of safety-related matters. The installation is thus equipped with skills in the area of criticality.

In accordance with the requirements of the BNI Order and the 'Human Resources' chapter of ISO standard 9001 – version 2000, the skills of the people assigned to positions of importance from the perspective of safety at a BNI must be guaranteed.

The accepted principles governing the qualification and authorisation procedure are:

- the separation of the responsibilities of qualification and authorisation;
- the recognition of a person's qualification by an official who may, if he deems it appropriate, call on the services of specialists;
- the recognition of a person's qualification, in particular by the validation of the skills acquired in the course of professional experience and not just through training;
- account is taken of the various means of acquiring skills (initial and professional training, professional experience, self-training, mentoring); and
- the traceability of qualification and authorisation decisions.

Before taking up their position, the installation managers undertake a specific training course covering the following matters: personnel and operational management, nuclear safety at the CEA and, during operations, the legal responsibilities of the operator, radiation protection and waste management.

In addition, the follow-up, supervision and coordination of safety-related matters are performed by various stakeholders, namely:

- the nuclear safety cell at each centre; and
- the Protection and Nuclear Safety Division.

The human resources required for these activities amount to 10 to 20 engineers per site.

Recourse is had to experts from one or more centres of excellence established within the CEA and headed by the DPNS in relation to some aspects of the technical files.

For instance, targeted training courses have been set up covering the integration of OHF into the activities of significance in terms of safety and a significant OHF component.

Reference may also be made in this regard to Section 6.5.1.2.

Measures adopted by the ILL

The Reactor Division is responsible for the operation of the reactor and its annexes. In view of the particular importance to safety presented by these operational activities, and in accordance with the provisions of the BNI Order, a quality assurance organisation is set up with the intention of guaranteeing that the level of quality required is achieved and maintained and of providing proof of that level's achievement and maintenance. One of the accepted guidelines states that the officials qualified to perform a 'quality controlled' activity are appointed by the operations manager. Such officials are said to be 'authorised'.

In addition, the steps taken by the HFR in the area of OHF largely mirror those of the CEA. The two institutions are in regular contact with each other in this regard. The ILL's Quality

Assurance Manager is now directly answerable to the Head of the Reactor Division and is wholly independent from an operational standpoint.

Measures adopted by the ITER International Organisation

The ITER personnel with responsibilities in the field of nuclear safety have the necessary skills and qualifications.

The recruitment process, organisational matters, the definition of the responsibilities of each individual, the annual appraisal and the training courses contribute to the maintenance and development of skills and qualifications in the field of nuclear safety.

7.2 Expertise and skills of the regulatory authority

It is the view of the ASN that expertise is one of the conditions of its credibility. In particular, management of the expertise of the ASN's inspectors is based on formal training courses, including technical training courses, and professional experience acquired prior to their authorisation to operate as inspectors. This training standard, a standard which evolves, is tailored to the duties of each inspector. In addition, since 1997 the ASN has authorised some of its inspectors to act as 'confirmed' inspectors. That authorisation represents the formal recognition of an advanced level of expertise which has its basis in training courses and professional experience supplementary to those required to be authorised as an inspector. That authorisation is based on the opinion of a committee specially created in 1997 and placed under the Director-General of the ASN.

In addition to continuous training, 'buddying' and initial training are means of acquiring expertise which the ASN promotes and wishes to develop further.

Beyond the expertise of its inspectors, the ASN endeavours to ensure that every official, irrespective of his duties and his position, can develop his expertise by accessing various training courses.

In 2013, almost 4 100 days of training were provided to ASN officials. The financial cost of the training programmes provided by bodies other than the ASN amounted to EUR 520 000.

8. Article 8: Information to the public

Member States shall ensure that information in relation to the regulation of nuclear safety is made available to the workers and the general public. This obligation includes ensuring that the competent regulatory authority informs the public in the fields of its competence. Information shall be made available to the public in accordance with national legislation and international obligations, provided that this does not jeopardise other interests such as, inter alia, security, recognised in national legislation or international obligations.

The Law on transparency and nuclear safety ('TNS Law') of 13 June 2006 significantly extended the scope of the provisions governing information to the public. Accordingly, it provides that any person has the right to obtain, directly from the operator of a BNI, information about the risks associated with exposure to ionizing radiation and about the safety and radiation protection measures. The law requires all BNI operators to produce an annual report covering, *inter alia*, the arrangements made in relation to safety and radiation protection. The law assigns to the ASN the particular task of providing information to the public within its areas of competence. It also established the HCTISN, a national forum for information, discussion and debate on nuclear activities, their safety and their impact on public health and the environment. The law broadened the use of Local Information Committees (LIC) within BNI; those committees have a general role of monitoring, providing information and debate in matters of nuclear safety, radiation protection and the impact of nuclear activities on people and the environment. The HCTISN and the LIC are pluralist bodies in which the stakeholders are represented.

8.1 Measures adopted by the regulatory authority

Information relating to nuclear safety, one component of environmental information, is provided with the greatest transparency. The law guarantees 'the public's right to reliable and accessible information about nuclear security' (Article L. 125-12 of the Environment Code). The right to information about nuclear safety and radiation protection covers all fields of activity of the ASN, in particular:

- information provided to the public about events occurring in the BNI or during the transportation of radioactive substances, and about discharges, whether normal or accidental, from the BNI;
- information provided to workers about their individual exposure to radiation; and
- information provided to patients about a medical procedure, in particular its radiological aspects.

Where appropriate, provision is made to protect *inter alia* public security and commercial or industrial secrets. In the event of an operator's refusal to communicate information, the applicant may refer the matter to the *Commission d'accès aux documents administratifs* [Commission for Access to Administrative Documents] ('CADA'), an independent administrative authority, which gives an opinion on the justification for the refusal.

The ASN's website (www.asn.fr) provides access to all national and international legislation (laws, regulations, conventions, standards, guides etc.) which form the framework governing nuclear safety and radiation protection. The main actions, decisions and views of the ASN as well as breach notifications are also available on that site.

Since 2002, www.asn.fr has provided access to letters issued following inspections conducted by the ASN at the BNI. The ASN has extended such public disclosure to all its inspection follow-up letters; there are currently more than 11 000 letters available on its website.

In addition, since 2008 the ASN has published the opinions and recommendations of the Permanent Groups of Experts to the ASN on its website.

The ASN involves the public in its decision-making process by developing consultations via www.asn.fr. This approach has been adopted in connection with the development of the legal rules governing the participation of the public in the drawing-up of development and equipment plans which have a significant impact on the environment (Article L. 120-1 of the Environment Code).

In accordance with legal requirements, every year the ASN publishes the *Rapport de l'ASN sur l'état de la sûreté nucléaire et de la radioprotection en France* [ASN Report on the State of Nuclear Safety and Radiation Protection in France]. This document is presented to the Parliament and to the media.

The work of the ASN is carried out against an institutional landscape which includes a large number of stakeholders, in particular MPs and locally elected officials. The *Lettre de l'ASN* [Letter from the ASN] is intended for MPs, locally elected officials, senior officials, associations, LIC, operators and journalists. The ASN maintains close and regular contact with the international, national and regional media, as well as with major nuclear operators and users of ionizing radiation in industry and in the health sector. It produces specific publications, and organises and attends seminars and meetings with a view to increasing awareness of the relevant regulations and of the culture of safety and radiation protection. Finally, it publishes a specialist journal, '*Contrôle*', which is distributed to more than 10 000 subscribers in France and overseas. The journal presents the ASN's point of view and gives stakeholders the opportunity to express their opinions.

The ASN's Information Centre makes more than 3 000 documents relating to nuclear safety and radiation protection available for consultation. The opportunity is offered to consult administrative documents such as public inquiry files, impact studies and operators' annual reports on site. In 2013, the ASN's public information centre responded to over 1 920 requests from the public: requests for the communication of administrative documents, for environmental information, for the sending of publications, for documentary research and for views of the ASN.

Finally, the Public Health Code provides for the creation of a *Réseau national de mesures de la radioactivité de l'environnement* [National Network of Environmental Radioactivity Measurements] ('RNM'), thus satisfying a dual aim:

- ensuring information transparency through the public disclosure of the findings of such monitoring and of information pertaining to the radiological impact of nuclear activities in France; and
- guaranteeing the quality of environmental radioactivity measurements, through the introduction of a laboratory approval system, with approvals issued by the ASN.

On 2 February 2010, the RNM launched a website presenting the findings of environmental radioactivity monitoring and information on the impact of the nuclear industry on health in France. In order to guarantee the quality of measurements, only measurements made by an approved laboratory or by the IRSN may be communicated to the RNM.

The website offers information on radioactivity and on the RNM, and provides access to the database that contains all the radioactivity measurements made in France (almost 600 000 measurements). More information about the RNM is available at www.mesure-radioactivite.fr.

8.2 Measures adopted by the licence holders

8.2.1 Measures adopted by the operators of nuclear power plants

EDF seeks to inform the public of the operation of installations, of technical events and of activities concerning this form of energy in general and safety-related aspects in particular.

The purpose of the approach adopted by EDF is to ensure that the objectives of dialogue and transparency are met by making available information about events and their potential impacts. This policy of dialogue and transparency is conducted for the benefit of staff and staff representatives, subcontractors, supervisory bodies, local contacts, in particular the Local Information Commissions (LIC), and all other stakeholders in the field of nuclear safety.

For instance, such transparency and communication campaigns cover a range of different components: an annual report, meetings with and subject-specific visits by the LIC, meetings with elected officials, press releases, monthly newsletters, a public information centre, a website (www.edf.com), a freephone hotline, and responses to public requests for information about the safety and radiation protection measures adopted.

More specifically, under the TNS Law each site is required to publish an annual report describing, *inter alia*, the provisions adopted in relation to nuclear safety and radiation protection, the nuclear safety and radiation protection-related incidents and accidents, the nature and results of measurements of radioactive and non-radioactive discharges into the

environment, and the nature and quantity of radioactive waste stored at the installation site. This report is made public and sent to the LIC.

8.2.2 Measures adopted by the operators of fuel cycle facilities

AREVA delivers on its commitments by making discharge levels and the results of the environmental monitoring available to the public on a regular basis via the website www.aveva.com as well as via the National Network for the Measurement of Environmental Radioactivity.

In addition, every year each BNI of the AREVA group publishes:

- under the order authorising it to discharge waste, an annual public report presenting *inter alia* the status of the annual water samples, an overview of the monitoring of the sampling sites, the status of the annual discharge levels, and the estimates of doses received by the population on account of the activities conducted over the course of the past year. The reports relating to the year 2013 are available on the group's website;
- under Article 21 of the TNS Law of 2006, a report setting out *inter alia* the arrangements adopted in relation to nuclear safety and radiation protection, details of any incidents and accidents, the nature and results of the measurements of radioactive and non-radioactive waste, the nature and quantity of radioactive waste stored at the installation site, and the measures adopted to limit the volume and effects on health and on the environment, particularly on the land and water. The reports for 2013 have been available since 30 June 2013 and uploaded to the AREVA website (www.aveva.com). In accordance with the legislation, they have been presented to the HSWCC, to the representatives of the nuclear safety authority (ASN), to the LIC and to a broad range of internal and external stakeholders (elected representatives, journalists, suppliers etc.).

Every year the AREVA group also publishes a reference document, its annual report and a report on the safety status of nuclear installations. All those documents are available on its website.

In France, the Local Information Committees facilitate direct exchanges with the main local stakeholders (elected officials, associations, experts etc.), *inter alia* through meetings. Those meetings, to which the press is also invited, are the opportunity to provide the latest news about AREVA sites and to take stock of the actions adopted in relation to the environment, security and safety. AREVA attended fourteen LIC meetings in 2013.

8.2.3 Measures adopted by the operators of research reactor facilities

Measures adopted by the CEA

An LIC (see Section 8.3) is established at each CEA centre; the CEA keeps the committees regularly informed of its research activities, changes to the regulatory provisions applicable to the facilities and events relating to nuclear safety and radiation protection.

The consequences of the accident at the Fukushima Daiichi plant, and more specifically the SSA, have been the subject-matter of specific presentations by the CEA and have been debated at length within the LIC.

Every year the Directorate-General of the CEA attends the meeting of all the LIC located in France and attached to EDF, AREVA and CEA facilities.

The CEA is involved in the work of the HCTISN, a delegation from which visited the Cadarache centre in October 2012. Two days were devoted to exchanges focussed on:

- the CEA's industrial policy vis-à-vis the use of external service providers;
- the means of engagement of such external service providers within the installations, in a manner consistent with the nuclear safety standard; and
- the Supplementary Safety Assessments.

Every year, the CEA publishes a Risk Management Report and, under Article 21 of the TNS Law of 2006, a report setting out, *inter alia*, the provisions adopted in relation to nuclear safety and radiation protection, details of any incidents and accidents, the nature and results of the measurements of radioactive and non-radioactive waste, the nature and quantity of radioactive waste stored at the installation site, and the measures adopted to limit the volume and effects on health and on the environment, particularly on the land and water. These documents are available on the CEA's websites (www.cea.fr and the sites of the individual centres).

Measures adopted by the ILL

The ILL is involved in numerous actions to promote transparency and the provision of information to the public, in particular:

- attendance of meetings of the LIC;
- involvement in regional information campaigns about industrial risks;
- updating on its website (www.ill.eu) of the information relating to the TNS Law, reactor safety, environmental monitoring, security, inspections, emergency exercises and incidents. The consequences of the accident at the Fukushima Daiichi plant form the subject-matter of detailed presentations. Q&A sections have been integrated;
- attendance at technical/scientific forums; and
- public meetings with neighbouring local authorities and businesses.

Measures adopted by the ITER International Organisation

The scientific and technical information relating to the ITER installation, and in particular that connected with nuclear safety regulations, is made available to workers and the general public via intranet sites (in English, given the international scope of the project) and on the internet in French and English (<http://www.iter.org>).

Visits to the site are organised, on request, for the general public and schools in the region. Open days are also organised periodically.

ITER provides information to the public via the ITER Local Information Committee (ITER LIC), created in 2009 in accordance with the regulatory requirements under the TNS Law.

8.3 The other parties involved in the provision of information to the public

8.3.1 The High Committee for Transparency and Information on Nuclear Safety (HCTISN)

In the context of its provisions on nuclear safety and radiation protection, the TNS Law established the HCTISN, a national forum for information, discussion and debate on the risks associated with nuclear activities and the impact of those activities on public health, the environment and nuclear security.

The High Committee may issue an opinion on any question falling within those areas, as well as on the related inspections and information provided. Any question relating to access to information concerning nuclear security may also be referred to it and it may propose any measure capable of guaranteeing or improving transparency in nuclear-related matters.

Any matter relating to information regarding nuclear security and its monitoring may be referred to the High Committee by the minister with responsibility for nuclear safety, by the chairs of the competent committees of the National Assembly and the Senate, by the chair of the OPECST, by the chairs of the LIC and by the operators of BNI.

The chair of the High Committee is appointed by decree from among the MPs, representatives of the local information committees and the individuals chosen on account of their expertise.

8.3.2 The Local Information Committees (LIC)

In accordance with a circular issued by the Prime Minister of 15 December 1981, local information committees (LIC) were established in the 1980s around the majority of nuclear installations, at the initiative of the *conseils généraux* [departmental councils].

The TNS Law formalised the status of the Local Information Committees (LIC) attached to the BNI. Those committees, established by the chair of the departmental council and comprising elected officials, associations, trade unions, qualified individuals and

representatives from the world of economics, have a general role of monitoring, providing information and debate in matters of nuclear safety, radiation protection and the impact of nuclear activities on people and the environment of the installations concerned.

The LIC receives the information necessary to perform that task from the operator, the ASN and the other State departments. It may order the production of expert reports or the taking of measurements relating to discharges from the installation into the environment.

When operating as they should, the LIC make a contribution to safety by the regular questioning of the individuals in charge. The ASN thus seeks to provide the LIC with information that is as complete as possible. With the consent of the operators, the ASN may also invite representatives of the LIC to take part in inspections.

The activity of the LIC takes the form of plenary meetings, some of which are open to the public, and the operation of specialist committees.

8.3.3 Measures adopted by the IRSN

One of the IRSN's missions is to provide information to the public about nuclear and radiological risks. The IRSN endeavours to disseminate educational, transparent and scientifically substantiated information about the risks associated with radioactivity and the means of preventing and containing those risks. It contributes to the provision of information via publications, the Internet (www.irsn.fr), exhibitions, conferences etc.

In April 2009, the IRSN published its Charter of Openness. The transparency of its work and the provision of information to the public are key to contributing towards the monitoring of risks.

That Charter is addressed to all stakeholders involved in risks to health or to the environment at local and national levels: Local Information Committees (LIC) and their national association (ANCCLI), elected officials and associations which bring together members of the public with an interest in radiological and nuclear risks as well as the IRSN's usual partners (authorities and industry).

Under the Charter, the IRSN commits to three objectives aimed at improving risk assessment through increased dialogue with society:

- to increase the transparency of its work so as to enable civil society stakeholders, as well as the Institute's experts and researchers, to obtain a greater understanding of the complex issues connected with risk-related situations and the means of tackling those issues. More specifically, the opinions given to the Nuclear Safety Authority (ASN) are made public and the research work of the Institute is published in scientific journals;

- to share its scientific knowledge, in particular by means of a ‘technical dialogue’ with those stakeholders who wish to highlight uncertainties, flaws and potential controversies, in order to enable those stakeholders to have an informed opinion; and
- to assist civil society stakeholders to acquire the expertise necessary for their involvement and to establish a risk assessment system with them. To that end, the IRSN initiates or takes part in assessment actions or – in the case of pluralist groups bringing together a wide range of stakeholders from different backgrounds – monitoring actions.

ANNEX 1 – LIST AND LOCATION OF NUCLEAR INSTALLATIONS IN FRANCE

1.1 Location of nuclear reactors

The 58 nuclear power reactors and the nine research reactor facilities in operation or under construction as at 31 July 2013 are spread across the territory of France as shown on the map below. In addition, one nuclear power reactor and one research reactor facility are under construction.

[MAP]

PWR: 58 + 1 across 19 sites

Research reactor facilities: 7 + 2

34 x 900 MWe PWR

7 x RRF: 0.1 kW – 70 MW

20 x 1300 MWe PWR

1 x JHR-RRF: 100 MW – under construction

4 x 1450 MWe PWR

1 x ITER-RRF - under construction

1 x 1650 MWe PWR – under construction

Figure 1: Map of France showing the location of nuclear reactors in operation or under construction

1.2 List of nuclear power reactors

Table 1: Nuclear power reactors in operation or under construction

BNI No	NAME AND LOCATION OF THE INSTALLATION	Operator	Nature of the installation	Licence granted on:
75	FESSENHEIM NUCLEAR POWER PLANT (reactors 1 and 2) 68740 Fessenheim	EDF	2 PWR reactors CP0 900 MWe	3 February 1972
78	BUGEY NUCLEAR POWER PLANT (reactors 2 and 3) 01980 Loyettes	EDF	2 PWR reactors CP0 900 MWe	20 November 1972
84	DAMPIERRE-EN-BURLY NUCLEAR POWER PLANT (reactors 1 and 2) 45570 Ouzouer-sur-Loire	EDF	2 PWR reactors CP1 900 MWe	14 June 1976
85	DAMPIERRE-EN-BURLY NUCLEAR POWER PLANT (reactors 3 and 4) 45570 Ouzouer-sur-Loire	EDF	2 PWR reactors CP1 900 MWe	14 June 1976
86	BLAYAIS NUCLEAR POWER PLANT (reactors 1 and 2) 33820 Saint-Ciers-sur-Gironde	EDF	2 PWR reactors CP1 900 MWe	14 June 1976
87	TRICASTIN NUCLEAR POWER PLANT (reactors 1 and 2) 26130 Saint-Paul-Trois-Châteaux	EDF	2 PWR reactors CP1 900 MWe	2 July 1976
88	TRICASTIN NUCLEAR POWER PLANT (reactors 3 and 4) 26130 Saint-Paul-Trois-Châteaux	EDF	2 PWR reactors CP1 900 MWe	2 July 1976
89	BUGEY NUCLEAR POWER PLANT (reactors 4 and 5) 01980 Loyettes	EDF	2 PWR reactors CP1 900 MWe	27 July 1976
96	GRAVELINES NUCLEAR POWER PLANT (reactors 1 and 2) 59820 Gravelines	EDF	2 PWR reactors CP1 900 MWe	24 October 1977
97	GRAVELINES NUCLEAR POWER PLANT (reactors 3 and 4) 59820 Gravelines	EDF	2 PWR reactors CP1 900 MWe	24 October 1977
100	ST-LAURENT-DES-EAUX NUCLEAR POWER PLANT (reactors B1 and B2) 41220 La-Ferté-St-Cyr	EDF	2 PWR reactors CP2 900 MWe	8 March 1978

BNI No	NAME AND LOCATION OF THE INSTALLATION	Operator	Nature of the installation	Licence granted on:
103	PALUEL NUCLEAR POWER PLANT (reactor 1) 76450 Cany-Barville	EDF	1 PWR reactor P4 1300 MWe	10 November 1978
104	PALUEL NUCLEAR POWER PLANT (reactor 2) 76450 Cany-Barville	EDF	1 PWR reactor P4 1300 MWe	10 November 1978
107	CHINON NUCLEAR POWER PLANT (reactors B1 and B2) 37420 Avoine	EDF	2 PWR reactors CP2 900 MWe	4 December 1979
108	FLAMANVILLE NUCLEAR POWER PLANT (reactor 1) 50830 Flamanville	EDF	1 PWR reactor P4 1300 MWe	21 December 1979
109	FLAMANVILLE NUCLEAR POWER PLANT (reactor 2) 50830 Flamanville	EDF	1 PWR reactor P4 1300 MWe	21 December 1979
110	BLAYAIS NUCLEAR POWER PLANT (reactors 3 and 4) 33820 Saint-Ciers-sur-Gironde	EDF	2 PWR reactors CP1 900 MWe	5 February 1980
111	CRUAS NUCLEAR POWER PLANT (reactors 1 and 2) 07350 Cruas	EDF	2 PWR reactors CP2 900 MWe	8 December 1980
112	CRUAS NUCLEAR POWER PLANT (reactors 3 and 4) 07350 Cruas	EDF	2 PWR reactors CP2 900 MWe	8 December 1980
114	PALUEL NUCLEAR POWER PLANT (reactor 3) 76450 Cany-Barville	EDF	1 PWR reactor P4 1300 MWe	3 April 1981
115	PALUEL NUCLEAR POWER PLANT (reactor 4) 76450 Cany-Barville	EDF	1 PWR reactor P4 1300 MWe	3 April 1981
119	SAINT-ALBAN NUCLEAR POWER REACTOR (reactor 1) 38550 Le Péage-de-Roussillon	EDF	1 PWR reactor P4 1300 MWe	12 November 1981
120	SAINT-ALBAN NUCLEAR POWER REACTOR (reactor 2) 38550 Le Péage-de-Roussillon	EDF	1 PWR reactor P4 1300 MWe	12 November 1981

BNI No	NAME AND LOCATION OF THE INSTALLATION	Operator	Nature of the installation	Licence granted on:
122	GRAVELINES NUCLEAR POWER PLANT (reactors 5 and 6) 59820 Gravelines	EDF	2 PWR reactors CP1 900 MWe	18 December 1981
124	CATTENOM NUCLEAR POWER PLANT (reactor 1) 57570 Cattenom	EDF	1 PWR reactor P'4 1300 MWe	24 June 1982
125	CATTENOM NUCLEAR POWER PLANT (reactor 2) 57570 Cattenom	EDF	1 PWR reactor P'4 1300 MWe	24 June 1982
126	CATTENOM NUCLEAR POWER PLANT (reactor 3) 57570 Cattenom	EDF	1 PWR reactor P'4 1300 MWe	24 June 1982
127	BELLEVILLE-SUR-LOIRE NUCLEAR POWER PLANT (reactor 1) 18240 Léré	EDF	1 PWR reactor P'4 1300 MWe	15 September 1982
128	BELLEVILLE-SUR-LOIRE NUCLEAR POWER PLANT (reactor 2) 18240 Léré	EDF	1 PWR reactor P'4 1300 MWe	15 September 1982
129	NOGENT-SUR-SEINE NUCLEAR POWER PLANT (reactor 1) 10400 Nogent-sur-Seine	EDF	1 PWR reactor P'4 1300 MWe	28 September 1982
130	NOGENT-SUR-SEINE NUCLEAR POWER PLANT (reactor 2) 10400 Nogent-sur-Seine	EDF	1 PWR reactor P'4 1300 MWe	28 September 1982
132	CHINON NUCLEAR POWER PLANT (reactors B3 and B4) 37420 Avoine	EDF	2 PWR reactors CP2 900 MWe	7 October 1982
135	GOLFECH NUCLEAR POWER PLANT (reactor 1) 82400 Golfech	EDF	1 PWR reactor P'4 1300 MWe	3 March 1983
136	PENLY NUCLEAR POWER PLANT (reactor 1) 76370 Neuville-lès-Dieppe	EDF	1 PWR reactor P'4 1300 MWe	23 February 1983
137	CATTENOM NUCLEAR POWER PLANT (reactor 4) 57570 Cattenom	EDF	1 PWR reactor P'4 1300 MWe	29 February 1984

BNI No	NAME AND LOCATION OF THE INSTALLATION	Operator	Nature of the installation	Licence granted on:
139	CHOOZ NUCLEAR POWER PLANT B (reactor 1) 08660 Givet	EDF	1 PWR reactor N4 1300 MWe	9 October 1984
140	PENLY NUCLEAR POWER PLANT (Reactor 2) 76370 Neuville-lès-Dieppe	EDF	1 PWR reactor P'4 1300 MWe	9 October 1984
142	GOLFECH NUCLEAR POWER PLANT (reactor 2) 82400 Golfech	EDF	1 PWR reactor P'4 1300 MWe	31 July 1985
144	CHOOZ NUCLEAR POWER PLANT B (reactor 2) 08660 Givet	EDF	1 PWR reactor N4 1450 MWe	18 February 1986
158	CIVAUX NUCLEAR POWER PLANT (reactor 1) BP 1 86320 Civaux	EDF	1 PWR reactor N4 1450 MWe	6 December 1993
159	CIVAUX NUCLEAR POWER PLANT (reactor 2) BP 1 86320 Civaux	EDF	1 PWR reactor N4 1450 MWe	6 December 1993
167	FLAMANVILLE NUCLEAR POWER PLANT (reactor 3) 50830 Flamanville	EDF	1 PWR reactor EPR 1600 MWe	10 April 2007

1.3. List of fuel cycle facilities

Table 2: Fuel cycle facilities in operation

BNI No	NAME AND LOCATION OF THE INSTALLATION	Operator	Nature of the installation and thermal power	Declaration made on:	Licence granted on:
63	FUEL ELEMENT FABRICATION PLANT 26104 Romans-sur-Isère	FBFC	Fabrication of radioactive substances	9 May 1967	
93	GEORGES BESSE PLANT FOR THE SEPARATION OF URANIUM ISOTOPES BY GASEOUS DIFFUSION (Eurodif) 26702 Pierrelatte Cedex	EURODIF PRODUCTION	Transformation of radioactive substances		8 September 1977

BNI No	NAME AND LOCATION OF THE INSTALLATION	Operator	Nature of the installation and thermal power	Declaration made on:	Licence granted on:
98	NUCLEAR FUEL FABRICATION PLANT 26104 Romans-sur-Isère	FBFC	Fabrication of radioactive substances		2 March 1978
116	PLANT FOR THE REPROCESSING OF IRRADIATED FUEL ELEMENTS ORIGINATING FROM 'UP3 A' LIGHT WATER REACTORS (La Hague) 50107 Cherbourg	AREVA NC	Transformation of radioactive substances		12 May 1981
117	PLANT FOR THE REPROCESSING OF IRRADIATED FUEL ELEMENTS ORIGINATING FROM 'UP2 800' LIGHT WATER REACTORS (La Hague) 50107 Cherbourg	AREVA NC	Transformation of radioactive substances		12 May 1981
118	LIQUID EFFLUENT AND SOLID WASTE TREATMENT STATION 'STE3' (La Hague) 50107 Cherbourg	AREVA NC	Transformation of radioactive substances		12 May 1981
151	NUCLEAR FUEL FABRICATION PLANT (MELOX) BP 2 30200 Chusclan	AREVA NC	Transformation of radioactive substance		21 May 1990
155	TU 5 INSTALLATION BP 16 26701 Pierrelatte	AREVA NC	Fabrication of radioactive substances		7 July 1992
168	GEORGES BESSE PLANT 2 FOR THE SEPARATION OF URANIUM ISOTOPES BY CENTRIFUGATION 26702 Pierrelatte Cedex	SET	Transformation of radioactive substances		27 April 2007
-	Ponds B1 and B2 (Malvésí) 11100 Narbonne (Aude)	AREVA NC	Conditioning and storage of radioactive substances		22 December 2009

1.4 List of research nuclear reactor facilities

Table 3: Research reactor facilities in operation or under construction

BNI No	NAME AND LOCATION OF THE INSTALLATION	Operator	Nature of the installation and thermal power	Declaration made on:	Licence granted on:
24	CABRI (Cadarache) 13115 Saint-Paul-lez-Durance	CEA	25 MW-th reactor	27 June 1964	
39	MASUCRA (Cadarache) 13115 Saint-Paul-lez-Durance	CEA	0.005 MW-th reactor		14 December 1966
40	OSIRIS (Saclay) 91191 Gif-sur-Yvette Cedex	CEA	70 MW-th reactor		8 June 1965
	ISIS (Saclay) 91191 Gif-sur-Yvette Cedex	CEA	0.70 MW-th reactor		8 June 1965
42	EOLE (Cadarche) 13115 Saint-Paul-lez-Durance	CEA	0.0001 MW-th reactor		23 June 1965
67	HIGH-FLUX REACTOR (HRF) 38041 Grenoble Cedex	Laue-Langevin Institute	57 MW-th reactor		19 June 1969 5 December 1994
95	MINERVE (Cadarache) 13115 Saint-Paul-lez-Durance	CEA	0.0001 MW-th reactor		21 September 1977
101	ORPHÉE (Saclay) 91191 Gif-sur-Yvette Cedex	CEA	14 MW-th reactor		8 March 1978
172	JULES HOROWITZ (JHR) (Cadarache) 13115 Saint-Paul-lez-Durance	CEA	100 MW reactor		12 October 2009
174	ITER (Cadarache) 13115 Saint-Paul-lez-Durance	ITER Organisation	Research installation (fusion)		

1.5 List of nuclear installations in the process of being decommissioned or being prepared for final shutdown

Table 4: Nuclear installations in the process of being decommissioned or being prepared for final shutdown

BNI No	Installation	Installation type	Commissioned	Final shutdown	Current status
163	Chooz AD	Reactor	1967	1991	In the process of being decommissioned
161	Chinon A3D	Reactor	1966	1990	In the process of being decommissioned
20	Siloé	Reactor	1963	1997	In the process of being decommissioned
162	EL 4D	Reactor	1966	1985	In the process of being decommissioned
33	UP2 400	Plant for the reprocessing of irradiated fuel	1964	2004	In the process of being decommissioned
45	Bugey 1	Reactor	1972	1994	In the process of being decommissioned
46	St Laurent A1	Reactor	1969	1994	In the process of being decommissioned
46	St Laurent A2	Reactor	1971	1994	In the process of being decommissioned
32	ATPU	Fuel fabrication plant	1962	2003	In the process of being decommissioned
91	Superphénix	Reactor	1985	1998	In the process of being decommissioned
18	Ulysse	Reactor	1967	2007	Preparation for final shutdown
25	Rapsodie	Reactor	1967	1985	Preparation for final shutdown
71	Phénix	Reactor	1973	2009	Preparation for final shutdown
105	Comurhex	Plant for the chemical transformation of uranium	1979	2008	Preparation for final shutdown

ANNEX 2 – MAIN LEGISLATIVE AND REGULATORY PROVISIONS

2.1. Codes, laws and regulations

- Environment Code:
 - Book I – Title II – Chapter V (Articles L. 125-10 to L. 125-40)
 - Book V – Title IV – Chapter II (Articles L. 542-1 to L. 542-14)
 - Book V – Title IX (Articles L. 591-1 to L. 597-46);
- Public Health Code: Part I – Book III – Title III – Chapter III (Articles L. 1333-1 et seq. and corresponding articles of the regulatory part of this code) on the general protection of people from the dangers of ionizing radiation;
- Labour Code: Articles L. 4451-1 et seq. and R. 4451-1 et seq. on the protection of workers from the dangers of ionizing radiation;
- Defence Code: Articles D. 1333-68 and 69 on the inter-ministerial committee on nuclear and radiological crises;
- Law No 2006-686 of 13 June 2006 on transparency and nuclear safety (Articles 19 and 21);
- Programme Law No 2006-739 of 28 June 2006 on the sustainable management of radioactive materials and waste (Articles 3 and 4);
- Law No 68-943 of 30 October 1968 on Civil Responsibility in the field of nuclear energy;
- Decree No 2007-830 of 11 May 2007 on the nomenclature of basic nuclear installations;
- Decree No 2007-831 of 11 May 2007 laying down the arrangements for the designation and authorisation of nuclear safety inspectors;
- Decree No 2007-1557 of 2 November 2007 on basic nuclear installations and the supervision, in terms of nuclear safety, of the transportation of radioactive substances (decree relating to procedures);
- Decree No 2007-1572 of 6 November 2007 on the technical studies on accidents or incidents relating to nuclear activity;
- Decree No 2007-1582 of 7 November 2007 on the protection of people from the dangers of ionizing radiation and amending the Public Health Code;
- Decree No 2008-521 of 12 March 2008 on the local information committees attached to basic nuclear installations;
- Decree No 2010-277 of 16 March 2012 on the High Committee for Transparency and Information on Nuclear Safety;
- Order of 7 February 2012 laying down the general rules on basic nuclear installations (in force from 1 July 2013);
- Ministerial Order of 10 August 1984 on the quality of the design, construction and operation of BNI (repealed on 1 July 2013);
- Inter-ministerial Order of 10 November 1999 on the monitoring of the operation of the main primary system and of the main secondary systems of pressurised water reactors;

- Order of 26 November 1999 laying down the general requirements relating to the limits and arrangements for intakes and discharges subject to licences performed by the BNI (repealed on 1 July 2013);
- Ministerial Order of 31 December 1999 laying down the general technical regulations intended to prevent or mitigate the nuisances and external risks resulting from the operation of the BNI (repealed on 1 July 2013);
- Ministerial Order of 12 December 2005 on pressurised nuclear equipment.

2.2. Regulatory decisions of the ASN

Table 5: List of regulatory decisions of the ASN as at July 2014

Subject	Text adopted	Consultations
Acts relating to procedures		
Safety review		Consultation ended
Handling of changes to equipment	Decision No 2014-DC-0420 of 13 February 2014 Approval: Order of 1 April 2014	Consultation ended
Safety report (content)		Consultation ended
GOR (content)		Consultation ended
Internal authorisations	Decision No 2008-DC-0106 of the ASN of 11 July 2008 Approval: Order of 26 September 2008 (French Official Journal of 11 October 2008)	
Decommissioning plan (content)		
Public consultation procedures		Consultation ended
Miscellaneous procedural provisions		
Hearing of the operators and LIC	Decision No 2010-DC-0179 of the ASN of 13 April 2013	
Technical acts		
Organisation and management system		
Protection of interests policy		Consultation ended
Management of the risks of accident and nuisance (except waste)		
Decision on the Operation of BNI		Consultation ended
Order on the refuelling of PWR		Consultation ended

Management of the risks of fire	Decision No 2014-DC-0417 of 28 January 2014 Approval: Order of 20 March 2014 (French Official Journal of 2 April 2014)	Consultation ended
Criticality		Consultation ended
Management of nuisances and the environmental impact	Decision No 2013-DC-0360 of 16 July 2013 Approval: 9 August 2013 (French Official Journal of 21 August 2013)	Consultation ended
Management and disposal of waste		
Content of the BNI waste study		Consultation ended
Arrangements for approval of the conditioning of waste		Consultation ended
Design and operation of the internal waste storage sites		
Design and operation of the waste storage sites		
Management of emergency situations		
Management of emergency situations		Consultation ended
Provision of information to the authorities and the public		
Incident reporting		
PNE		
Replacement parts for the MPS and MSS	Decision No 2012-DC-0236 of the ASN of 3 May 2012 Approval: Order of 22 June 2012 (French Official Journal of 4 July 2012)	Consultation ended

Regulations applicable to PNE		
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Following a series of consultations conducted in 2010 and 2011, the draft decisions were reviewed in the light of any observations made and of the Order of 7 February 2012 *laying down the general rules applicable to basic nuclear installations*. The new versions of the draft decisions have been or will be submitted for consultation in 2013 or 2014 prior to their adoption.

ANNEX 3 – BIBLIOGRAPHY

3.1. Documents

- /1/ Council Directive 2009/71/EURATOM of 25 June 2009 establishing a Community framework for the nuclear safety of nuclear installations
- /2/ ENSREG Guidelines regarding Member States Reports as required under Article 9(1) of Council Directive 2009/71/EURATOM of 25 June 2009 establishing a Community framework for the nuclear safety of nuclear installations
- /3/ Convention on Nuclear Safety – Sixth national report on France’s implementation of its obligations under the Convention, August 2013

3.2. Websites

Readers may wish to consult the following sites in particular:

- Légifrance: www.legifrance.fr
- ASN: www.asn.fr
- IRSN: www.irsn.fr
- EDF: www.edf.fr
- Information site about the Flamanville 3 EPR: <http://energies.edf.com/edf-fr-accueil-la-production-d-electricite-edf/-nucleaire/le-nucleaire-du-futur/epr-flamanville-3/flamanville-3-en-images-120266.html>
- AREVA: www.areva.fr
- CEA: www.cea.fr
- ILL: www.ill.fr
- ITER International Organisation: <http://www.iter.org/fr/accueil>

ANNEX 4 – LIST OF MAIN ABBREVIATIONS

Table 6: List of main abbreviations

ALARA	As Low As Reasonably Achievable
ASN	<i>Autorité de Sûreté Nucléaire</i> (French Nuclear Safety Authority)
BNI	Basic Nuclear Installations
BSR	Basic Safety Rules
CEA	<i>Commissariat à l’Energie Atomique et aux Energies Alternatives</i> (Atomic Energy and Alternative Energies Commission)
DCR	Design and Construction Rules
DLC	Decree Licensing Construction
EDF	Electricité de France
ENSREG	European Nuclear Safety Regulators Group
EXA	Experience Acquired
GOR	General Operating Rule
GPR	<i>Groupe Permanent Réacteur</i> (Standing Group for Reactors)
HCTISN	<i>Haut Comité pour la Transparence et l’Information sur la Sécurité Nucléaire</i> (High Committee for Transparency and Information on Nuclear Safety)
IAEA	International Atomic Energy Agency
ICPE	Installations Classified for the Protection of the Environment
IEP	Internal Emergency Plan
ILL	<i>Institut Laue – Langevin</i> (Laue-Langevin Institute)
IRSN	<i>Institut de Radioprotection et de Sûreté Nucléaire</i> (Institute of Radiation Protection and Nuclear Safety)
ITER	International Thermonuclear Experimental Reactor
JHR	Jules-Horowitz Reactors
LIC	Local Information Committee
MEDDE	<i>Ministère de l’écologie, du développement durable et de l’énergie</i> (Ministry of Ecology, Sustainable Development and Energy)
MPS	Main Primary System
MSS	Main Secondary System
MSNR	<i>Mission sûreté nucléaire et radioprotection du MEDDE</i> (Nuclear Safety and Radiation Protection Mission of the MEDDE)
NPP	Nuclear Power Plants
NRRF	Nuclear Rapid Response Force
OHF	Organisational and Human Factors
OPECST	<i>Office Parlementaire d’Evaluation des Choix Scientifiques and Technologiques</i>

	(Parliamentary Office for the Evaluation of Scientific and Technological Choices)
OSART	Operational Safety Review Team
OSRDE	<i>Observatoires Sûreté Radioprotection Disponibilité Environnement</i> (Safety Radiation Protection Availability Environment Observatories)
PGE	Permanent Group of Experts
PNE	Pressurised Nuclear Equipment
PSR	Preliminary Safety Report
PWR	Pressurised Water Reactor
RNM	<i>Réseau national de mesure de la radioactivité de l'environnement</i> (French National Network for the Measurement of Environmental Radioactivity)
SARG	Serious Accident Response Guide
SR	Safety Report
SSA	Supplementary Safety Assessment
TOS	Technical Operating Specifications
TYI	Ten-yearly Inspection
WANO	World Association of Nuclear Operators
WENRA	Western European Nuclear Regulators Association